SOIL SURVEY OF

Sheboygan 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

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. 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 who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1967–73. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. 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 Sheboygan County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Sheboygan County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetical order by map symbol and gives the page where each is described. It also shows the capability unit, woodland group, wildlife group, recreation group, and tree and shrub group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of capability units and woodland groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation areas in the sections "Engineering interpretations" and "Recreation."

Engineers and builders can find, under "Engineering," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of Soils."

Newcomers in Sheboygan County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Environmental Factors Affecting Soil Use."

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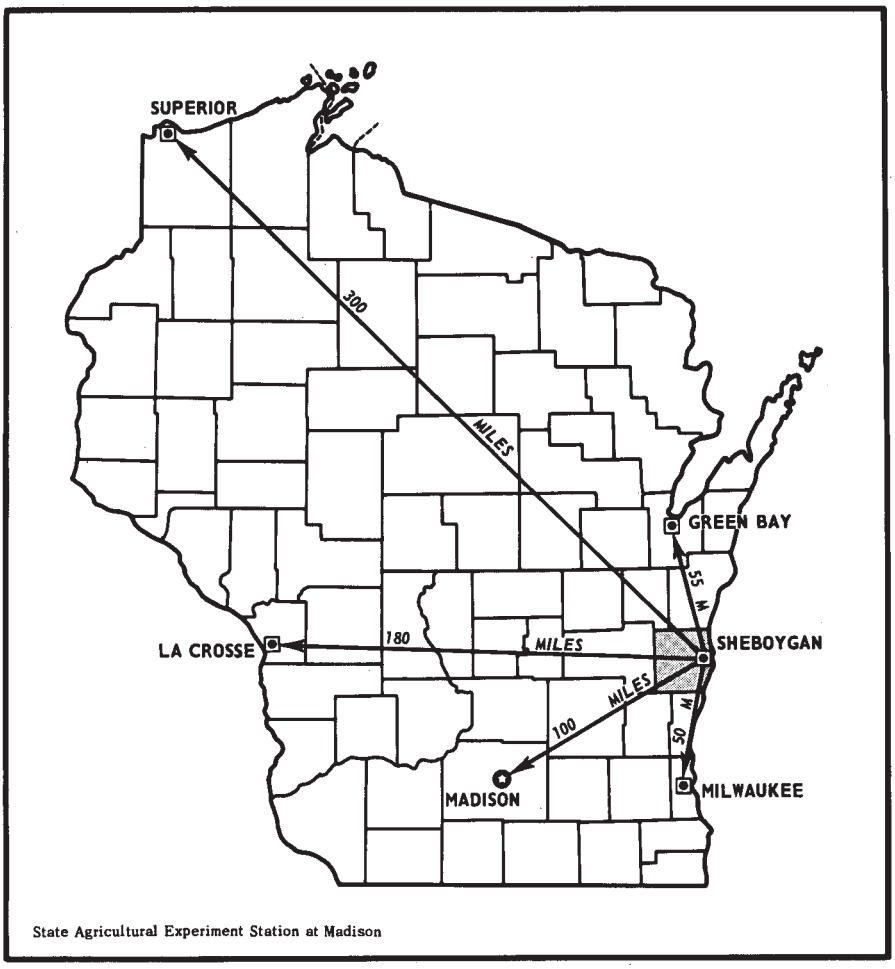

Location of Sheboygan County in Wisconsin.

SOIL SURVEY OF SHEBOYGAN COUNTY, WISCONSIN

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE RESEARCH DIVISION OF THE COLLEGE OF AGRICULTURAL AND LIFE SCIENCES, UNIVERSITY OF WISCONSIN

SHEBOYGAN COUNTY is in the southeastern part of Wisconsin (see facing page). It is bordered on the east by Lake Michigan, on the south by Ozaukee and Washington Counties, on the west by Fond du Lac County, and on the north by Calumet and Manitowoc Counties. It has a total land area of 323,392 acres. Sheboygan, the largest city, is the county seat.

Commerce and industry are important in the east-central part of the county, especially near Sheboygan, Kohler, Sheboygan Falls, and Plymouth.

Most of the soils in Sheboygan County are nearly level to sloping. They are suited to many different crops. Corn, oats, and alfalfa are the main crops, but canning and truck crops are grown extensively in the eastern half of the county. Canneries are chiefly located at Random Lake, Adell, Waldo, and Plymouth. Much of the farm income is derived from dairying and from livestock and livestock products. Many cheese factories are throughout the county. Wooded areas are chiefly on the steeper soils in the western half of the county and on low, wet soils.

Recreational use of soils is increasing, especially in the area south of Sheboygan bordering Lake Michigan and in the Kettle Moraine area, which extends southwest from the village of Elkhart Lake through the townships of Greenbush, Mitchell, and Scott.

The increasing demand for homesites, industries, and recreational facilities makes it important to select suitable soil areas for the intended use. This survey is designed to provide useful information for community and county planning as well as for farming purposes.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Sheboygan County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose 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 that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Hochheim and Kewaunee, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Kewaunee silt loam, 2 to 6 percent slopes, is one of several phases within the Kewaunee series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of dif-

ferent series, or of different phases within one series. One such kind of mapping unit that is shown on the soil map of Sheboygan County is a soil complex.

A soil complex consists of areas of two or more soils so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils joined by a hyphen. Casco-Rodman complex, 6 to 12 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Alluvial land and Dune land are examples of two land types in Sheboygan County.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing medium for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this failure to slow permeability or a high water table. They see that streets, road pavements, and foundations for houses crack on a given kind of soil, and they relate this failure to a high shrink-swell potential. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their study and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. It typically consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in an association can occur in other associations but in different patterns.

A map showing soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that area, or who want to locate large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide for broad planning of a watershed, a wooded tract, or a wildlife area or for broad planning of recreational facilities, community developments, and such engineering works as transportation corridors. It is not a suitable map for detailed planning for management of a farm or field or for selecting the exact location of a road or building or other structure because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

Soil associations and delineations on the general soil map do not fully agree with those of the general soil map in adjacent counties published at a different date. Differences in the maps are the result of improvement in the classification of soils, particularly in the modifications or refinements in soil series concepts. In addition, more precise and detailed maps are needed because the use of the general soil maps has expanded in recent years. The more modern maps meet this need. Still another difference is the pattern of occurrence of the major soils or the range in slope that is permitted within associations in different surveys.

The five soil associations in this survey area are described on the following pages.

1. Mosel-Oakville-Hebron association

Somewhat poorly drained to well drained soils that have a subsoil of mainly clay loam to sand and are underlain by medium and fine sand or stratified silt loam and silty clay loam

This association makes up about 5 percent of the county. It is about 25 percent Mosel soils, 17 percent Oakville soils, 16 percent Hebron soils, and 42 percent minor soils.

Mosel soils are in old glacial lake basins. Slopes are slightly concave. The soils are nearly level and gently sloping and are somewhat poorly drained. The surface layer is loam. The subsoil is clay loam and gravelly sandy loam in the upper part and silty clay loam in the lower part. The substratum to a depth of 60 inches is silty clay loam.

Oakville soils are on sand dunes and old beach deposits that formed when the water level in Lake Michigan was higher than it is now. They are nearly level to sloping and are well drained and moderately well drained. The surface layer is loamy fine sand. The subsoil is loamy fine sand in the upper part and fine sand in the lower part. The substratum to a depth of 60 inches is sand and fine sand.

Hebron soils are in old glacial lake basins. Slopes are slightly convex. The soils are nearly level and gently sloping and are well drained and moderately well drained. The surface layer is loam. The subsoil is loam, sandy clay loam, and sandy loam in the upper part and silty clay loam in the lower part. The substratum to a depth of 60 inches is stratified silt, silty clay, and silty clay loam.

Among the minor soils in this association are the Colwood, Kibbie, Navan, Sisson, and Yahara soils and

the Hebron variant. Sisson soils and the Hebron variant are intermingled with other Hebron soils and with Oakville soils. Colwood, Kibbie, Navan, and Yahara soils are in swales and depressions throughout the association.

This association has a moderate or low potential for all cultivated crops commonly grown in the county. Most of it is used for corn, small grain, and legumes. A large acreage is also used for canning crops, such as sweet corn and peas, and for dairy farming. A few steeper areas and undrained, wet areas are used for pasture or wildlife habitat, and a few areas are in woodland. Where adequately drained, the wet soils are used for all crops commonly grown in the county.

Controlling erosion and soil blowing and maintaining organic-matter content, tilth, and fertility are the main concerns in managing the dominant soils for cultivation.

Mosel soils have severe limitations for most nonfarm uses because of wetness and high frost action. Hebron soils have severe limitations for septic tank absorption fields and local roads and streets and moderate limitations for dwellings with basements and for trench type sanitary landfill. Where slopes are less than 6 percent, Oakville soils have only slight limitations for septic tank absorption fields, local roads and streets, and homesites. Contaminating the ground water supply, however, is a risk if they are used for septic tank absorption fields. They have severe limitations for sanitary landfill.

2. *Kewaunee-Waymor-Manawa association*

Well drained to somewhat poorly drained soils that have a subsoil of mainly clay loam to clay and are underlain by loam or silty clay loam glacial till

This association makes up about 45 percent of the county. It is about 42 percent Kewaunee soils, 11 percent Waymor soils, 11 percent Manawa soils, and 36 percent minor soils.

Kewaunee soils are on broad till plains. Slopes are convex. The soils are nearly level to moderately steep and are well drained and moderately well drained. The surface layer is mainly silt loam, but in eroded areas it is silty clay loam or silty clay. The subsoil is silty clay and silty clay loam. The substratum to a depth of 60 inches is silty clay loam.

Waymor soils also are on broad till plains. Slopes are convex. The soils are nearly level to sloping and are well drained. The surface layer is silt loam. The subsoil is silty clay loam in the upper part and clay loam in the lower part. The substratum to a depth of 60 inches is loam.

Manawa soils are in slightly concave, old glacial lake basins and drainageways. They are nearly level and gently sloping and are somewhat poorly drained. The surface layer is silt loam. The subsoil is silty clay loam and clay. The substratum to a depth of 60 inches is silty clay loam.

Among the minor soils in this association are the Hebron and Poygan soils. Hebron soils are in old glacial lake basins and are intermingled with Kewaunee and Waymor soils. Poygan soils are in swales and wet drainageways near Manawa soils.

This association is mostly moderately well suited to all crops commonly grown in the county. Most of it is used for corn, small grain, and legumes. A large acreage is also used for dairy farming and beef cattle. Some areas are used for canning crops, such as sweet corn and peas. Some steeper areas and undrained, wet areas are used for pasture or wildlife habitat, and some areas are in woodland. Where adequately drained, the wet soils are used for all crops commonly grown in the county.

Controlling erosion and maintaining organic-matter content, tilth, and fertility are the main concerns in managing the dominant soils for cultivation.

Kewaunee soils have severe limitations for septic tank absorption fields, trench type sanitary landfill, and local roads and streets and moderate limitations for dwellings with basements. Where slopes are no more than 2 percent, they have slight limitations for sewage lagoons. Where slopes are no more than 6 percent, Waymor soils have slight limitations for dwellings with basements. These soils have slight limitations for trench type sanitary landfill and moderate limitations for septic tank absorption fields and local roads and streets. Where slopes are no more than 6 percent, they have moderate limitations for sewage lagoons. Manawa soils have severe limitations for nonfarm uses.

3. *Hochheim-Theresa association*

Well drained soils that have a subsoil of mainly clay loam or silty clay loam and are underlain by gravelly sandy loam glacial till

This association makes up about 30 percent of the county. It is about 44 percent Hochheim soils, 17 percent Theresa soils, and 39 percent minor soils.

Hochheim soils are on convex till plains and drumlins. Slopes are convex. The soils are nearly level to steep and are well drained. The surface layer is silt loam. The subsoil is clay loam. The substratum to a depth of 60 inches is gravelly sandy loam.

Theresa soils are on convex till plains. Slopes are convex. The soils are nearly level to sloping and are well drained. The surface layer is silt loam. The subsoil is mainly silty clay loam in the upper part and clay loam in the lower part. The substratum to a depth of 60 inches is gravelly sandy loam.

Among the minor soils in this association are the Barry, Casco, Lamartine, Nenno, and Pella soils. Casco soils are on outwash plains, primarily in Rhine Township and in the southern part of Sherman and Scott Townships. Barry, Lamartine, Nenno, and Pella soils are in swales and wet drainageways throughout the association.

This association is well suited or suited to all crops commonly grown in the county. Most of it is used for corn, small grain, and legumes. A large acreage is also used for dairy farming and beef cattle, and some areas are used for canning crops, such as sweet corn and peas. Some steeper areas and undrained, wet areas are used for pasture or wildlife habitat, and some areas are in woodland. Where adequately drained, the wet soils are used for all crops commonly grown in the county.

Controlling erosion and maintaining organic-matter content, tilth, and fertility are the main concerns in managing the dominant soils for cultivation.

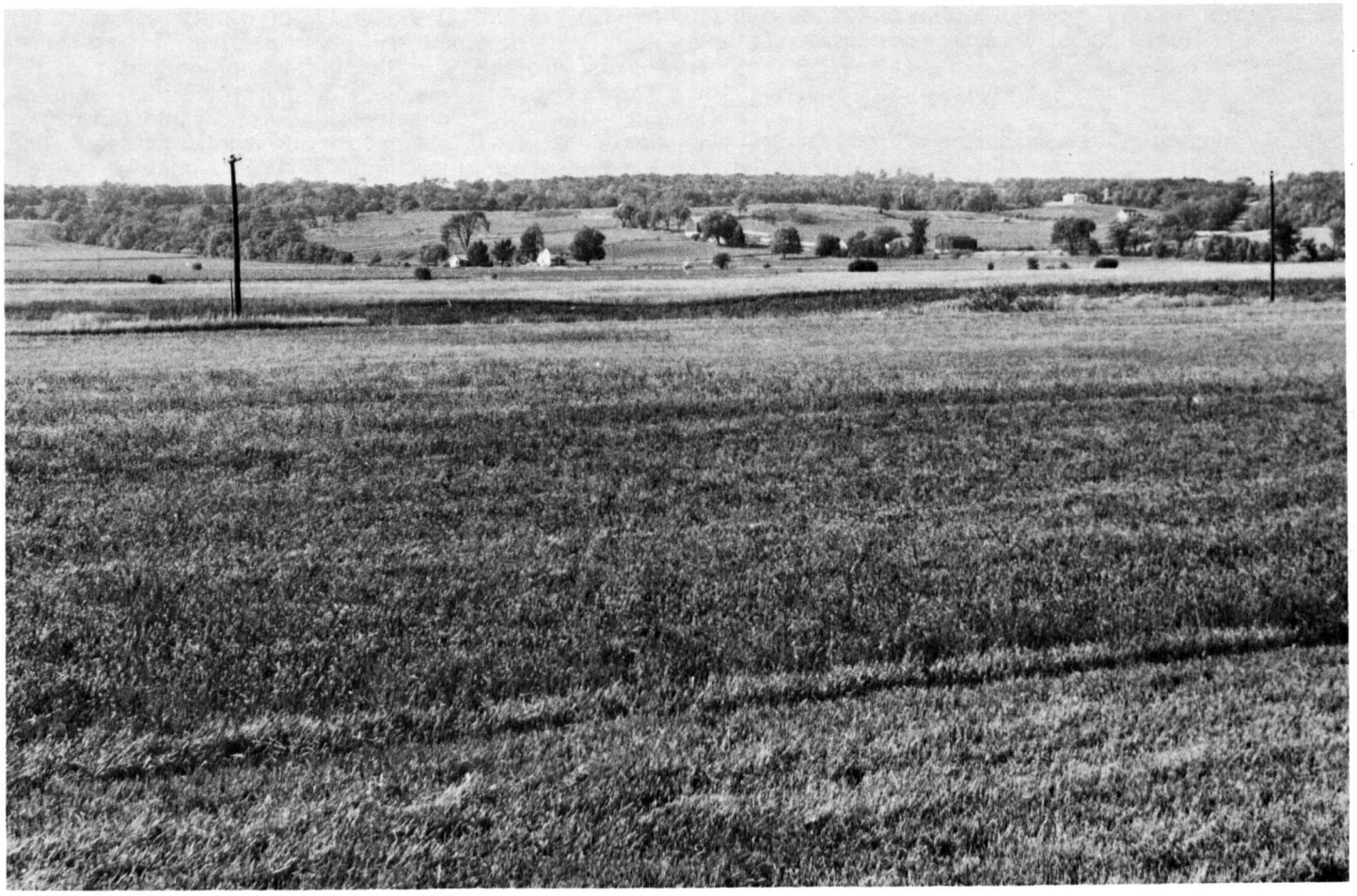

Figure 1.—Landscape of Casco and Fox soils in association 4.

Where slopes are less than 6 percent, the major soils of this association have slight limitations for septic tank absorption fields and dwellings with basements and moderate limitations for sewage lagoons. Where slopes are less than 12 percent, they have slight limitations for trench type sanitary landfill. The limitations for local roads and streets are moderate or severe.

4. Casco-Fox-Rodman association

Well drained to excessively drained soils that have a subsoil of mainly silty clay loam to sandy clay loam or gravelly sandy loam and are underlain by stratified gravel and sand outwash

This association makes up about 17 percent of the county. It is about 54 percent Casco soils, 28 percent Fox soils, 5 percent Rodman soils, and 13 percent minor soils (fig. 1).

Casco soils are on outwash plains, terraces, and moraines. They are nearly level to very steep and are well drained. The surface layer is loam. The subsoil is clay loam and sandy clay loam. The substratum to a depth of 60 inches is stratified gravel and sand.

Fox soils are on outwash plains and terraces. They are nearly level to sloping and are well drained. The surface layer is silt loam. The subsoil is silty clay loam in the upper part and clay loam in the lower part. The substratum to a depth of 60 inches is stratified gravel and sand.

Rodman soils are on outwash plains, kames, and eskers. They are sloping to very steep and are excessively drained. The surface layer and subsoil are gravelly sandy loam. The substratum to a depth of 60 inches is stratified gravel and sand.

Among the minor soils in this association are the Boyer, Fabius, Matherton, St. Charles, and Sebewa soils. Boyer soils are intermingled with Casco, Fox, and Rodman soils. St. Charles and Matherton soils are in areas where the silty mantle is thick. Fabius and Sebewa soils are in swales and wet drainageways throughout the association.

Where slopes are no more than 12 percent, this association is suited to poorly suited to all the general farm crops commonly grown in the county. In an average year, however, crop yields are limited by the available water capacity. Much of the association is used for corn, small grain, and legumes. A large acreage is also used for dairy farming and beef cattle. Some areas are used for pasture and wildlife habitat, especially steeper areas and undrained, wet areas. Where adequately drained, the wet soils are used for

all general farm crops commonly grown in the county. Small woodlots are common. Some areas are used as a source of sand and gravel.

Controlling erosion and maintaining organic-matter content, tilth, available water capacity, and fertility are the main concerns in managing the dominant soils for cultivation.

Where slopes are less than 6 percent, the major soils of this association have only slight limitations for septic tank filter fields and dwellings with basements. They have severe limitations for sewage lagoons and trench type sanitary landfills. Where slopes are no more than 6 percent, Casco soils have slight limitations for local roads and streets and Fox soils have moderate limitations.

5. *Boots-Houghton association*

Very poorly drained organic soils that are underlain by muck

This association makes up about 3 percent of the county. It is about 71 percent Boots soils, 13 percent Houghton soils, and 16 percent minor soils.

Boots soils are in depressions, drainageways, and old glacial lake basins. They are nearly level and very poorly drained. The organic layer is highly decomposed muck more than 51 inches thick. In many areas marl is at depths between 51 and 64 inches.

Houghton soils are in depressions, drainageways, and old glacial lake basins. They are nearly level and very poorly drained. The organic layer is highly decomposed muck more than 60 inches thick.

Among the minor soils in this association are the Adrian, Edwards, and Palms soils. These soils are intermingled with Boots and Houghton soils throughout the association.

Most of this association is used for wildlife habitat or woodland. Unless drained, the soils of this association are too wet for cultivated crops. Where adequately drained, they are generally used for corn, but are also moderately well suited to specialty crops, such as lettuce, carrots, and mint.

Maintaining adequate but not excessive drainage, protecting against rapid subsidence and soil blowing, and maintaining fertility are the main concerns in managing the dominant soils for cultivation.

The major soils of this association have very severe limitations for homesites, septic tank absorption fields, local roads and streets, and sanitary landfills.

Descriptions of the Soils

This section describes the soil series and mapping units in Sheboygan County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping unit in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit or they are differences that are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Dune land and Marsh, for example, do not belong to a soil series, but nevertheless are listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, woodland group and wildlife group in which the mapping unit has been placed. The page for the description of each capability unit can be found by referring to the Guide to Mapping Units at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*26*).[1]

Adrian Series

The Adrian series consists of nearly level, very poorly drained soils formed in herbaceous organic material overlying sand. These soils are depressional areas in old glacial lake plains, stream valleys, and outwash plains. The native vegetation was marsh grasses, sedges, cattails, and some water-tolerant trees and shrubs.

In a representative profile the organic layer is about 40 inches thick. The upper part is black muck, and the lower part is very dark brown muck. The substratum to a depth of 60 inches is light gray loose sand.

Permeability is moderately rapid, and available water capacity is very high. Organic-matter content is very high, and natural fertility is low. The root zone is limited by the water table in undrained areas and by the underlying sand in drained areas.

Most of the acreage is used for woodland, wildlife habitat, and pasture. Some areas are drained and used for crops.

Representative profile of Adrian muck, slopes of 0 to 2 percent, in a wooded area, 2,180 feet north and 50 feet east of the southwest corner of sec. 27, T. 14 N., R. 23 E.

Oa1—0 to 11 inches; black (10YR 2/1 broken face and rubbed) sapric material; moderate coarse subangular blocky structure parting to moderate medium granular; friable; neutral; gradual wavy boundary.

Oa2—11 to 27 inches; black (10YR 2/1 broken face and

[1] Italic numbers in parentheses refer to Literature Cited, p. 113.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Mapping unit	Acres	Percent	Mapping unit	Acres	Percent
Adrian muck	960	0.3	Kewaunee silty clay loam, 2 to 6 percent slopes, eroded	14,500	4.5
Adrian-Granby-Oakville complex	635	.2	Kewaunee silty clay loam, 6 to 12 percent slopes, eroded	7,900	2.4
Alluvial land	600	.2	Kewaunee silty clay loam, 12 to 20 percent slopes, eroded	800	.2
Alluvial land, wet	3,300	1.0	Kewaunee silty clay, 6 to 12 percent slopes, severely eroded	500	.2
Barry silt loam	2,700	.8	Kewaunee silty clay, 12 to 20 percent slopes, severely eroded	700	.2
Beaches, sandy	225	(1)	Kibbie silt loam, 0 to 3 percent slopes	1,900	.6
Bellevue silt loam	950	.3	Lamartine silt loam, 0 to 3 percent slopes	3,150	1.0
Bellevue fine sandy loam, sandy subsoil variant	1,700	.5	Loamy land, seeped	610	.2
Boots muck	7,000	2.2	Made land	380	.1
Boyer loamy sand, 2 to 6 percent slopes	2,720	.8	Manawa silt loam, 0 to 3 percent slopes	16,950	5.3
Boyer loamy sand, 6 to 12 percent slopes, eroded	1,040	.3	Marsh	2,300	.7
Casco loam, 0 to 2 percent slopes	700	.2	Martinton silt loam, 0 to 3 percent slopes	800	.2
Casco loam, 2 to 6 percent slopes	6,100	1.9	Matherton silt loam, 0 to 3 percent slopes	2,400	.7
Casco loam, 6 to 12 percent slopes, eroded	8,200	2.5	Montgomery silty clay loam	800	.2
Casco-Rodman complex, 6 to 12 percent slopes	2,100	6	Mosel loam, 0 to 3 percent slopes	4,100	1.3
Casco-Rodman complex, 12 to 20 percent slopes, eroded	10,300	3.2	Muskego muck	880	.3
Casco-Rodman complex, 20 to 30 percent slopes	8,800	2.7	Navan loam	1,750	.5
Casco-Rodman complex, 30 to 45 percent slopes	3,000	.9	Nenno silt loam, 0 to 2 percent slopes	540	.2
Colwood silt loam	2,150	.7	Nenno silt loam, 2 to 6 percent slopes	2,850	.9
Cut and fill land, sandy and gravelly	440	.1	Oakville loamy fine sand, 0 to 6 percent slopes	2,400	.7
Cut and fill land, loamy	1,150	.4	Oakville loamy fine sand, 6 to 12 percent slopes	580	.2
Cut and fill land, clayey	460	.1	Otter silt loam	1,250	.4
Dune land	390	.1	Palms muck	4,500	1.4
Edwards muck	275	(1)	Pella silt loam	3,800	1.2
Elvers silt loam	225	(1)	Poygan silty clay loam	9,500	2.9
Fabius loam, 0 to 3 percent slopes	1,250	.4	Rough broken land	1,400	.4
Fox silt loam, 0 to 2 percent slopes	5,600	1.7	St. Charles silt loam, 0 to 2 percent slopes	1,100	.3
Fox silt loam, 2 to 6 percent slopes	9,950	3.1	St. Charles silt loam, 2 to 6 percent slopes	1,300	.4
Fox silt loam, 6 to 12 percent slopes, eroded	1,130	.4	Saylesville silt loam, 0 to 2 percent slopes	490	.2
Granby loam fine sand	800	.2	Saylesville silt loam, 2 to 6 percent slopes	620	.2
Granby silt loam, gravelly variant	990	.3	Saylesville silty clay loam, 6 to 12 percent slopes, eroded	215	(1)
Gravel pit	530	.2	Sebewa silt loam	3,300	1.0
Hebron loam, 0 to 2 percent slopes	990	.3	Sisson very fine sandy loam, 0 to 2 percent slopes	1,400	.4
Hebron loam, 2 to 6 percent slopes	1,650	.5	Sisson very fine sandy loam, 2 to 6 percent slopes	2,250	.7
Hebron sandy loam, sandy subsoil variant, 0 to 2 percent slopes	710	.2	Sisson very fine sandy loam, 6 to 12 percent slopes, eroded	680	.2
Hebron sandy loam, sandy subsoil variant, 2 to 6 percent slopes	1,200	.4	Stony land, wet	420	.1
Hochheim silt loam, 2 to 6 percent slopes eroded	19,600	6.2	Theresa silt loam, 0 to 2 percent slopes	1,850	.6
Hochheim silt loam, 6 to 12 percent slopes, eroded	15,300	4.8	Theresa silt loam, 2 to 6 percent slopes	14,330	4.4
Hochheim silt loam, 12 to 20 percent slopes, eroded	5,540	1.7	Theresa silt loam, 6 to 12 percent slopes, eroded	660	.2
Hochheim silt loam, 20 to 30 percent slopes	890	.3	Wasepi sandy loam	600	.2
Hochheim-Casco-Sisson complex, 6 to 12 percent slopes, eroded	1,400	.4	Waymor silt loam, 0 to 2 percent slopes	1,600	.5
Hochheim-Casco-Sisson complex, 12 to 20 percent slopes, eroded	1,450	.4	Waymor silt loam, 2 to 6 percent slopes	11,700	3.6
Hochheim-Casco-Sisson complex, 20 to 30 percent slopes	1,850	.6	Waymor silt loam, 4 to 12 percent slopes, eroded	2,860	.9
Hochheim-Knowles silt loams, 1 to 6 percent slopes	470	.1	Willette muck	1,650	.5
Houghton muck	8,100	2.5	Yahara very fine sandy loam, 0 to 3 percent slopes	1,300	.4
Juneau silt loam, 0 to 3 percent slopes	570	.2	Zurich silt loam, 0 to 2 percent slopes	440	.1
Kendall silt loam, 0 to 3 percent slopes	700	.2	Zurich silt loam, 2 to 6 percent slopes	967	.3
Kewaunee silt loam, 0 to 2 percent slopes	2,100	.6			
Kewaunee silt loam, 2 to 6 percent slopes	37,530	11.9	Total	323,392	100.0

[1] Less than 0.05 percent.

rubbed) sapric material; dark yellowish brown (10YR 3/4) plant fibers; moderate coarse subangular blocky structure; friable; estimated 12 percent fiber breaking down to 2 percent on rubbing; mildly alkaline; clear wavy boundary.

Oa3—27 to 32 inches; very dark brown (10YR 2/2 broken face and rubbed) sapric material; thin platy structure; friable; estimated 40 percent plant fiber breaking down to 3 percent on rubbing; 5 percent woody coarse fragments; friable; mildly alkaline; clear wavy boundary.

Oa4—32 to 40 inches; very dark brown (10YR 2/2 broken face and rubbed) sapric material; includes some light gray (10YR 7/2) fine sand; massive; friable; estimated 10 percent fine sand and 10 percent fiber breaking down to 2 percent on rubbing; mildly alkaline; abrupt smooth boundary.

IIC—40 to 60 inches; light gray (10YR 7/2) sand; single grained; loose; slight effervescence; mildly alkaline.

The thickness of the organic material ranges from 16 to 50 inches. The organic material is 1 to 50 percent fiber, but is less than 5 percent after rubbing. In places the organic layers contain some woody fragments. The organic material is slightly acid to mildly alkaline. The substratum is mildly alkaline or moderately alkaline.

Adrian soils are near Granby, Houghton, and Palms soils. They formed in thinner organic remains than Houghton soils. They contain more sand in the substratum than Palms soils. Adrian soils have an organic layer more than 16 inches thick, which is lacking in Granby soils.

Ag—Adrian muck. This nearly level soil is in depressional areas in old glacial lake plains, stream valleys, and outwash plains. Areas are irregularly shaped and range in size from 3 to 40 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Granby, Houghton, Palms, and Sebewa soils. Also included are areas of gently sloping Adrian soils, areas where a layer of sedimentary peat less than 6 inches thick is in the lower part of the organic material, and some areas where the substratum is gravelly.

Wetness is the major limitation of this soil. If drained and cultivated, however, the soil is subject to subsidence, soil blowing, and burning.

If properly drained, this soil is suited to crop production. Some areas are drained and used for crops. Most are used for woodland, wildlife habitat, and pasture. Capability unit IVw–7; woodland group 3w3; wildlife group 8.

Ak—Adrian-Granby-Oakville complex. These nearly level soils are on outwash plains and old glacial lake plains. Most areas are long and range in size from 5 to 70 acres. Slopes are less than 2 percent.

This complex consists of areas of Adrian, Granby, and Oakville soils that are so small and closely intermingled that they cannot be shown separately on the soil map. It is about 45 percent Adrian muck, 30 percent Granby loamy fine sand, 15 percent Oakville loamy fine sand, and 10 percent Alluvial land, wet, and Houghton soils. The Adrian soil is in the lowest part of basins, and the Granby and Oakville soils are narrow beach deposits at slightly higher elevations. The Oakville soil in this complex differs from the soil described as representative of the Oakville series in having a thinner, darker colored surface layer and a thin, light colored subsurface layer.

Where these soils are drained, cleared, and cultivated, the soil blowing hazard is slight. Unless drained, Adrian and Granby soils are too wet for crops commonly grown in the county.

The soils in this complex are poorly suited to the crops and pasture plants commonly grown in the county. Most of the acreage is used for woodland and wildlife habitat. Some areas of Oakville soils are used for lakeshore homes and cottages. The soils are suited to some types of woodland. Capability unit IVw–7; woodland group 3w3; wildlife group 8.

Alluvial Land

Am—Alluvial land is on the flood plains of streams and rivers. Most areas are long and narrow and range in size from 5 to 30 acres. This land is layered loamy and sandy soil material. In some areas it has layers of gravel. The layering is the result of floodwater deposition. The land is well drained and moderately well drained. Slopes are 0 to 2 percent.

Included with this land in mapping are small areas of Alluvial land, wet; the Bellevue variant; and other Bellevue and Juneau soils. Also included are small somewhat poorly drained areas.

Alluvial land ranges widely in permeability and available water capacity. It is subject to flooding.

Where Alluvial land is protected from overflow, it is moderately well suited to cultivated crops. Where flooding is frequent or cannot be controlled, this land is best suited to forage, woodland, or wildlife habitat. Most areas are used for pasture, woodland, and wildlife habitat. Capability unit IIw–13; woodland group 3o2; wildlife group 9.

Alluvial Land, Wet

An—Alluvial land, wet, is on the flood plains of streams and rivers. Most areas are long and narrow and range in size from 5 to 50 acres. This land is layered loamy, sandy, and gravelly soil material. In some areas it has layers of organic material. The layering is the result of floodwater deposition. The land is poorly drained or very poorly drained. Slopes are 0 to 2 percent.

Included with this land in mapping are small areas of Alluvial land and Elvers and Otter soils. Also included are small somewhat poorly drained areas.

Alluvial land, wet, varies widely in permeability and available water capacity. It is subject to frequent flooding.

This land is not suited to crop production. It is suited to some types of woodland and well suited to wildlife habitat. Most areas are used for woodland, wildlife habitat, and pasture. Capability unit Vw–14; woodland group 4w2; wildlife group 7.

Barry Series

The Barry series consists of nearly level, poorly drained soils that are underlain by loamy glacial till. These soils are in depressions, in broad drainageways, and on foot slopes on till plains. The native vegetation was a deciduous forest of mainly elm, maple, and basswood.

In a representative profile the surface layer is very dark grayish brown silt loam about 10 inches thick. The subsoil is about 19 inches thick and is mottled throughout. It is grayish brown, friable silt loam in the upper part; grayish brown, firm silty clay loam in the next part; and gray, friable loam in the lower part. The substratum to a depth of 60 inches is mottled grayish brown, friable gravelly sandy loam.

Permeability is moderate, and available water capacity is high. Organic-matter content and natural fertility are high. The root zone is limited by the water table.

Most of the acreage is used for pasture, corn, small grain, and other crops commonly grown in the county.

Representative profile of Barry silt loam, slopes of 0 to 2 percent, in a cultivated field, 1,580 feet north and 780 feet east of the southwest corner of sec. 18, T. 14 N., R. 20 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam; weak medium subangular blocky structure parting to moderate fine granular; friable; mildly alkaline; abrupt smooth boundary.

B21tg—10 to 16 inches; grayish brown (2.5Y 5/2) heavy silt loam; few fine prominent light olive brown (2.5Y 5/6) mottles; moderate medium subangular blocky structure; friable; thin patchy clay films on faces of peds; mildly alkaline; gradual smooth boundary.

IIB22tg—16 to 25 inches; grayish brown (2.5Y 5/2) gritty silty clay loam; common fine prominent light olive brown (2.5Y 5/6) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; thin continuous clay films on faces of peds; mildly alkaline; clear wavy boundary.

IIB3g—25 to 29 inches; gray (5Y 5/1) heavy loam; common coarse prominent light olive brown (2.5Y 5/6) mottles; weak coarse subangular blocky structure; friable; estimated 10 percent gravel by volume; slight effervescence; mildly alkaline; clear wavy boundary.

IIC—29 to 60 inches; grayish brown (10YR 5/2) gravelly sandy loam; common medium prominent light olive brown (2.5Y 5/6) and strong brown (7.5YR 5/6) mottles; massive; friable; estimated 16 percent gravel by volume; about 2 percent cobblestones; strong effervescence; mildly alkaline.

The solum ranges from 24 to 40 inches in thickness. The Ap or A1 horizon is 10 to 15 inches thick. It is black, very dark brown, very dark gray, very dark grayish brown, or dark brown. The B horizon ranges from 10 to 30 inches in thickness. It is silt loam or silty clay loam in the upper part and clay loam, loam, or sandy clay loam in the lower part. The C horizon is gravelly sandy loam or sandy loam and has 2 to 25 percent gravel by volume. It has cobblestones and boulders in places. The B horizon ranges from slightly acid to mildly alkaline, and the C horizon is mildly alkaline or moderately alkaline.

Barry soils are near Hochheim, Lamartine, and Nenno soils. They are grayer and more poorly drained than those soils. They have a thicker solum than Hochheim and Nenno soils.

Ba—Barry silt loam. This nearly level soil is in drainageways and depressions on glacial till plains. Areas are long and irregularly shaped and range in size from 5 to more than 100 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Hochheim, Lamartine, Nenno, and Sebewa soils. Also included are some small gently sloping areas. Areas where many stones are on the surface are identified by spot symbols on the soil map.

Wetness is a major limitation of this soil. If adequate drainage is established and maintained, however, the soil is productive. Runoff is slow, and ponding is a hazard during periods of heavy rainfall and in spring.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is also suited to pasture and some types of woodland. Most of the acreage is used for pasture, but where adequately drained, a considerable acreage is cropped. Capability unit IIw–1; woodland group 4w2; wildlife group 7.

Beaches, Sandy

Bd—Beaches, sandy, are along the shoreline of large lakes. They are of waterwashed fine and medium sand. Gravel is in some areas. Areas are long and narrow and range in size from 10 to 80 acres. Slopes are 2 to 6 percent.

Permeability is very rapid, and available water capacity is very low. Organic-matter content is very low, and natural fertility is low. The root zone is limited by the sand. The water table varies in depth with the water level of Lake Michigan.

This mapping unit is not suited to commercial crop production, woodland, or wildlife habitat. It is used for lakeshore recreation, bathing beaches, and other recreational uses. It has very little vegetation of any kind. Capability unit VIIIs–10; woodland group 6s1; wildlife group 10.

Bellevue Series

The Bellevue series consists of nearly level, well drained and moderately well drained soils formed in loamy alluvial material. These soils are on the flood plains of major streams and on alluvial fans. The native vegetation was a deciduous forest of mainly elm, basswood, and maple.

In a representative profile the surface layer is dark brown silt loam about 10 inches thick. The subsoil is about 23 inches thick and is reddish brown. It is firm silty clay loam in the upper part and friable loam in the lower part. The substratum to a depth of 60 inches is reddish brown and brown, friable, stratified silt loam, loam, and fine sandy loam.

Permeability is moderate, and available water capacity is high. Organic-matter content and natural fertility are high.

Most of the acreage is used for corn, small grain, and other crops commonly grown in the county. Some areas are used for pasture, woodland, and wildlife habitat.

Representative profile of Bellevue silt loam, slopes of 0 to 2 percent, in a cultivated field, 2,000 feet west and 650 feet south of the northeast corner of sec. 32, T. 15 N., R. 23 E.

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

B2—10 to 23 inches; reddish brown (5YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; thin patchy clay films; neutral; gradual wavy boundary.

B3—23 to 33 inches; reddish brown (5YR 4/4) loam; moderate medium subangular blocky structure; friable; thin patchy clay films; neutral; gradual wavy boundary.

C1—33 to 50 inches; reddish brown (5YR 5/4) stratified silt loam and loam; few fine prominent strong brown (7.5YR 5/8) mottles in the lower part; massive; friable; mildly alkaline; gradual smooth boundary.

C2—50 to 60 inches; brown (7.5YR 5/4) stratified fine sandy loam and loam; common medium distinct and prominent strong brown (7.5YR 5/6 and 5/8) mottles; massive; friable; slight effervescence; mildly alkaline.

The solum ranges from 24 to 36 inches in thickness. The A horizon is 10 to 15 inches thick. It is dark brown or very dark grayish brown. The B horizon ranges from 10 to 26 inches in thickness. It is silt loam or silty clay loam in the upper part and loam or fine sandy loam in the lower part. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Bellevue soils are similar to the Bellevue variant. They have more clay and less sand in the B horizon than the Bellevue variant.

Be—Bellevue silt loam. This nearly level soil is on flood plains of major streams and on alluvial fans. Areas are irregular or long and are generally less than 50 acres in size. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Alluvial land; Alluvial land, wet; the Bellevue variant; and Sisson soils. Also included are some small areas that are somewhat poorly drained.

This soil is subject to occasional flooding and streambank cutting. If protected from flooding, it is moderately well suited to crops commonly grown in the county. It is well suited to pasture and woodland. Small areas remain in mixed hardwood forest. Most areas are used for crops and pasture. Capability unit IIw–11; woodland group 3o1; wildlife group 9.

Bellevue Variant

The Bellevue variant consists of nearly level, well drained and moderately well drained soils formed in loamy and sandy alluvial material. These soils are on flood plains of major streams. The native vegetation was a deciduous forest of mainly elm, basswood, and maple.

In a representative profile the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is dark brown and is about 22 inches thick. It is very friable fine sandy loam in the upper part and very friable loamy fine sand in the lower part. The substratum is brown, very friable loamy fine sand and loose sand to a depth of 56 inches and pinkish gray, mottled loose sand to a depth of 60 inches.

Permeability is moderately rapid, and available water capacity is moderate. Organic-matter content is moderate, and natural fertility is medium.

Most of the acreage is used for corn, small grain, and other crops commonly grown in the county. Some areas are used for pasture, woodland, and wildlife habitat.

Representative profile of Bellevue fine sandy loam, sandy subsoil variant, slopes of 0 to 2 percent, in a cultivated area, 1,440 feet south and 2,340 feet east of the northeast corner of sec. 32, T. 15 N., R. 23 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam; weak medium granular structure; friable; few shell fragments less than 5 millimeters in size; slight efferverscence; mildly alkaline; abrupt smooth boundary.

B2—8 to 18 inches; dark brown (7.5YR 4/2) fine sandy loam; weak medium subangular blocky structure; very friable; few shell fragments less than 5 millimeters in size; slight effervescence; mildly alkaline; gradual wavy boundary.

B3—18 to 30 inches; dark brown (7.5YR 4/4) loamy fine sand; weak coarse subangular blocky structure; very friable; few shell fragments less than 5 millimeters in size; weakly stratified; strong effervescence; mildly alkaline; gradual wavy boundary.

C1—30 to 52 inches; brown (7.5YR 5/4) loamy fine sand; massive; very friable; very thin strata of very fine sand less than 1 millimeter thick; few shell fragments less than 5 millimeters in size; violent effervescence; mildly alkaline; abrupt wavy boundary.

C2—52 to 56 inches; brown (7.5YR 5/4) sand; single grained; loose; few shell fragments less than 5 willimeters in size; violent effervescence; mildly alkaline; abrupt wavy boundary.

C3—56 to 60 inches; pinkish gray (7.5YR 6/2) sand; common medium prominent strong brown (7.5YR 5/6 and 7.5YR 5/8) mottles; single grained; loose; few shell fragments less than 5 millimeters in size; violent effervescence; mildly alkaline.

The solum ranges from 20 to 36 inches in thickness. The A horizon is 7 to 10 inches thick. It is very dark grayish brown or dark brown. It is generally fine sandy loam, but in places is silt loam. The B horizon is 12 to 28 inches thick and has thin layers of silt loam or loam in places. The C horizon is sandy loam, loamy fine sand, or sand and has thin strata of silt loam in places. The B and C horizons are mildly alkaline or moderately alkaline.

The Bellevue variant is similar to other Bellevue soils. It has less clay and more sand than those soils.

Bf—Bellevue fine sandy loam, sandy subsoil variant. This nearly level soil is on flood plains of major streams. Areas are irregular or long in shape and range in size from about 5 to more than 50 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Alluvial land; Alluvial land, wet; other Bellevue soils; and Boyer and Sisson soils. Also included are some small somewhat poorly drained areas.

This soil is subject to flooding and streambank erosion. If protected from flooding, it is moderately well suited to all of the commonly grown crops. It is well suited to pasture and woodland. Most of the acreage is used for crops. Capability unit IIIw–12; woodland group 3o1; wildlife group 9.

Boots Series

The Boots series consists of nearly level, very poorly drained soils formed in herbaceous organic material more than 51 inches thick. These soils are in depressional areas in old glacial lake basins. They are mostly in one large area. The native vegetation was a ground cover of marsh grasses, sedges, and cattails and some tamarack, white-cedar, and alders.

In a representative profile the organic layer is more than 60 inches thick. The upper 14 inches is black muck. The next 26 inches is dark brown mucky peat that is very dark brown or black when exposed to air. The lower 20 inches is black muck.

Permeability is moderately rapid, and available water capacity is very high. Organic-matter content is very high, and natural fertility is low. The root zone is limited by the water table, which is at or near the surface in undrained areas.

Most areas of these soils are used for woodland and wildlife.

Representative profile of Boots muck, slopes of 0 to 2 percent, in a wooded area, 1,980 feet east and 1,320 feet north of the southwest corner of sec. 35, T. 16 N., R. 20 E.

Oa1—0 to 14 inches; black (N 2/0 broken face and rubbed) sapric material; estimated 10 percent fiber, less than 5 percent rubbed; weak fine subangular blocky structure; many woody and fibrous roots; mildly alkaline; clear smooth boundary.

Oe1—14 to 28 inches; dark brown (7.5YR 3/2 broken face) hemic material, changing to black (10YR 2/1) upon exposure to air or rubbing; estimated 60 percent fiber, 25 percent rubbed; weak thick platy structure; neutral; clear smooth boundary.

Oe2—28 to 40 inches; dark brown (7.5YR 4/4 broken face) hemic material, changing to very dark brown (10YR 2/2) upon exposure to air or rubbing; estimated 80 percent fiber, 30 percent rubbed; weak very thick platy structure; neutral; clear smooth boundary.

Oa2—40 to 60 inches; black (10YR 2/1 broken face and rubbed) sapric material; estimated 30 percent fiber, 10 percent rubbed; massive; neutral; clear smooth boundary.

The depth of the organic material ranges from 51 to about 84 inches. The surface layer ranges from 5 to 20 inches in thickness and is black sapric material. It is 5 to 15 percent fiber, but is less than 5 percent when rubbed. The next layer ranges from 20 to 45 inches in thickness. It is hemic material that is 35 to 90 percent fiber but is 20 to 40 percent when rubbed. The lower layer is sapric material that is 20 to 35 percent fiber but is 5 to 15 percent when rubbed. Marl is at a depth of 51 to 84 inches in some areas. The organic material ranges from slightly acid to mildly alkaline.

Boots soils are near Edwards and Palms soils. They have more fiber than Edwards and Palms soils. They lack the marl within a depth of 51 inches that is typical of Edwards soils and the mineral material within a depth of 51 inches that is typical of Palms soils.

Bk—Boots muck. This nearly level soil is in old lake basins. Areas are irregularly shaped and range in size up to 6,000 acres. This soil is mostly in one large area. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Edwards soils, Marsh, and Palms soils. Also included are some areas of Boots soils containing woody fragments in the organic layers.

Wetness is the major limitation of this soil. If drained, however, the soil is subject to subsidence, soil blowing, and burning.

If adequately drained, this soil is moderately well suited to the crops commonly grown in the county. Most areas are used for woodland, wildlife habitat, and recreation. Capability unit IIIw–9; woodland group 3w3; wildlife group 8.

Boyer Series

The Boyer series consists of gently sloping and sloping, well drained soils that are underlain by stratified sand and gravel. These soils are on outwash plains and river terraces along the major streams. Some areas of these soils have complex slopes. The native vegetation was a deciduous forest of mainly oak and hickory.

In a representative profile the surface layer is dark brown loamy sand about 4 inches thick (fig. 2). The subsurface layer is yellowish brown loamy sand about 4 inches thick. The subsoil is brown and dark brown and is about 18 inches thick. It is very friable sandy loam in the upper part; friable heavy sandy loam in the next part, and very friable sandy loam in the lower part. The substratum to a depth of 60 inches is loose, light yellowish brown, stratified sand and fine gravel.

Permeability is moderately rapid to a depth of about 26 inches and very rapid below. Available water capacity, organic-matter content, and natural fertility are low. The root zone is limited by the underlying sand and gravel.

Most areas of these soils are used for corn, small grain, legumes, and other crops commonly grown in the county. Some are used for pasture and woodland.

Representative profile of Boyer loamy sand, 2 to 6 percent slopes, in an idle field, 25 feet west of north end of wayside along State Highway 32, SE1/4SE1/4, sec. 11, T. 14 N., R. 22 E.

Ap—0 to 4 inches; dark brown (10YR 3/3) loamy sand; weak fine granular structure; very friable; mildly alkaline; abrupt smooth boundary.

A2—4 to 8 inches; yellowish brown (10YR 5/4) loamy sand; weak thin platy structure; very friable; mildly alkaline; clear wavy boundary.

Figure 2.—**Profile of Boyer loamy sand underlain by sandy outwash at a depth of about 28 inches.**

B1—8 to 14 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; slightly acid; gradual irregular boundary.

B2t—14 to 22 inches; dark brown (7.5YR 4/4) heavy sandy loam; moderate medium subangular blocky structure; friable; thin patchy clay films; neutral; gradual irregular boundary.

B3—22 to 26 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; neutral; abrupt irregular boundary.

C—26 to 60 inches; light yellowish brown (10YR 6/4) stratified sand and fine gravel; single grained; loose; estimated 35 percent gravel by volume; slight effervescence; mildly alkaline.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is 4 to 10 inches thick. It is dark brown or dark grayish brown. It is generally loamy sand, but in places is sandy loam. In undisturbed areas and areas where the Ap horizon is thin, the A2 horizon is up to 5 inches thick. It is yellowish brown or brown loamy sand or sandy loam. In some areas the A2 horizon does not occur. The B horizon is 15 to 30 inches thick. It is sandy loam and sandy clay loam, but includes transitional horizons of loamy sand. The average clay content of the Bt horizon is less than 18 percent. The C horizon is stratified sand and gravel or stratified medium and coarse sand. The B horizon ranges from slightly acid to mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Boyer soils are near Casco, Fox, Hebron, and Wasepi soils. They lack the mottles in the B horizon typical of Wasepi soils and are better drained than those soils. They have less clay in the B horizon than Casco, Hebron, and Fox soils and less silt and clay in the C horizon than Hebron soils.

BmB—Boyer loamy sand, 2 to 6 percent slopes. This gently sloping soil is on outwash plains along major streams. Areas are irregularly shaped and generally less than 40 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Fox, Hebron, and Wasepi soils. Also included are areas where the sand and gravel substratum is underlain by silt and fine sand or silt and clay below a depth of 4 feet, small areas of nearly level and sloping soils, areas of moderately well drained soils, and areas where the surface layer is sandy loam.

The soil blowing hazard is moderate, and the erosion hazard is slight. The soil is slightly droughty. Management that conserves moisture, reduces runoff, improves tilth, helps control erosion and soil blowing, and increases the available water capacity is beneficial where the soil is used for crops.

This soil is suited to all crops commonly grown in the county. It is also suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIIs–4; woodland group 3o1; wildlife group 3.

BmC2—Boyer loamy sand, 6 to 12 percent slopes, eroded. This sloping soil is on outwash plains along major streams. Areas are irregularly shaped and are generally less than 30 acres in size. This soil differs from the soil described as representative of the series in having some of the subsurface layer and subsoil mixed with the surface layer.

Included with this soil in mapping are small areas of Casco, Fox, and Hebron soils. Also included are areas where the sand and gravel substratum is underlain by silt and fine sand or silt and clay below a depth of 4 feet, small areas of gently sloping and moderately steep soil, areas where more sand is in the subsoil than is typical, areas where the surface layer is sandy loam, and somewhat poorly drained areas.

The hazards of soil blowing and erosion are moderate. The soil is slightly droughty. Controlling runoff, conserving moisture, improving tilth, and reducing the risk of erosion and soil blowing are beneficial where this soil is used for crops.

If well managed, this soil is suited to all crops commonly grown in the county. It is also suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIIe–7; woodland group 3o1; wildlife group 3.

Casco Series

The Casco series consists of nearly level to very steep, well drained soils that are underlain by stratified sand and gravel outwash. These soils are on outwash plains, stream terraces, and convex side slopes of glacial moraines. Many areas have complex slopes. The native vegetation was a deciduous forest of mainly oak and hickory.

In a representative profile the surface layer is dark grayish brown loam about 8 inches thick (fig. 3). The subsoil is about 9 inches thick and is dark brown. It is firm clay loam in the upper part and firm sandy clay loam with some gravel in the lower part. The sub-

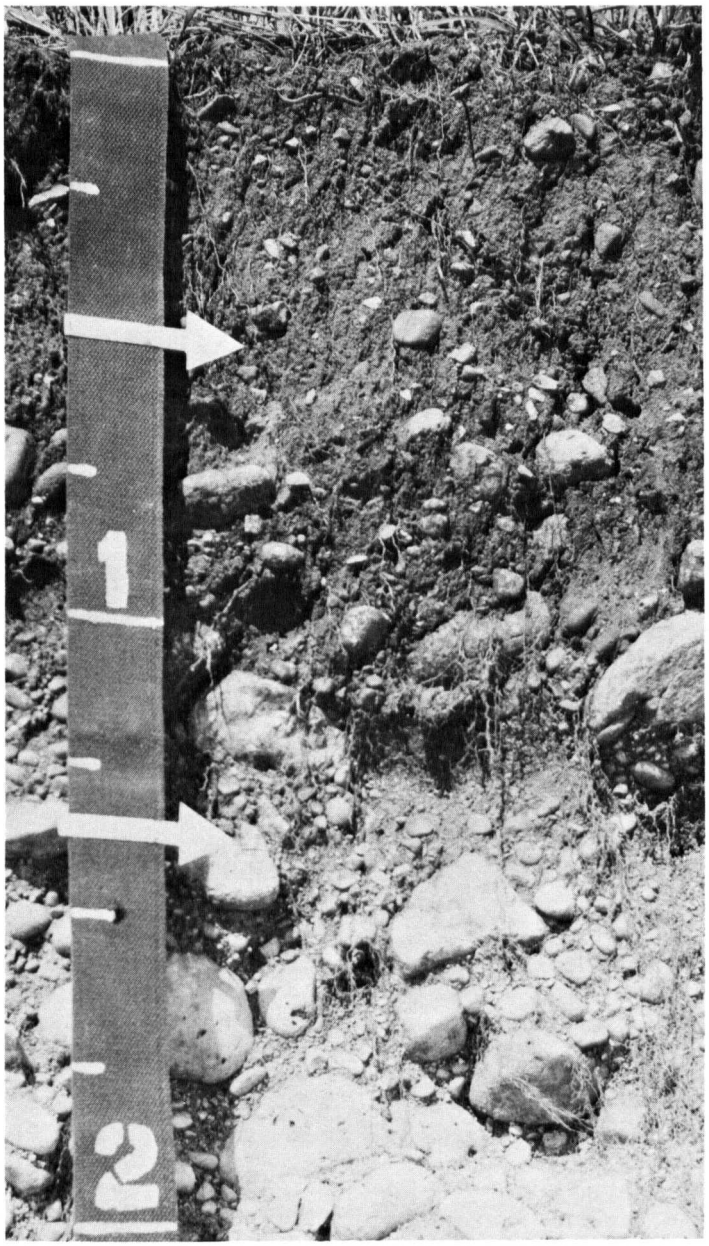

Figure 3.—**Profile of Casco loam underlain by gravel and sand at a depth of about 17 inches.**

stratum to a depth of 60 inches is brown, loose stratified gravel and sand.

Permeability is moderate to a depth of about 17 inches and very rapid below. Available water capacity is low. Organic-matter content is moderately low, and natural fertility is low. The root zone is limited by the underlying sand and gravel.

Most areas where slopes are less than 12 percent are used for corn, small grain, legumes, and other crops commonly grown in the county. Some of the less sloping areas and most areas where slopes are more than 12 percent are used for woodland, pasture, wildlife habitat, and recreation.

Representative profile of Casco loam, 2 to 6 percent slopes, in a cultivated area, 100 feet north and 2,440 feet west of the southeast corner of sec. 6, T. 14 N., R. 20 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; weak medium subangular blocky structure parting to moderate medium granular; friable; slightly acid; abrupt smooth boundary.

B21t—8 to 13 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thick continuous clay films on faces of peds; slightly acid; clear wavy boundary.

B22t—13 to 17 inches; dark brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; thick patchy clay films on faces of peds; estimated 9 percent gravel by volume in the lower part; neutral; abrupt wavy boundary.

IIC—17 to 60 inches; brown (10YR 5/3) stratified gravel and sand; single grained; loose; estimated 60 percent gravel by volume; strong effervescence; moderately alkaline.

The solum ranges from 11 to 24 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is dark grayish brown or dark brown. It is generally loam, but in places is silt loam. In uncultivated areas the A1 horizon is 3 to 5 inches thick and is very dark grayish brown. The A2 horizon, if it occurs, is 3 to 6 inches thick and is brown or grayish brown. Most cultivated areas lack an A2 horizon. The B horizon ranges from 5 to 18 inches in thickness. It is silty clay loam, clay loam, or sandy clay loam. In places the lower part of the B horizon is gravelly sandy loam or sandy loam. The C horizon is generally stratified sand and gravel, but in places is gravel and many cobblestones. The B horizon is slightly acid or neutral. The C horizon is mildly alkaline or moderately alkaline.

Casco soils are near Fabius, Fox, and Rodman soils. They have a thicker solum and more clay in the B horizon than Rodman soils. They have a thinner solum than Fox soils. Casco soils lack the mottles in the B horizon typical of Fabius soils and are better drained than those soils.

CeA—Casco loam, 0 to 2 percent slopes. This nearly level soil is on outwash plains. Areas are irregularly shaped and range in size from 4 to more than 40 acres. This soil is about 3 inches deeper over sand and gravel than is representative for the series.

Included with this soil in mapping are small areas of Boyer, Fabius, Fox, and Matherton soils. Also included are small gently sloping areas and small areas where the surface layer is sandy loam.

This soil is droughty. Conserving moisture and maintaining tilth help to maintain available water capacity.

This soil is suited to all crops commonly grown in the county. It is also suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIIs–8; woodland group 3d1; wildlife group 4.

CeB—Casco loam, 2 to 6 percent slopes. This gently sloping soil is on outwash plains. Areas are irregularly shaped and range in size from 4 to more than 100 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Boyer, Fabius, Fox, and Hochheim soils. Also included are small nearly level areas and small areas where the surface layer is sandy loam. Spot symbols have been used in some places on the soil map to identify areas where slopes are more than 6 percent. Spot symbols also identify areas where the surface is gravelly.

The erosion hazard is slight. The soil is droughty. Conserving moisture, reducing runoff, and maintaining tilth help to control erosion and maintain available water capacity.

This soil is suited to all crops commonly grown in the county and is well suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIIe–3; woodland group 3d1; wildlife group 4.

CeC2—Casco loam, 6 to 12 percent slopes, eroded. This sloping soil is on outwash plains. Areas are irregularly shaped and range in size from 4 to more than 150 acres. Many of the larger areas have complex slopes. This soil differs from the soil described as representative of the series in having some dark brown subsoil material mixed with the surface layer.

Included with this soil in mapping are small areas of Boyer, Fox, Hochheim, and Rodman soils. Also included are small areas of Casco soils that are severely eroded. Spot symbols have been used in some places on the soil map to identify areas where slopes are greater than 12 percent. Spot symbols also identify many areas where the surface is gravelly.

The erosion hazard is moderate. The soil is droughty. Reducing runoff, conserving moisture, and improving tilth help to control erosion and maintain available water capacity.

Even if well managed, this soil is poorly suited to most crops grown in the county. It is suited to woodland and pasture. Most areas are used for crops, but a considerable acreage is used for pasture and woodland. Capability unit IVe–3; woodland group 3d1; wildlife group 4.

CrC—Casco-Rodman complex, 6 to 12 percent slopes. These sloping soils are on escarpments on outwash plains. Areas are irregularly shaped and range in size from 4 to more than 40 acres.

This complex is made up of areas of Casco and Rodman soils that are so small and closely intermingled that they cannot be shown individually on the soil map. It is about 70 percent Casco soils, 20 percent Rodman soils, and 10 percent small areas of Boyer, Fox, Hochheim, and St. Charles soils. The Casco soils are generally on the concave sides of slopes, and the Rodman soils are on the convex sides of slopes and on ridgetops.

The Casco soils are shallower over sand and gravel and have a thinner, darker colored surface layer than is representative for the Casco series. They also differ in having a thin, light colored subsurface layer. Where cultivated, they have more clay and gravel in the surface layer. The Rodman soils are similar to the soil described as representative of the Rodman series, but

where cultivated, they are thinner and have a lighter colored, more sandy and gravelly surface layer.

These soils are droughty. The erosion hazard is moderate. Controlling runoff and conserving moisture help to control erosion and maintain available water capacity.

These soils are poorly suited to crops commonly grown in the county, but are suited to woodland and pasture. About half the areas have remained in woodland, and about half have been cleared and farmed. Most farmed areas are eroded. Some areas are used for crops, and some areas cleared for crops are in pasture or pine plantations (fig. 4). Capability unit IVe–3; woodland group 3d1; wildlife group 4.

CrD2—Casco-Rodman complex, 12 to 20 percent slopes, eroded. These moderately steep soils are on escarpments of outwash plains and on eskers and kames. Areas are long and range in size from 4 to more than 500 acres.

This complex is made up of areas of Casco and Rodman soils that are so small and so closely intermingled that they cannot be shown individually on the soil map. It is about 60 percent Casco soils, 30 percent Rodman soils, and 10 percent small areas of Boyer, Fox, Hochheim, and St. Charles soils. The Casco soils are generally on the concave sides of slopes, and the Rodman soils are on the convex sides of slopes and on ridgetops.

The Casco soils are thinner over sand and gravel and have more sand and gravel in the surface layer than is representative for the Casco series. In unplowed areas they have a thinner, darker colored surface layer. The Rodman soils are similar to the soil described as representative of the Rodman series, but where cultivated, they have a lighter colored, more sandy and gravelly surface layer. Both soils are droughty. The erosion hazard is severe.

These soils are generally not suited to crops. They are suited to pasture and woodland. About three-fourths of the areas are in woodland, and about one-fourth have been cleared and farmed. Most farmed areas are eroded. Most areas that have been used for crops are in pasture or pine plantations. Capability unit VIe–3; woodland group 3d2; wildlife group 4.

CrE—Casco-Rodman complex, 20 to 30 percent slopes. These steep soils are on outwash plains, eskers, and kames. Areas are long and range in size from 4 to more than 500 acres.

This complex is made up of areas of Casco and Rodman soils that are so small and so closely intermingled that they cannot be shown separately on the soil map. It is about 55 percent Casco soils, 30 percent Rodman soils, and 15 percent small areas of Boyer, Fox, Hochheim, and St. Charles soils. The deeper soils are generally on concave foot slopes, and the Rodman soils are on the convex side slopes and on ridgetops.

The Casco soils are shallower over sand and gravel and have a thinner, darker colored surface layer than is representative for the Casco series. They also differ

Figure 4.—Area of Casco-Rodman complex that is no longer cultivated and has been planted to conifers.

in having a light colored subsurface layer. The Rodman soils have the profile described as representative of the Rodman series. Both soils are droughty. The hazard of erosion is very severe.

These soils are not suited to commercial crop production and are poorly suited to pasture. They are suited to woodland. Most of the acreage is in woodland, but some areas have been cleared and farmed or pastured. Most areas that have been farmed are eroded and are planted to pine trees. Capability unit VIIe–3; woodland group 3d2; wildlife group 4.

CrF—Casco-Rodman complex, 30 to 45 percent slopes. These very steep soils are on outwash plains, eskers, and kames. Areas are long and range in size from 4 to more than 300 acres.

This complex is made up of areas of Casco and Rodman soils that are so small and so closely intermingled that they cannot be shown separately on the soil map. It is about 45 percent Casco soils, 35 percent Rodman soils, and 20 percent small areas of Boyer, Fox, Hochheim, and St. Charles soils. The deeper soils are generally on concave foot slopes, and the Rodman soils are on the convex side slopes and on ridgetops.

The Casco soils are shallower over sand and gravel and have a thinner, darker colored surface layer than is representative for the Casco series. They also differ in having a light colored subsurface layer. Both soils are droughty. The erosion hazard is very severe.

These soils are not suited to commercial crop production and are poorly suited to pasture. They are suited to woodland. Most areas are in woodland, but small areas have been cleared for pasture. Capability unit VIIe–3; woodland group 3d3; wildlife group 4.

Colwood Series

The Colwood series consists of nearly level, poorly drained soils that are underlain by stratified silt and very fine sand. These soils are in old glacial lake basins. The native vegetation was a deciduous forest of elm, ash, and maple.

In a representative profile the surface layer is silt loam about 11 inches thick. The upper part is very dark brown, and the lower part is very dark gray. The subsoil is about 22 inches thick and is mottled throughout. It is dark gray, firm silt loam in the upper part and gray, friable loam in the lower part. The substratum to a depth of about 60 inches is stratified, friable silt and very fine sand. It is grayish brown in the upper part and yellowish brown in the lower part and is mottled.

Permeability is moderate, and available water capacity is high. Organic-matter content is high, and natural fertility is medium. The root zone is limited by saturated soil during wet periods of the growing season.

Most of the acreage has been cleared and is used for crops or pasture or is idle. Some areas are in woodland.

Representative profile of Colwood silt loam, slopes of 0 to 2 percent, in a cultivated area, 800 feet north and 600 feet east of the southwest corner of sec. 14, T. 13 N., R. 21 E.

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

A12—8 to 11 inches; very dark gray (10 YR 3/1) heavy silt loam; moderate medium prismatic structure parting to moderate thick platy; friable; few black (10YR 2/1) organic stains on vertical faces of peds; mildly alkaline; abrupt wavy boundary.

B2g—11 to 27 inches; dark gray (5Y 4/1) silt loam; weak coarse prismatic structure parting to moderate medium angular blocky; few medium prominent yellowish brown (10YR 5/6) mottles; firm; neutral; clear wavy boundary.

IIB3g—27 to 33 inches; gray (5YR 5/1) loam; common coarse prominent yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; neutral; abrupt wavy boundary.

IIIC1—33 to 40 inches; grayish brown (2.5Y 5/2) stratified coarse silt and very fine sand; fine medium distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; strong effervescence; mildly alkaline; abrupt wavy boundary.

IIIC2—40 to 60 inches; yellowish brown (10 YR 5/4) stratified coarse silt and very fine sand; common medium distinct brownish yellow (10YR 6/6) mottles; massive; friable; strong effervescence; mildly alkaline.

The solum ranges from 24 to 40 inches in thickness. The A horizon is 10 to 15 inches thick. It is very dark grayish brown, very dark gray, very dark brown, or black. The B horizon ranges from 12 to 28 inches in thickness. It is silty clay loam, silt loam, clay loam, loam, or fine sandy loam. In places it is stratified. The C horizon is stratified with layers of silt, silt loam, fine sand, and very fine sand. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Colwood soils are near Kibbie, Sisson, and Yahara soils. They are grayer and more poorly drained than those soils.

Cw—Colwood silt loam. This nearly level soil is in depressions in old glacial lake plains. Areas are irregularly shaped and range in size from 3 to more than 40 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Kibbie, Sebewa, and Yahara soils. Also included are some small sloping areas, some areas where the substratum has layers of clay at a depth of more than 40 inches, and areas where the surface layer is fine sandy loam.

Wetness is the major limitation of this soil. The soil is subject to ponding in spring and after periods of heavy rainfall. It is difficult to drain because the silt and very fine sand in the substratum flow easily and fill tile lines.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and some types of woodland. Most of the acreage is used for pasture or cropland, but a considerable acreage is in woodland. Capability unit IIw–1; woodland group 1w1; wildlife group 7.

Cut and Fill Land, Sandy and Gravelly

Cx—Cut and fill land, sandy and gravelly, is cut and filled sandy and gravelly soil material. Slopes are 0 to 6 percent. The percentage of sand and gravel ranges from almost 100 percent gravel to 100 percent sand. Most areas, however, are a mixture of both. Most of the acreage was gently sloping to steep Casco and Rodman soils that have been mixed and leveled during gravel pit operation and construction.

Permeability is rapid or very rapid, and available water capacity is very low. Organic-matter content is very low, and natural fertility is low. The root zone is limited by the sand and gravel.

This land is very difficult to vegetate unless a layer of loamy soil material is placed on the surface. Most of the acreage is used for such urban developments as school grounds, mobile homesites, and resorts. Capability unit VIIIs–10; woodland group 6s1; wildlife group 10.

Cut and Fill Land, Loamy

Cy—Cut and fill land, loamy, is cut and filled silt loam, loam, clay loam, sandy loam, or sandy clay loam. Slopes are 0 to 6 percent. Many of the filled areas are underlain by a poorly drained soil. Most cut areas are in glacial till, but some are in lacustrine basins.

Permeability is moderate or moderately rapid, and available water capacity is moderate. Organic-matter content is very low, and natural fertility is low.

If fertilized and maintained, this land supports a cover of grass and other landscape plants. Most of the acreage is used for such urban developments as school grounds, mobile home sites, shopping centers, and industrial parks. Capability unit IIIe–1; woodland group 6s1; wildlife group 1.

Cut and Fill Land, Clayey

Cz—Cut and fill land, clayey, is cut and filled silty and clayey soil material. Slopes are 0 to 6 percent. The filled areas are generally underlain by a poorly drained soil. The cut areas are generally areas of Kewaunee soils from which the topsoil and subsoil have been removed. Included in mapping are some small areas of Cut and fill land, loamy; Made land; and Kewaunee and Manawa soils.

Permeability is moderately slow, and available water capacity is moderate. Organic-matter content is very low, and natural fertility is low.

This soil material supports a growth of grass and other landscape plants if it is maintained and fertilized. Most of the acreage is used for such urban developments as schools, shopping centers, mobile homesites, and industrial parks. Capability unit IIIe–6; woodland group 6s1; wildlife group 2.

Dune Land

Dn—Dune land is excessively drained medium and fine sand that has been blown into dunes up to 40 feet high. Slopes are 6 to 60 percent. This land is adjacent to beaches and lakes. Areas are long and narrow and range in size from 3 to 100 acres.

Included with this land in mapping are small areas of Beaches, sandy, and Oakville soils. Also included are some low areas between dunes where the water table is near the surface.

Permeability is very rapid, and available water capacity is very low. Organic-matter content is very low, and natural fertility is low. The root zone is limited by the sand. Many areas are partly stabilized by drought-resistant grasses, shrubs, and trees. Areas that lack cover are subject to soil blowing.

This land is not suited to commercial crop production, woodland, or pasture. It is suited to some recreational uses and some types of wildlife cover. Most of the acreage is used for recreation. Capability unit VIIIs–10; woodland group 6s1; wildlife group 10.

Edwards Series

The Edwards series consists of nearly level, very poorly drained soils formed in herbaceous organic material underlain by marl. These soils are in depressional areas in old glacial lake plains. The native vegetation was grasses, sedges, and cattails and some elm, ash, white cedar, and tamarack.

In a representative profile the organic layer is about 38 inches thick. The upper 21 inches is very dark brown muck, and the lower 17 inches is dark yellowish brown muck which becomes very dark brown when exposed to air. The substratum to a depth of 60 inches is mainly light gray, massive marl.

Permeability is moderately rapid to a depth of 38 inches and slow below. Available water capacity is very high, and natural fertility is low. The root zone is limited by the water table, which is at or near the surface much of the year.

Most of the acreage is used for woodland, wildlife habitat, and pasture. Some small areas are drained and used for crops.

Representative profile of Edwards muck, slopes of 0 to 2 percent, in a wooded area, 2,620 feet west and 500 feet north of the southeast corner of sec. 2, T. 13 N., R. 20 E.

Oa1—0 to 14 inches; very dark brown (10YR 2/2 broken face and rubbed) sapric material; weak medium subangular blocky structure parting to moderate medium granular; friable; mildly alkaline; clear wavy boundary.

Oa2—14 to 21 inches; very dark brown (10YR 2/2 broken face and rubbed) sapric material; moderate coarse subangular blocky structure; friable; mildly alkaline; gradual wavy boundary.

Oa3—21 to 38 inches; dark yellowish brown (10YR 3/4 broken face and rubbed) sapric material changing to very dark brown (10YR 2/2) on exposure to air; moderate coarse subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

Lco—38 to 42 inches; mixed dark brown (10YR 3/3 broken face and rubbed) sapric material and grayish brown (10YR 5/2) marl; massive; friable; estimated 30 percent shells and shell fragments ranging from 2 to 20 millimeters in size; strong effervescence; mildly alkaline; clear smooth boundary.

Lca—42 to 60 inches; light gray (10YR 7/1) marl; massive; friable; strong effervescence; mildly alkaline.

The depth of the organic material ranges from 16 to 50 inches. The organic material is 1 to 50 percent fiber, but is less than 15 percent after rubbing. In places woody fragments are in the organic layers. The organic material is slightly acid to mildly alkaline. The underlying marl is mildly alkaline or moderately alkaline.

Edwards soils are similar to Boots, Houghton, and Palms soils. They differ from those soils in having underlying marl.

Ed—Edwards muck. This nearly level soil is in old glacial lake basins. Areas are irregularly shaped and range in size from 3 to 80 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Houghton and Palms soils. Also included are some areas where a layer of sedimentary peat less than 6 inches thick is in the lower part of the organic material. In some areas the marl is underlain by loamy material at a depth of less than 60 inches.

Wetness is the major limitation of this soil. If

drained and cultivated, however, the soil is subject to subsidence, soil blowing, and burning.

Most of the acreage is used for woodland, wildlife habitat, and pasture. Some small areas are drained and used for crops. Capability unit IVw–7; woodland group 3w3; wildlife group 8.

Elvers Series

The Elvers series consists of nearly level, poorly drained soils formed in alluvium over herbaceous organic material. These soils are in small depressions, along the edge of large organic soil areas, and on flood plains. The native vegetation was elm, ash, maple, and white cedar.

In a representative profile the surface layer and substratum are mottled very dark grayish silt loam about 22 inches thick. The underlying organic soil to a depth of about 60 inches is black, friable muck in the upper part; dark reddish brown, friable muck in the next part; and very dark grayish brown, firm muck in the lower part.

Permeability is moderate to a depth of about 22 inches and moderately rapid below. Available water capacity is very high. Organic-matter content also is very high. Natural fertility is high. The root zone is limited by the water table.

Most of the acreage is used for pasture, woodland, and wildlife habitat. Some areas are drained and used for crops.

Representative profile of Elvers silt loam, slopes of 0 to 2 percent, in a cultivated area, 2,520 feet north and 1,200 feet east of the southwest corner of sec. 31, T. 13 N., R. 21 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 6/1) dry; few fine distinct dark reddish brown (5YR 3/4) mottles; moderate medium granular structure; friable; neutral; abrupt smooth boundary.

Cg—8 to 22 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 6/1) dry; common fine distinct dark reddish brown (5YR 3/4) mottles; moderate medium platy structure parting to moderate medium granular; friable; neutral; abrupt smooth boundary.

IIOa1—22 to 30 inches; black (10YR 2/1 broken face and rubbed) sapric material; moderate medium subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

IIOa2—30 to 36 inches; dark reddish brown (5YR 3/2 broken, 5YR 2/2 rubbed) sapric material; massive; friable; thinly layered; mildly alkaline; clear smooth boundary.

IIOa3—36 to 60 inches; very dark grayish brown (2.5Y 3/2 broken face and rubbed) sapric material; massive; firm; thinly layered; mildly alkaline.

The depth of the mineral material ranges from 16 to 40 inches. The organic material beneath the mineral soil is 20 or more inches thick. The Ap or A1 horizon is 2 to 8 inches thick. It is very dark grayish brown or dark grayish brown. The C horizon is similar to the A horizon, but it has platy structure as a result of floodwater deposition. The organic layers have less than 15 percent fiber after rubbing. The mineral and organic layers range from slightly acid to mildly alkaline.

Elvers soils are similar to Otter soils and are near Palms and Willette soils. They have an organic layer 20 or more inches thick, which does not occur in Otter soils, and a mineral upper layer, which does not occur in Palms and Willette soils.

Ev—Elvers silt loam. This nearly level soil is in depressions and around the border of large organic soil areas along streams. Most areas are long and are less than 20 acres in size. Slopes are 0 to 2 percent.

Included with this soil in mapping are some small areas of Alluvial land, wet, and Otter soils. In some areas the mineral layer is less than 16 inches thick.

This soil is too wet for crop production unless it is artificially drained. It is subject to ponding and flooding. If adequately drained and protected from ponding and flooding, this soil is productive. If adequately drained, it is moderately well suited to all crops commonly grown in the county. It is suited to pasture and some types of woodland. Most of the acreage is used for pasture, woodland, and wildlife habitat. Some areas are drained and used for crops. Capability unit IIw–13; woodland group 4w2; wildlife group 7.

Fabius Series

The Fabius series consists of nearly level and gently sloping, somewhat poorly drained soils that are underlain by sand and gravel. These soils are on outwash plains and low stream terraces. The native vegetation was deciduous forest and an undergrowth of grasses.

In a representative profile the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is 11 inches thick. It is brown, friable loam in the upper part; dark brown, firm clay loam in the next part; and brown, friable gravelly sandy loam in the lower part. The substratum is light yellowish brown, loose sand and gravel in the upper part and pale brown, loose fine sand to a depth of 60 inches.

Permeability is moderate to a depth of 19 inches and moderately rapid below. Available water capacity is low. Organic-matter content is moderate, and natural fertility is low. The root zone is limited by the underlying sand and gravel and by saturated soil during wet periods of the growing season.

Most of the acreage is used for crops and pasture, but some is used for woodland.

Representative profile of Fabius loam, 0 to 3 percent slopes, in an idle field, 1,910 feet south and 685 feet east of the northwest corner of sec. 29, T. 15 N., R. 21 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam; moderate medium subangular blocky structure parting to weak fine granular; friable; neutral; abrupt smooth boundary.

B1—8 to 12 inches; brown (10YR 5/3) loam; few fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure parting to weak fine subangular blocky; friable; mildly alkaline; clear smooth boundary.

B2t—12 to 16 inches; dark brown (10YR 4/3) clay loam; common fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thick discontinuous clay films; estimated 10 percent gravel by volume; mildly alkaline; clear smooth boundary.

B3—16 to 19 inches; brown (10YR 4/3) gravelly sandy loam; common fine faint grayish brown (10YR 5/2) mottles and few fine prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; estimated 16 percent gravel by volume; mildly alkaline; clear wavy boundary.

IIC1—19 to 43 inches; light yellowish brown (10YR 6/4) sand and gravel; single grained; loose; 45 percent gravel by volume; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC2—43 to 60 inches; pale brown (10YR 6/3) fine sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 12 to 20 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is very dark grayish brown, very dark brown, very dark gray, or black. The B horizon is dominantly clay loam or loam 5 to 12 inches thick. It is brown or dark brown and is mottled. The C horizon is generally sand and gravel, but has strata entirely of sand and also strata of gravel. The B horizon is neutral to mildly alkaline.

Fabius soils are near Casco soils. They are not so well drained as Casco soils. They also differ from these soils in having mottles.

FaA—Fabius loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is on outwash plains and stream terraces. Areas are long and irregularly shaped and range in size from 3 to more than 30 acres.

Included with this soil in mapping are small areas of Casco soils. Also included are areas where the surface layer is sandy loam. In places silt and very fine sand layers are in the substratum at a depth of more than 42 inches.

Wetness is the major limitation of this soil. The soil dries slowly and in some areas is ponded in spring and after periods of heavy rainfall.

If adequately drained and well managed, this soil is moderately well suited to all crops commonly grown in the county. It is suited to woodland and pasture. Most of the acreage is used for crops and pasture. Capability unit IIw–5; woodland group 3o2; wildlife group 6.

Fox Series

The Fox series consists of nearly level to sloping, well drained soils that are underlain by gravelly and sandy outwash. These soils are on outwash plains and stream terraces. Some areas have complex slopes. The native vegetation was a deciduous forest of mainly oak, hickory, and maple.

In a representative profile the surface layer is dark grayish brown silt loam about 9 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is about 14 inches thick. It is brown, firm silty clay loam in the upper part and dark brown, firm clay loam in the lower part. The substratum to a depth of 60 inches is yellowish brown stratified, loose gravel and sand.

Permeability is moderate to a depth of about 27 inches and very rapid below. Available water capacity is moderate. Organic-matter content is low, and natural fertility is medium.

Most of the acreage is used for corn, small grain, legumes, and other crops commonly grown in the county. Some areas are used for pasture and woodland.

Representative profile of Fox silt loam, 0 to 2 percent slopes, in a pine plantation, 150 feet north of the east-west road and 20 feet east of lane in NE¼ SW¼, sec. 27, T. 15 N., R. 20 E.

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

A2—9 to 13 inches; brown (10YR 5/3) silt loam; moderate thin platy structure; friable; neutral; clear wavy boundary.

B1—13 to 18 inches; brown (7.5YR 4/4) light silty clay loam; strong medium subangular blocky structure; firm; thin discontinuous clay films; brown (10YR 5/3) silt coatings on faces of some peds; neutral; clear wavy boundary.

IIB21t—18 to 22 inches; dark brown (7.5YR 4/4) clay loam; strong medium subangular blocky structure; firm; thick continuous clay films; slightly acid; abrupt wavy boundary.

IIB22t—22 to 27 inches; dark brown (7.5YR 3/2) heavy clay loam; strong medium subangular blocky structure; firm; thick continuous clay films; estimated 10 percent gravel by volume; neutral; abrupt wavy boundary.

IC—27 to 60 inches; yellowish brown (10YR 5/4) stratified gravel and sand; single grained; loose; estimated 55 percent gravel by volume; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is 6 to 9 inches thick. It is dark grayish brown or dark brown. It is generally silt loam, but in places is loam. The A2 horizon is 3 to 6 inches thick. It is grayish brown or brown. In places the A2 horizon does not occur. In uncultivated areas there is an A1 horizon that is 3 to 5 inches thick. It is very dark brown or very dark grayish brown. The B horizon is 13 to 32 inches thick. It is silt loam or silty clay loam in the upper part and clay loam or sandy clay loam in the lower part. The lower part of the B horizon is 5 to 15 percent gravel by volume. The C horizon is generally stratified gravel and sand, but ranges from mostly gravel to mostly sand. The B horizon ranges from slightly acid to mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Fox soils are near Casco, Matherton, and Sebewa soils. Fox soils have a thicker solum than Casco soils. They are better drained than Matherton and Sebewa soils and also differ from those soils in having no mottles. Fox soils have more clay and less sand in the B horizon than Boyer soils.

FsA—Fox silt loam, 0 to 2 percent slopes. This nearly level soil is on outwash plains. Areas are irregularly shaped and range in size from 4 to more than 100 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are some small areas of Boyer, Casco, Matherton, and St. Charles soils. Also included are areas where the surface layer is sandy loam, some small gently sloping areas, and some moderately well drained areas.

This soil is slightly droughty. Conserving moisture and maintaining tilth help to increase available water capacity.

This soil is suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIs–1; woodland group 2o1; wildlife group 1.

FsB—Fox silt loam, 2 to 6 percent slopes. This gently sloping soil is on outwash plains. Areas are irregularly shaped and range in size from 4 to more than 100 acres. In most cultivated areas this soil lacks the subsurface layer that occurs in the soil described as representative of the series. In some the subsoil is mixed with the plow layer.

Included with this soil in mapping are small areas of Boyer, Casco, Matherton, St. Charles, and Theresa soils. Also included are areas where the surface layer is sandy loam, some small nearly level and sloping areas, and some moderately well drained areas.

This soil is subject to slight erosion and is slightly droughty. Conserving moisture, reducing runoff, and maintaining tilth help to control erosion and maintain available water capacity.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to wood-

land and pasture. Most of the acreage is used for crops. Capability unit IIe–2; woodland group 2o1; wildlife group 1.

FsC2—Fox silt loam, 6 to 12 percent slopes, eroded. This sloping soil is on outwash plains. Areas are irregularly shaped and range in size from 3 to more than 20 acres. This soil differs from the soil described as representative of the series in having all of the subsurface layer and some of the subsoil mixed in the plow layer.

Included with this soil in mapping are small areas of Boyer, Casco, Rodman, St. Charles, and Theresa soils. Also included are areas where the surface layer is sandy loam and some moderately steep areas.

This soil is subject to moderate erosion and is slightly droughty. Conserving moisture, reducing runoff, and maintaining tilth help to control erosion and maintain available water capacity.

If well managed, this soil is suited to all crops commonly grown in the county. It is well suited to woodland and pasture. It is used for crops, pasture, and woodland. Capability unit IIIe–2; woodland group 2o1; wildlife group 1.

Granby Series

The Granby series consists of nearly level, poorly drained and very poorly drained sandy soils in depressions and on stream terraces. The native vegetation was a forest of elm, ash, and white cedar and a ground cover of sedges and grasses.

In a representative profile the surface layer is loamy fine sand about 13 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is grayish brown loose sand about 13 inches thick. The substratum to a depth of 60 inches is grayish brown loose sand in the upper part and brown loose sand in the lower part.

Permeability is rapid, and available water capacity is low. Organic-matter content is moderate, and natural fertility is low. The root zone is limited by the seasonal water table.

Most areas are used for woodland and wildlife habitat. Some are used for pasture and crops.

Representative profile of Granby loamy fine sand, slopes of 0 to 2 percent, in a wooded area, 40 feet east and 740 feet north of the southwest corner of sec. 14, T. 14 N., R. 23 E.

A11—0 to 5 inches; black (10 YR 2/1) loamy fine sand; moderate very fine subangular blocky structure; very friable; neutral; clear wavy boundary.

A12—5 to 13 inches; very dark gray (10YR 3/1) loamy fine sand; moderate medium subangular blocky structure; very friable; neutral; clear wavy boundary.

B2—13 to 26 inches; grayish brown (10YR 5/2) sand; few fine prominent strong brown (7.5YR 5/6) mottles; single grained; loose; neutral; gradual wavy boundary.

C1—26 to 36 inches; grayish brown (10YR 5/2) sand and coarse sand; single grained; loose; neutral; clear wavy boundary.

C2—36 to 60 inches; brown (10YR 5/3) sand and coarse sand; single grained; loose; neutral.

The solum ranges from 20 to 40 inches in thickness. The A horizon is 10 to 16 inches thick. It is black or very dark gray. It is generally loamy fine sand, but in places is loamy sand or sand. The B horizon is 10 to 30 inches thick. It is sand or fine sand and has strata of sandy loam in some pedons. The C horizon is coarse, medium, or fine sand. Both the B and C horizons are slightly acid or neutral.

Granby soils are near Adrian and Oakville soils. Granby soils are grayer and more poorly drained than Oakville soils. They lack the organic surface layer typical of the Adrian soils.

Gb—Granby loamy fine sand. This nearly level soil is in depressions and on stream terraces. Areas are irregularly shaped and range in size from 3 to more than 50 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Adrian, Colwood, and Oakville soils. Also included are some areas where the substratum has strata of very fine sand, silt, or clay below a depth of 40 inches.

This soil is too wet for crop production unless it is drained. If drained and cultivated, however, it is droughty and subject to soil blowing.

This soil is poorly suited to crops and pasture, but is suited to some types of woodland and to wildlife habitat. Most of the acreage is used for woodland and wildlife habitat. Capability unit IVw–5; woodland group 3w1; wildlife group 7.

Granby Variant

The Granby variant consists of nearly level, poorly drained soils that are underlain by gravel and sand. These soils are on outwash plains and low stream terraces. The native vegetation was a deciduous forest of mainly ash and elm.

In a representative profile the surface layer is very gray silt loam about 9 inches thick. The subsoil is light brownish gray and is about 9 inches thick. It is very friable gravelly loamy fine sand in the upper part and very friable gravelly sandy loam in the lower part. The substratum is light brownish gray, very friable gravelly loamy sand to a depth of 30 inches and light brownish gray loose gravel and sand to a depth of 60 inches.

Permeability is moderately rapid to a depth of about 18 inches and very rapid below. Available water capacity is low. Organic matter content is high, and natural fertility is low. The root zone is limited by the seasonal water table.

Most of the acreage of these soils is used for crops and pasture. Some is used for woodland.

Representative profile of Granby silt loam, gravelly variant, slopes of 0 to 2 percent, in a cultivated area, 980 feet north and 250 feet west of the southeast corner of sec. 19, T. 15 N., R. 21 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam; weak fine subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.

B1—9 to 12 inches; light brownish gray (2.5Y 6/2) gravelly loamy fine sand; few fine prominent brownish yellow (10YR 6/6) mottles and common medium faint grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; very friable; estimated 16 percent gravel by volume; slight effervescence; mildly alkaline; clear smooth boundary.

B2—12 to 18 inches; light brownish gray (2.5Y 6/2) gravelly sandy loam; many medium prominent brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; very friable; estimated 45 percent gravel by volume; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—18 to 30 inches; light brownish gray (2.5Y 6/2) gravelly loamy sand; moderate medium prominent

brownish yellow (10YR 6/6) mottles and common medium faint grayish brown (10YR 5/2) mottles; massive; very friable; estimated 45 percent gravel by volume; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—30 to 60 inches; light brownish gray (2.5Y 6/2) gravel and sand; single grained; loose; estimated 60 percent gravel by volume; strong effervescence; moderately alkaline.

The solum ranges from 12 to 20 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is very dark gray, very dark grayish brown, or black. It is generally silt loam, but in places is loam or gravelly loam. The B horizon ranges from 6 to 12 inches in thickness. It is gravelly loam, gravelly sandy loam, or gravelly loamy fine sand. The gravel content ranges from 15 to 50 percent by volume. The C horizon is typically gravel and sand, but contains strata entirely of gravel and also strata of gravelly loamy sand. The B horizon is neutral to moderately alkaline.

The Granby variant is near Fabius and Sebewa soils. It is more poorly drained and has more gravel in the B horizon than Fabius soils. It has a thinner solum and more gravel and less clay in the solum than Sebewa soils.

Gg—Granby silt loam, gravelly variant. This nearly level soil is on outwash plains and low stream terraces. Areas are irregularly shaped and range in size from 3 to more than 40 acres. Slopes are 0 to 2 percent. Included in mapping are some small areas of Colwood and Sebewa soils.

This soil is too wet for crop production unless it is drained. If drained, however, it is droughty.

If drained, this soil is moderately well suited to crops. It is suited to some types of woodland and to wildlife habitat. Most of the acreage is used for cropland, but some is used for woodland and pasture. Capability unit IIw–5; woodland group 3w1; wildlife group 7.

Gravel Pit

Gp—Gravel pit is mostly on outwash plains and terraces where glacial melt water has washed and sorted the sand and gravel. Areas range in size from 3 to more than 40 acres.

Gravel pit consists of areas where sand, gravel, or sand and gravel have been removed. It commonly has very steep banks on one or more sides and a gently sloping bottom.

Included with this unit in mapping are small areas of Cut and fill land, loamy, and Cut and fill land, sandy and gravelly.

Most areas are not suited to crops. Available water capacity is very low, and the soil material is droughty unless the bottom of the pit is near the water table. In many areas sand and gravel are still being removed. Most areas have no vegetative cover. Capability unit VIIIs–10; woodland group 6s1; wildlife group 10.

Hebron Series

The Hebron series consists of nearly level and gently sloping, well drained and moderately well drained soils formed in a thin layer of loamy material over stratified silty and clayey lacustrine deposits. These soils are on old glacial lake plains and in depressions in till plains. The native vegetation was a deciduous forest of mainly oak, hickory, maple, and basswood.

In a representative profile the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is 20 inches thick. The upper 4 inches is brown, friable loam; the next 11 inches is dark reddish brown, firm sandy clay loam and friable sandy loam; and the lower 5 inches is reddish brown, firm silty clay loam. The substratum to a depth of 60 inches is brown, stratified, firm silt, silty clay, and silty clay loam.

Permeability is moderate to a depth of about 23 inches and moderately slow below. Available water capacity is high. Organic-matter content is moderately low, and natural fertility is medium.

Most of the acreage is used for corn, small grain, legumes, and other crops commonly grown in the county. Some areas are used for pasture and woodland.

Representative profile of Hebron loam, 2 to 6 percent slopes, in a cultivated field, 600 feet north and 2,610 feet west of the southeast corner of sec. 18, T. 15 N., R. 23 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate fine subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.

B1—8 to 12 inches; brown (7.5YR 5/4) loam; moderate medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

B21t—12 to 17 inches; dark reddish brown (5YR 3/4) sandy clay loam; moderate fine subangular blocky structure; firm; thin patchy clay films; estimated 10 percent fine gravel by volume; mildly alkaline; clear wavy boundary.

B22t—17 to 23 inches; dark reddish brown (5YR 3/4) sandy loam; moderate fine subangular blocky structure; friable; few thin patchy clay films; mildly alkaline; abrupt wavy boundary.

IIB23t—23 to 28 inches; reddish brown (5YR 5/4) silty clay loam; moderate medium prismatic structure parting to moderate fine angular blocky; firm; thick patchy clay films; slight effervescence; mildly alkaline; clear wavy boundary.

IIC—28 to 60 inches; brown (7.5YR 4/4) stratified silt, silty clay, and silty clay loam; weak thick platy structure; firm; many soft pinkish gray (7.5YR 7/2) lime segregations; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is generally loam, but in places is sandy loam or silt loam. In undisturbed areas there are a 2 to 4-inch A1 horizon of very dark brown or very dark grayish brown and a 2- to 5-inch, dark grayish brown A2 horizon. The B horizon is 15 to 36 inches thick. The upper part is sandy loam, loam, sandy clay loam, or clay loam. The lower part is silty clay, heavy silty clay loam, or heavy clay loam. In some areas high and low chroma mottles are in the lower part of the B horizon. The C horizon is stratified silty clay, silt, silty clay loam, or clay. In places it has thin bands of fine sand. The B horizon is neutral to moderately alkaline. The C horizon is mildly alkaline or moderately alkaline.

Hebron soils in this survey area have a redder hue in the subsoil than is defined as the range for the series, but this difference does not alter use or management.

Hebron soils are near Boyer, Kewaunee, Mosel, and Oakville soils. Hebron soils are better drained than Mosel soils and also differ from those soils in having no mottles. They have more clay in the lower part of the B horizon and in the C horizon than Boyer and Oakville soils. Hebron soils have more sand and less clay in the upper part of the B horizon than Kewaunee soils.

HeA—Hebron loam, 0 to 2 percent slopes. This nearly level soil is in old glacial lake basins and on glacial till plains. Areas are irregularly shaped and range in size from 4 to more than 30 acres. This soil is about 6 inches thicker than the soil described as representative of the series.

Included with this soil in mapping are small areas

of Fox, Kewaunee, Mosel, and Sisson soils. Also included are areas where a thin layer of sand or sand and gravel is between the loamy upper layer and the silty and clayey substratum, small areas where the surface layer is sandy loam, and small gently sloping areas.

Runoff is slow, and the erosion hazard is slight. Because of the moderately slow permeability in the substratum, water does not readily move through this soil, and the soil dries somewhat slowly in spring and after periods of heavy rainfall. Removing surface water and preventing the entry of runoff from surrounding areas help to reduce ponding.

This soil is suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops, and a small acreage is used for woodland and pasture. Capability unit IIs–7; woodland group 2o1; wildlife group 1.

HeB—Hebron loam, 2 to 6 percent slopes. This gently sloping soil is in old glacial lake basins and on glacial till plains. Areas are irregularly shaped and range in size from 3 to more than 40 acres.

Included with this soil in mapping are small areas of Fox, Mosel, and Sisson soils. Also included are small areas where a thin layer of sand or sand and gravel is between the loamy upper layer and the clayey substratum, small areas of nearly level and sloping soils, and small areas where the surface layer is sandy loam.

The erosion hazard is slight. In some areas the soil dries somewhat slowly in spring and after periods of heavy rainfall. Controlling runoff and improving tilth help to control erosion. Preventing the entry of runoff from surrounding areas decreases wetness.

If well managed, this soil is moderately well suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops, but some is used for woodland and pasture. Capability unit IIe–6; woodland group 2o1; wildlife group 1.

Hebron Variant

The Hebron variant consists of nearly level and gently sloping, well drained and moderately well drained soils formed in sandy and loamy sediments overlying stratified silty and clayey lacustrine deposits. These soils are on old glacial lake plains. The native vegetation was a deciduous forest of mainly oak, hickory, maple, and basswood.

In a representative profile the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsurface layer is grayish brown loamy sand about 10 inches thick. The subsoil is 20 inches thick. The upper 8 inches is dark brown, firm sandy clay loam; the next 7 inches is yellowish brown, very friable loamy sand; and the lower 5 inches is dark brown, firm silty clay. The substratum to a depth of 60 inches is stratified, light yellowish brown silt loam, brown silty clay loam, and reddish brown silty clay.

Permeability is moderately rapid to a depth of 33 inches and moderately slow below. Available water capacity is moderate. Organic-matter content and natural fertility are low.

Most of the acreage is used for corn, small grain, and legumes. Some areas are used for woodland and pasture.

Representative profile of Hebron sandy loam, sandy subsoil variant, 0 to 2 percent slopes, in an idle field, 900 feet south and 1,500 feet east of the northwest corner of sec. 3, T. 15 N., R. 23 E.

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

A2—8 to 18 inches; grayish brown (10YR 5/2) loamy sand; weak medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.

B2t—18 to 26 inches; dark brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; many thin patchy clay films; neutral; clear smooth boundary.

B31t—26 to 33 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; clay bridging between sand grains; neutral; abrupt wavy boundary.

IIB32t—33 to 38 inches; dark brown (7.5YR 4/4) light silty clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine angular blocky structure; firm; many thin patchy clay films; neutral; clear wavy boundary.

IIC—38 to 60 inches; stratified light yellowish brown (10YR 6/4) silt loam, brown (7.5YR 5/4) silty clay loam, and reddish brown (5YR 4/4) silty clay; firm; pinkish gray (7.5YR 7/2) lime segregations; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is 6 to 9 inches thick. It is generally sandy loam, but in places is loamy sand. It is grayish brown or dark grayish brown. In some areas there is an A2 horizon that is 3 to 9 inches thick. The B horizon is 15 to 36 inches thick. The upper part is sandy clay loam or heavy sandy loam; the next part is loamy sand or sandy loam; and the lower part, which formed in the lacustrine material, is silty clay loam or light silty clay. The C horizon is stratified silt, silt loam, silty clay loam, silty clay, or clay. The B horizon is slightly acid or neutral in the upper part and neutral to mildly alkaline in the lower part.

The Hebron variant is near Kewaunee, Mosel, and Oakville soils. It has more clay in the lower part of the B horizon and in the C horizon than Oakville soils. It lacks the mottles typical of Mosel soils and is better drained than those soils. It has more sand and less clay in the upper part of the B horizon than Kewaunee soils.

HfA—Hebron sandy loam, sandy subsoil variant, 0 to 2 percent slopes. This nearly level soil is on old lake plains. Areas are irregularly shaped and range in size from 3 to more than 100 acres. This soil has the profile described as representative of the variant.

Included with this soil in mapping are small areas of Boyer, Mosel, and Sisson soils. Also included are small areas where the surface layer is loam or loamy sand and small gently sloping areas.

In places this soil dries somewhat slowly in spring and after periods of heavy rainfall. The hazard of soil blowing is slight. The soil is somewhat droughty.

This soil is moderately well suited to crops commonly grown in the county. It is well suited to woodland and pasture. Capability unit IIs–7; woodland group 2o1; wildlife group 1.

HfB—Hebron sandy loam, sandy subsoil variant, 2 to 6 percent slopes. This gently sloping soil is on old lake plains. Areas are irregularly shaped and range in size from 3 to more than 40 acres. This soil lacks a subsurface layer and is thinner than is representative for the series.

Included with this soil in mapping are small areas

of Boyer, Mosel, and Sisson soils. Also included are small areas where the surface layer is loam or loamy sand and areas that are nearly level or sloping.

The hazards of erosion and soil blowing are slight. This soil is slightly droughty. In some areas it dries somewhat slowly in spring and after periods of heavy rainfall. Reducing runoff, improving tilth, and conserving moisture are beneficial if the soil is used for crops.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops. Some is used for woodland and pasture. Capability unit IIe–7; woodland group 2o1; wildlife group 1.

Hochheim Series

The Hochheim series consists of nearly level to steep, well drained soils that are underlain by gravelly sandy loam or gravelly loam glacial till. These soils are on till plains and on the sides and tops of drumlins. The native vegetation was a deciduous forest of mainly maple, basswood, oak, beech, and hickory.

In a representative profile the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown, friable silt loam about 2 inches thick. The subsoil is brown, firm clay loam about 12 inches thick. The substratum to a depth of 60 inches is pale brown, friable gravelly sandy loam.

Permeability and available water capacity are moderate. Organic-matter content is moderately low, and natural fertility is medium.

Most of the acreage where slopes are less than 15 percent is used for crops. Most of the acreage where slopes are steeper is used for pasture and woodland.

Representative profile of Hochheim silt loam, 2 to 6 percent slopes, eroded, in an uneroded part of the unit, in a cultivated area, 1,600 feet south and 25 feet east of the northwest corner of sec. 8, T. 15 N., R. 21 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine subangular blocky structure parting to weak fine granular structure; friable; neutral; abrupt smooth boundary.

A2—8 to 10 inches; brown (10YR 5/3) heavy silt loam; moderate medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

B21t—10 to 18 inches; brown (7.5YR 4/4) clay loam; strong fine subangular blocky structure; firm; thick continuous clay films; estimated 5 percent gravel; slightly acid; gradual wavy boundary.

B22t—18 to 22 inches; brown (7.5YR 4/4) heavy clay loam; moderate medium subangular blocky structure; firm; dark brown (7.5YR 3/2) organic stains on faces of peds; neutral; clear wavy boundary.

C—22 to 60 inches; pale brown (10YR 6/3) gravelly sandy loam; massive; friable; estimated 18 percent gravel and 2 percent stones by volume; strong effervescence; moderately alkaline.

The solum ranges from 12 to 24 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is dark grayish brown, dark brown, or very dark grayish brown. It is generally silt loam, but in places is loam. In undisturbed areas there is a 2- to 4-inch A1 horizon that is very dark brown or very dark grayish brown. In most places where this soil is not eroded, an A2 horizon that is 1 inch to 6 inches thick occurs. This horizon is pale brown, brown, or yellowish brown silty loam or loam. The B horizon is typically clay loam, but in places the upper part is silt loam, loam, or silty clay loam. In places gravel and stones are in the lower part. The C horizon is loam, sandy loam, gravelly loam, or gravelly sandy loam. It is 5 to 35 percent gravel and as much as 10 percent stones and boulders. The calcium carbonate equivalent of the C horizon is 40 to 60 percent. The B horizon is slightly acid to mildly alkaline.

Hochheim soils in this survey area have a lighter colored surface layer than is defined as the range for the series, but this difference does not alter use or management.

Hochheim soils are near Knowles, Nenno, and Theresa soils. Hochheim soils are better drained than Nenno soils and also differ from those soils in having no mottles. They have a thinner solum and silty layer than Theresa soils. They differ from Knowles soils in not having bedrock within a depth of 40 inches.

HmB2—Hochheim silt loam, 2 to 6 percent slopes, eroded. This gently sloping soil formed in glacial till on till plains and the crests of drumlins. Areas are irregularly shaped and range in size from 3 to more than 200 acres. In most areas this soil has a surface layer that is about 2 to 4 inches thinner than is representative for the series. It also differs in having no subsurface layer in most areas.

Included with this soil in mapping are small areas of Casco and Nenno soils. Also included are areas of sloping Hochheim soils; some stony areas, many of which are identified on the soil map by spot symbols; and moderately well drained areas.

The hazard of erosion is moderate. Controlling runoff and adding organic matter help to prevent further erosion and improve tilth.

If well managed, this soil is moderately well suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIe–1; woodland group 2o1; wildlife group 1.

HmC2—Hochheim silt loam, 6 to 12 percent slopes, eroded. This sloping soil formed in glacial till on till plains and the sides of drumlins. Areas are irregularly shaped and range in size from 3 to more than 40 acres. This soil is about 4 or 5 inches thinner than the soil described as representative of the series and also differs from that soil in having no subsurface layer.

Included with this soil in mapping are small areas of Casco and Nenno soils and areas of Hochheim soils that have a clay loam surface layer. Also included are some small gently sloping and moderately steep areas, small severely eroded areas, and some stony areas. Many of the stony areas are identified on the soil map by spot symbols.

The hazard of erosion is moderate. Controlling runoff and increasing the organic-matter content help to prevent further erosion and improve tilth.

If well managed, this soil is suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops, but a small acreage is used for woodland and pasture. Capability unit IIIe–1; woodland group 2o1; wildlife group 1.

HmD2—Hochheim silt loam, 12 to 20 percent slopes, eroded. This moderately steep soil formed in glacial till on drumlins and moraines and along drainageways on till plains. Areas are irregularly shaped and range in size from 3 to more than 40 acres. This soil is 4 or 5 inches thinner than the soil described as representative of the series and also differs from that soil in

having the subsurface layer and some of the subsoil mixed with the plow layer.

Included with this soil in mapping are small areas of Casco, Nenno, Sisson, and Theresa soils and areas of Hochheim soils that have a surface layer of clay loam. Also included are some small sloping and steep areas, severely eroded areas, and some stony areas. Many of the stony areas are identified on the soil map by spot symbols.

The hazard of erosion is severe. Controlling runoff and increasing the organic-matter content help to prevent further erosion and improve tilth.

Even if well managed, this soil is poorly suited to most crops commonly grown in the county. It is well suited to woodland and pasture. Most areas are used for cropland, but a considerable acreage is used for pasture or has remained in woodland. Capability unit IVe–1; woodland group 2r1; wildlife group 1.

HmE—Hochheim silt loam, 20 to 30 percent slopes. This steep soil is on the sides of drumlins, on moraines, and along drainageways on till plains. Areas are irregularly shaped and range in size from 3 to more than 40 acres. This soil has a thinner, darker colored surface layer, a thicker subsurface layer, and a thinner subsoil than is representative for the series.

Included with this soil in mapping are small areas of Casco, Rodman, and Theresa soils. Also included are some very steep areas and stony areas.

The hazard of erosion is very severe, and runoff is very rapid. Controlling runoff helps to control erosion.

This soil is generally not suited to crops. It is suited to woodland and pasture. Most of the acreage is used for woodland. Capability unit VIe–1; woodland group 2r1; wildlife group 1.

HsC2—Hochheim-Casco-Sisson complex, 6 to 12 percent slopes, eroded. These sloping soils are on pitted till and outwash plains. Areas are irregularly shaped and range in size from 4 to more than 40 acres.

This complex consists of areas of Hochheim, Casco, and Sisson soils that are so small and closely intermingled that they cannot be shown separately on the soil map. This complex is about 40 percent Hochheim soils, 30 percent Casco soils, 15 percent Sisson soils, and 15 percent Fox, Rodman, St. Charles, Theresa, and Zurich soils.

The Hochheim soils have a browner surface layer and contain more gravel and stones in the substratum than is representative for the Hochheim series. They also differ in having no subsurface layer. The Casco soils have a browner surface layer and more clay in the surface layer than is representative for the Casco series. The Sisson soils are about 4 inches thinner than is representative for the Sisson series.

Included with these soils in mapping are some gently sloping and moderately steep areas. Also included are stony areas, most of which are identified on the soil map by spot symbols. Some small poorly drained and somewhat poorly drained areas are also identified by spot symbols.

The hazard of erosion is moderate. The Casco soils are droughty. Controlling runoff and increasing the organic-matter content help to control further erosion, conserve available water, and improve tilth.

If well managed, the soils in this complex are moderately well suited to all crops commonly grown in the county. They are well suited to woodland and pasture. Most of the acreage is used for cropland, but one-third has remained in woodland. Capability unit IIIe–1; woodland group 2o1; wildlife group 1.

HsD2—Hochheim-Casco-Sisson complex, 12 to 20 percent slopes, eroded. These moderately steep soils are on pitted till and outwash plains. Areas are irregularly shaped and range in size from 10 to more than 80 acres.

This complex consists of areas of Hochheim, Casco, and Sisson soils that are so small and closely intermingled that they cannot be shown separately on the soil map. This complex is about 40 percent Hochheim soils, 30 percent Casco soils, 15 percent Sisson soils, and 15 percent Fox, Rodman, St. Charles, Theresa, and Zurich soils.

The Hochheim soils have a browner surface layer and contain more stones and gravel in the substratum than is representative for the Hochheim series. They also differ in having no subsurface layer. The Casco soils have a browner surface layer and more clay in the surface layer than is representative for the Casco series. The Sisson soils are about 5 inches thinner than is representative for the Sisson series.

Included with these soils in mapping are some sloping and steep areas. Also included are some stony areas, most of which are identified on the soil map by spot symbols. Some small poorly drained and somewhat poorly drained areas are also identified by spot symbols.

The hazard of erosion is severe. The Casco soils are droughty. Controlling runoff and increasing the organic-matter content help to prevent further erosion, conserve available water, and improve tilth.

Even if well managed, these soils are poorly suited to most crops grown in the county. They are suited to woodland and pasture. About 60 percent of the acreage is used for crops, and about 40 percent is used for woodland and pasture. Capability unit IVe–1; woodland group 2r1; wildlife group 1.

HsE—Hochheim-Casco-Sisson complex, 20 to 30 percent slopes. These steep soils are on pitted till and outwash plains. Areas are irregularly shaped and range in size from 10 to more than 80 acres.

This complex consists of areas of Hochheim, Casco, and Sisson soils that are so small and closely intermingled that they cannot be shown separately on the soil map. This complex is about 35 percent Hochheim soils, 30 percent Casco soils, 15 percent Sisson soils, and 20 percent Fox, Rodman, St. Charles, Theresa, and Zurich soils.

The Hochheim, Casco, and Sisson soils differ from the soils described as representative of their respective series in having a thin, dark colored surface layer and a 2- to 6-inch subsurface layer. The Hochheim soils also contain more stones and gravel in the substratum.

Included with these soils in mapping are some small sloping areas and some very steep areas. Also included are stony areas, most of which are identified on the soil map by spot symbols.

The hazard of erosion is severe. The Casco soils are droughty.

The soils in this complex are generally not suited to crops. They are suited to woodland and pasture. Most of the acreage is used for woodland. Capability unit VIe–1; woodland group 2r1; wildlife group 1.

HtB—Hochheim-Knowles silt loams, 1 to 6 percent slopes. These nearly level and gently sloping soils formed in loess and glacial till on drumlins and ground moraines in areas where the soil is somewhat shallow over dolomite bedrock. This complex is about 50 percent Hochheim silt loam, 40 percent Knowles silt loam, and 10 percent Theresa and St. Charles soils.

The Hochheim soils differ from the soil described as representative of the Hochheim series in having dolomite bedrock at a depth of 40 to 60 inches in places. The Knowles soils have the profile described as representative of the Knowles series.

Included with these soils in mapping are small areas where dolomite bedrock is at a depth of less than 20 inches and areas where slopes are greater than 6 percent. These areas are identified on the soil map by spot symbols.

The hazard of erosion is slight. Controlling runoff and improving tilth help to control erosion and maintain available water capacity.

The soils in this complex are moderately well suited to all crops commonly grown in the county. They are well suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIe–1; woodland group 2o1; wildlife group 1.

Houghton Series

The Houghton series consists of nearly level, very poorly drained soils formed in herbaceous organic material more than 51 inches thick. These soils formed in depressional areas on old glacial lake plains, in stream valleys, and on outwash plains. The native vegetation was marsh grasses, sedges, cattails, and some water-tolerant trees and shrubs.

In a representative profile the organic material is more than 60 inches thick. The upper 22 inches is black muck. The lower 38 inches is dark yellowish brown muck.

Permeability is moderately rapid, and available water capacity is very high. Organic-matter content is very high, and natural fertility is low. The root zone is limited by the water table, which is at or near the surface.

Most of the acreage is used for woodland and pasture. Some is drained and used for crops.

Representative profile of Houghton muck, slopes of 0 to 2 percent, in a wooded area, 1,200 feet south and 1,760 feet east of the northwest corner of sec. 23, T. 13 N., R. 21 E.

Oa1—0 to 10 inches; black (10YR 2/1 broken face and rubbed) sapric material; moderate medium granular structure; friable; mildly alkaline; clear smooth boundary.

Oa2—10 to 22 inches; black (10YR broken face and rubbed) sapric material; dark yellowish brown (10YR 3/4) fibers; massive; friable; estimated 30 percent fibers breaking down to less than 2 percent on rubbing; few woody fragments 5 to 10 millimeters in size; mildly alkaline; gradual smooth boundary.

Oa3—22 to 42 inches; dark yellowish brown (10 YR 3/4 broken face and rubbed) sapric material changing to very dark brown (10YR 2/2) on exposure to air; massive; friable; estimated 30 percent fiber, 2 percent rubbed; mildly alkaline; clear smooth boundary.

Oa4—42 to 60 inches; dark yellowish brown (10YR 3/4 broken face and rubbed) sapric material changing to very dark brown (10YR 2/2) on exposure to air; massive; friable; estimated 30 percent fiber, 2 percent rubbed; mildly alkaline.

The depth of the organic material is more than 51 inches. The organic material is 1 to 50 percent fiber, but is less than 15 percent after rubbing. Some pedons contain woody fragments 1 inch to 5 inches in diameter. The surface tier is black, very dark brown, or very dark grayish brown. Some pedons have a hemic layer less than 10 inches thick. The organic material is slightly acid to mildly alkaline.

Houghton soils are similar to Muskego, Palms, and Willette soils. Houghton soils lack the mineral soil within a depth of 51 inches typical of Palms and Willette soils and the sedimentary peat layers within a depth of 51 inches typical of Muskego soils.

Hu—Houghton muck. This nearly level soil is in depressional areas throughout the county. Areas are irregularly shaped and range in size from 3 to more than 200 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are some small areas of Adrian, Edwards, Muskego, Palms, and Willette soils. Also included are some small gently sloping areas.

Wetness is the major limitation of this soil. If drained and cultivated, however, the soil is subject to subsidence, soil blowing, and burning.

If drained and well managed, this soil is moderately well suited to corn, small grain, and truck crops commonly grown in the county. It is suited to pasture and some types of woodland. Most of the acreage is used for woodland or pasture, but some is drained and used for crops. Capability unit IIIw–9; woodland group 3w3; wildlife group 8.

Juneau Series

The Juneau series consists of nearly level and gently sloping, well drained or moderately well drained soils formed in colluvium or alluvium that is underlain by an older soil. These soils are in small depressions, kettles, and intermittent drainageways and on foot slopes. The native vegetation was deciduous forest.

In a representative profile the surface layer is dark brown silt loam about 9 inches thick. The substratum is dark brown silt loam 17 inches thick. The buried surface layer is dark grayish brown, friable silt loam 3 inches thick, and the buried subsurface layer is brown, friable silt loam about 6 inches thick. The buried subsoil is yellowish brown, firm, mottled silt loam about 10 inches thick. The substratum to a depth of 60 inches is brown, friable silt loam.

Permeability is moderate, and available water capacity is very high. Organic-matter content is moderate, and natural fertility is high.

Most areas of these soils are used for crops or pasture, but some small areas are in woodland.

Representative profile of Juneau silt loam, 0 to 3 percent slopes, in a cultivated field, 650 feet north and 1,300 feet west of the southeast corner of sec. 14, T. 15 N., R. 20 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam; moderate medium granular structure; friable; neutral; abrupt smooth boundary.

C1—9 to 14 inches; dark brown (10YR 4/3) silt loam; weak coarse subangular blocky structure parting to moderate medium granular; friable; neutral; abrupt smooth boundary.
C2—14 to 26 inches; dark brown (10YR 4/3) silt loam and few strata (less than ½ inch) of dark yellowish brown (10YR 4/4) fine sandy loam; weak coarse subangular blocky structure parting to moderate medium granular; friable; neutral; abrupt smooth boundary.
A1b—26 to 29 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; neutral; clear smooth boundary.
A2b—29 to 35 inches; brown (10YR 5/3) silt loam; moderate medium platy structure; friable; neutral; gradual smooth boundary.
B2b—35 to 45 inches; yellowish brown (10YR 5/4) heavy silt loam; few fine faint brown (7.5YR 5/4) and distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; slightly acid; gradual smooth boundary.
C3—45 to 60 inches; brown (10YR 5/3) silt loam; common fine faint brown (1.5YR 5/3) and prominent strong brown (7.5YR 5/6) mottles; massive; friable; slightly acid.

The thickness of the alluvium or colluvium is 20 to 40 inches. The alluvium or colluvium is dark brown or dark grayish brown. It is generally silt loam, but some thin layers of fine or very fine sandy loam are in some pedons. The buried A and B horizons are silt loam or silty clay loam. The C horizon is silt loam, silty clay loam, or clay loam. The reaction to a depth of 60 inches ranges from slightly acid to mildly alkaline.

Juneau soils are similar to Otter soils, but are better drained and lighter colored than those soils.

JuA—Juneau silt loam, 0 to 3 percent slopes. This nearly level and gently sloping soil formed in colluvium or alluvium that is underlain by an older soil. It is in depressions, kettles, and intermittent drainageways and on foot slopes. Most areas are irregular or long and range in size from 2 to about 5 acres.

Included with this soil in mapping are small areas of Casco, Fox, Otter, and St. Charles soils. Also included are areas where slopes are more than 3 percent.

This soil is subject to overflow and ponding. In sloping areas the hazard of erosion is slight.

This soil is well suited to all crops commonly grown in the county. It is also well suited to woodland and pasture. Most of the acreage is used for crops or pasture, but some small areas are in woodland. Capability unit I–2; woodland group 2o1; wildlife group 9.

Kendall Series

The Kendall series consists of nearly level and gently sloping, somewhat poorly drained soils that are underlain by loamy lacustrine material or gravelly sandy loam and gravelly loam glacial till. These soils are on concave foot slopes of drumlins and ground moraines. The native vegetation was a deciduous forest of mainly oak, maple, and basswood.

In a representative profile the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 41 inches thick and is mottled throughout. The upper part is brown and grayish brown, firm silty clay loam; the next part is gray, friable silt loam; and the lower part is pale brown, friable loam. The substratum to a depth of 60 inches is mottled pale brown gravelly loam.

Permeability is moderate, and available water capacity is high. Organic-matter content is moderate, and natural fertility is high. The root zone is limited by saturated soil during wet periods of the growing season.

Most areas of these soils are used for crops. Some areas are used for pasture and woodland.

Representative profile of Kendall silt loam, 0 to 3 percent slopes, in a cultivated field, 1,700 feet west and 300 feet south of the northeast corner of sec. 5, T. 16 N., R. 20 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; friable; neutral; abrupt smooth boundary.
B21t—9 to 19 inches; brown (10YR 5/3) silty clay loam; few fine faint dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) mottles and common medium faint light yellowish brown (10YR 6/4) mottles; moderate medium subangular blocky structure; firm; thin continuous clay films; mildly alkaline; clear smooth boundary.
B22t—19 to 34 inches; grayish brown (10YR 5/2) silty clay loam; few fine prominent yellowish brown (10YR 5/8) mottles and many medium prominent brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; firm; thin continous clay films; mildly alkaline; gradual smooth boundary.
B31g—34 to 42 inches; gray (10YR 6/1) silt loam; many medium prominent brownish yellow (10YR 6/6) and yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; mildly alkaline; gradual smooth boundary.
IIB32—42 to 50 inches; pale brown (10YR 6/3) loam; many medium prominent brownish yellow (10YR 6/6) and yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; estimated 5 percent fine gravel by volume; slight effervescence; mildly alkaline; gradual smooth boundary.
IIC—50 to 60 inches; pale brown (10YR 6/3) gravelly loam; many medium distinct brownish yellow (10YR 6/6) mottles; massive; friable; estimated 18 percent gravel by volume; strong effervescence; mildly alkaline.

The solum ranges from 48 to 66 inches in thickness. The silty upper layers range from 40 to 60 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is dark grayish brown or very dark grayish brown. The B horizon ranges from 38 to 60 inches in thickness. It is silty clay loam or silt loam in the upper part and silt loam, loam, gravelly loam, sandy loam, or gravelly sandy loam in the lower part. The IIC horizon is stratified very fine sand, silt, and silt loam or gravelly sandy loam or gravelly loam. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Kendall soils in this survey area are less gray and more alkaline in the subsoil than is defined as the range for the series, but these differences do not alter use or management.

Kendall soils are near Pella and St. Charles soils. Kendall soils have more mottles than St. Charles soils and are not so well drained as those soils. They have fewer mottles and are better drained than Pella soils.

KlA—Kendall silt loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is in drainageways and depressions. Areas are long or irregular and range in size from 3 to more than 30 acres.

Included with this soil in mapping are small areas of Pella and St. Charles soils. Some areas of the wet Pella soils are identified by spot symbols on the soil map.

This soil dries slowly in spring and after periods of heavy rainfall. It is subject to ponding. The main concern of management is removing excess water.

If adequately drained, this soil is moderately well

suited to all crops commonly grown in the county. It is suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIw–2; woodland group 2o2; wildlife group 6.

Kewaunee Series

The Kewaunee series consists of nearly level to moderately steep, well drained and moderately well drained soils formed in silty clay loam glacial till. These soils are on till plains. The native vegetation was a forest of mainly oak, maple, beech, basswood, and white pine.

In a representative profile the surface layer is dark reddish gray silt loam about 8 inches thick. The subsoil is about 17 inches thick. It is reddish brown, firm silty clay in the upper part and reddish brown, firm silty clay loam in the lower part. The substratum to a depth of 60 inches is reddish brown, firm silty clay loam.

Permeability is moderately slow, and available water capacity is moderate. Organic-matter content is moderately low, and natural fertility is medium.

Most areas of these soils are used for crops and pasture, but many small areas remain in woodland.

Representative profile of Kewaunee silt loam, 2 to 6 percent slopes, in a cultivated area, 30 feet north of Crocker Avenue and 2,600 feet west and 1,350 feet north of the southeast corner of sec. 33, T. 15 N., R. 23 E.

Ap—0 to 8 inches; dark reddish gray (5YR 4/2) silt loam; moderate fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

B2t—8 to 20 inches; reddish brown (5YR 4/4) silty clay; strong fine angular blocky structure; firm; thick continuous clay films; neutral; clear smooth boundary.

B3—20 to 25 inches; reddish brown (5YR 4/4) silty clay loam; strong fine angular blocky structure; firm; thin discontinuous clay films; strong effervescence; mildly alkaline; clear smooth boundary.

C—25 to 60 inches; reddish brown (5YR 5/4) silty clay loam; massive; firm; many gray (5Y 6/1) carbonate coatings; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is dark brown, dark yellowish brown, dark reddish brown, dark reddish gray, or reddish brown. It is generally silt loam or silty clay loam, but in places is loam or silty clay. In uncultivated areas there is a very dark brown A1 horizon 3 to 5 inches thick and a brown A2 horizon 4 to 9 inches thick. The B horizon is silty clay loam, silty clay, or clay. It averages between 35 and 60 percent clay. The C horizon is clay loam or silty clay loam. The B horizon ranges from slightly acid to mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Kewaunee soils in this survey area have slightly less clay in the C horizon within a depth of 40 inches than is defined as the range for the series, but this difference does not alter use or management.

Kewaunee soils are near Manawa, Poygan, and Waymor soils. Kewaunee soils have fewer mottles and are better drained than Manawa and Poygan soils. They have more clay and less sand in the lower part of the B horizon and in the C horizon than Waymor soils.

KnA—Kewaunee silt loam, 0 to 2 percent slopes. This nearly level soil is on till plains. Areas are irregularly shaped and range in size from 4 to more than 40 acres. This soil has a subsoil that is about 5 inches thicker than that in the soil described as representative of the series.

Included with this soil in mapping are small areas of Hebron, Manawa, Poygan, and Sisson soils. Most areas of the wet Manawa and Poygan soils are along intermittent drainageways or are identified by spot symbols on the soil map. Many areas of the sandy Hebron and Sisson soils are also identified by spot symbols. Also included in mapping are some small gently sloping areas and areas that are underlain by sand and gravel at a depth of less than 60 inches.

Runoff is slow. Because permeability is moderately slow, this soil dries slowly in spring and after periods of heavy rainfall. Removing surface water and preventing the entry of runoff from surrounding areas reduce ponding.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIs–7; woodland group 2c1; wildlife group 2.

KnB—Kewaunee silt loam, 2 to 6 percent slopes. This gently sloping soil is on till plains. Areas are irregularly shaped and range in size from 4 to more than 250 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Hebron, Manawa, Poygan, and Sisson soils. Most areas of the wet Manawa and Poygan soils are along intermittent drainageways or are identified by spot symbols on the soil map. Many areas of the sandy Hebron and Sisson soils are also identified by spot symbols. Also included in mapping are areas where the surface layer is clay loam, small nearly level and sloping areas, and areas that are underlain by sand and gravel at a depth of less than 60 inches.

The hazard of erosion is moderate. This soil dries slowly in spring and after periods of heavy rainfall. Reducing runoff and increasing the organic-matter content help to control erosion and improve tilth.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops, but some is used for woodland and pasture. Capability unit IIe–6; woodland group 2c1; wildlife group 2.

KpB2—Kewaunee silty clay loam, 2 to 6 percent slopes, eroded. This gently sloping soil is on till plains. Areas are irregularly shaped and range in size from 4 to more than 100 acres. This soil has a finer textured surface layer than the representative profile.

Included with this soil in mapping are small areas of Hebron, Manawa, Poygan, and Sisson soils. Most areas of the wet Manawa and Poygan soils are along intermittent drainageways or are identified by spot symbols on the soil map. Many areas of the sandy Hebron and Sisson soils and severely eroded spots are also identified by spot symbols. Also included in mapping are areas where the surface layer is silt loam or loam, small nearly level and sloping areas, and areas that are underlain by sand and gravel at a depth of less than 60 inches.

The hazard of erosion is moderate. This soil dries slowly in spring and after periods of heavy rainfall, and it has poor tilth in many places. Reducing runoff and increasing the organic-matter content help to

control further erosion and improve tilth. Seedbed preparation and tillage should be done at optimum moisture conditions.

This soil is moderately well suited to all crops commonly grown in the county. It is suited to woodland and pasture. Capability unit IIe–6; woodland group 2c1; wildlife group 2.

KpC2—Kewaunee silty clay loam, 6 to 12 percent slopes, eroded. This sloping soil is on till plains, on the sides of valleys, and in small depressions. Areas are irregularly shaped and range in size from 3 to more than 40 acres. This soil has a profile that is thinner than is representative for the series.

Included with this soil in mapping are small areas of Hebron, Manawa, Poygan, Sisson, and Waymor soils. Most areas of the wet Manawa and Poygan soils are along intermittent drainageways or are identified by spot symbols on the soil map. Many areas of the sandy Hebron and Sisson soils and small severely eroded areas are also identified by spot symbols. Also included in mapping are areas where the surface layer is silt loam or loam, small gently sloping and moderately steep areas, and areas where sand and gravel are at a depth of less than 60 inches.

The hazard of erosion is moderate. This soil dries slowly in spring and after periods of heavy rainfall. It has poor tilth in many places. Reducing runoff and increasing the organic-matter content help to control further erosion and improve tilth. Seedbed preparation and tillage should be done at optimum moisture conditions.

If well managed, this soil is suited to all crops commonly grown in the county. It is well suited to woodland and pastures. Most of the acreage is used for crops, but some is used for woodland or pasture. Capability unit IIIe–6; woodland group 2c1; wildlife group 2.

KpD2—Kewaunee silty clay loam, 12 to 20 percent slopes, eroded. This moderately steep soil is on till plains and along drainageways, streams, and rivers. Areas are irregularly shaped and range in size from 3 to more than 20 acres. This soil has a profile that is similar to the profile described as representative for the series except the surface layer is finer textured.

Included with this soil in mapping are small areas of Hebron, Manawa, Poygan, Sisson, and Waymor soils. Most areas of the wet Manawa and Poygan soils are along intermittent drainageways or are identified by spot symbols on the soil map. Many areas of the sandy Hebron and Sisson soils are also identified by spot symbols. Also included in mapping are areas where the surface layer is loam or silt loam, areas where sand and gravel are at a depth of less than 60 inches, and small sloping and steep areas.

The hazard of erosion is severe. This soil has poor tilth in many places. Reducing runoff and increasing the organic-matter content help to control further erosion and improve tilth.

Even if well managed, this soil is poorly suited to most crops grown in the county. It is suited to woodland and pasture. Most of the acreage is used for crops and pasture, but some is used for woodland. Capability unit IVe–6; woodland group 2c3; wildlife group 2.

KsC3—Kewaunee silty clay, 6 to 12 percent slopes, severely eroded. This sloping soil is on till plains, on the sides of valleys, and in small depressions. Areas are irregularly shaped and range in size from 3 to 40 acres. This soil contains more clay in the surface layer than the soil described as representative of the series.

Included with this soil in mapping are small areas of Hebron, Sisson, and Waymor soils. Many areas of the sandy Hebron and Sisson soils are identified by spot symbols on the soil map. Also included in mapping are small less eroded areas where the surface layer is silt loam, loam, or clay loam; small gently sloping or moderately steep areas; and small areas where sand and gravel are at a depth of less than 60 inches.

The hazard of erosion is severe. This soil has very poor tilth. Reducing runoff and increasing the organic-matter content help to control further erosion and improve tilth.

This soil is poorly suited to crops that do not provide good ground cover. It is suited to pasture and woodland. Most of the acreage is used for crops. Capability unit IVe–6; woodland group 3c1; wildlife group 2.

KsD3—Kewaunee silty clay, 12 to 20 percent slopes, severely eroded. This moderately steep soil is on till plains and along drainageways, streams, and rivers. Areas are irregularly shaped and range in size from 3 to more than 20 acres. This soil has a finer textured surface layer than the soil described as representative for the series.

Included with this soil in mapping are small areas of Hebron, Sisson, and Waymor soils and small areas of Rough broken land. Many areas of the sandy Hebron and Sisson soils are identified by spot symbols on the soil map. Also included in mapping are small less eroded areas where the surface layer is loam, silt loam, or clay loam; small sloping or steep areas; and areas where sand and gravel are at a depth of less than 60 inches.

The hazard of further erosion is very severe. This soil has very poor tilth.

This soil is so severely eroded that it is generally not suited to crops. It is suited to pasture and woodland. Most of the acreage is used for pasture or crops. Capability unit VIe–6; woodland group 3c2; wildlife group 2.

Kibbie Series

The Kibbie series consists of nearly level and gently sloping, somewhat poorly drained soils that are underlain by stratified silt and very fine sand. These soils are in old glacial lake basins. The native vegetation was deciduous forest and an undergrowth of grasses.

In a representative profile the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 18 inches thick. It is brown, firm clay loam in the upper part and brown friable silt loam in the lower part. It is mottled. The substratum to a depth of 60 inches is yellowish brown, very friable stratified silt and very fine sand.

Permeability is moderate, and available water capacity is high. Organic-matter content is moderate, and natural fertility is medium. The root zone is limited

by saturated soil during wet periods of the growing season.

Most areas of these soils are used for crops. Some are used for pasture or woodland.

Representative profile of Kibbie silt loam, 0 to 3 percent slopes, in a cultivated area, 125 feet south and 620 feet east of the northwest corner of sec. 10, T. 16 N., R. 23 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; weak fine subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.
B2t—8 to 18 inches; brown (10YR 5/3) clay loam; common fine faint grayish brown (10YR 5/2) mottles, common fine faint light brownish gray (2.5Y 6/2) mottles, and common fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; thin discontinuous clay films; neutral; clear wavy boundary.
IIB3—18 to 26 inches; brown (10YR 5/3) silt loam; few fine faint grayish brown (10YR 5/2) mottles and common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; thin strata of very fine sand; slight effervescence; mildly alkaline; clear wavy boundary.
IIC—26 to 60 inches; yellowish brown (10YR 5/4) stratified silt and very fine sand; massive; very friable; strong effervescence; mildly alkaline.

The solum is 24 to 36 inches thick. The Ap horizon is 6 to 10 inches thick. It is very dark grayish brown, very dark gray, or very dark brown. It is generally silt loam, but in places is loam or fine sandy loam. The B horizon ranges from 14 to 30 inches in thickness. It is silt loam, loam, or clay loam. The C horizon is stratified silt, silt loam, fine sand, or very fine sand. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Kibbie soils in this survey area are shallower over carbonates than is defined as the range for the series, but this difference does not alter use or management.

Kibbie soils are similar to Colwood, Sisson, and Yahara soils. They have more mottles and are more poorly drained than Sisson soils, are less gray and better drained than Colwood soils, and have more clay in the B horizon than Yahara soils.

KuA—Kibbie silt loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is in depressions in old glacial lake plains. Areas are irregularly shaped and range in size from 3 to more than 80 acres.

Included with this soil in mapping are small areas of Colwood, Sisson, and Yahara soils. Many included areas of the wet Colwood soils are identified by spot symbols on the soil map. In places the substratum has layers of clay at a depth of more than 40 inches. In some areas the soil is gravelly. Also included are areas where the surface layer is fine sandy loam.

This soil dries slowly in spring and after periods of heavy rainfall, and ponding occurs in places. This soil is difficult to drain because the silt and very fine sand in the substratum tend to flow easily and fill tile lines.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and woodland. Most of the acreage is used for crops and pasture, but some is used for woodland. Capability unit IIw–2; woodland group 1o2; wildlife group 6.

Knowles Series

The Knowles series consists of nearly level and gently sloping, well drained soils that are underlain by dolomite bedrock. These soils are on ground moraines where the soil is somewhat shallow over bedrock. The native vegetation was deciduous forest.

In a representative profile the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 18 inches thick. It is dark brown, firm silty clay loam in the upper part and dark brown, firm clay loam in the lower part. Dolomite bedrock is at a depth of about 26 inches.

Permeability is moderate, and available water capacity is low. Organic-matter content is moderately low, and natural fertility is medium. The root zone is limited by the underlying bedrock.

Most of the acreage is used for crops. Some areas are used for pasture and woodland.

Knowles soils in this survey area are mapped only with Hochheim soils.

Representative profile of Knowles silt loam, in a cultivated area of Hochheim-Knowles silt loams, 1 to 6 percent slopes, 1,970 feet north and 225 feet west of the southeast corner of sec. 2, T. 16 N., R. 20 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak medium subangular blocky structure; very friable; neutral; abrupt smooth boundary.
B1—8 to 14 inches; dark brown (10YR 4/3) light silty clay loam; moderate fine subangular blocky structure; firm; neutral; clear smooth boundary.
B21t—14 to 20 inches; dark brown (10YR 4/3) silty clay loam; dark yellowish brown (10YR 3/4) clay films on faces of most peds; moderate medium subangular blocky structure; firm; mildly alkaline; gradual smooth boundary.
IIB22t—20 to 26 inches; dark brown (10YR 4/3) clay loam; dark yellowish brown (10YR 3/4) clay films on faces of most peds; moderate medium subangular blocky structure; firm; slight effervescence; mildly alkaline; abrupt wavy boundary.
R—26 to 60 inches; dolomitic limestone bedrock.

The solum ranges from 20 to 40 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is dark brown, dark grayish brown, or very dark grayish brown. The B horizon ranges from 12 to 32 inches in thickness. It is silt loam or silty clay loam in the upper part and loam, clay loam, or sandy clay loam in the lower part. In places the lower part of the B horizon is gravelly or has a clayey layer 1 inch thick overlying the dolomite bedrock. The B horizon ranges from slightly acid to mildly alkaline.

Knowles soils are near Hochheim soils. In contrast to those soils, they are underlain by dolomite and lack the loamy C horizon.

Lamartine Series

The Lamartine series consists of nearly level and gently sloping, somewhat poorly drained soils that are underlain by gravelly loam or gravelly sandy loam glacial till. These soils are along drainageways, on concave foot slopes of drumlins, and in depressions in ground moraines. The native vegetation was a deciduous forest of mainly oak, maple, and basswood.

In a representative profile the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 20 inches thick and is mottled. The upper part is dark grayish brown, friable silt loam; the next part is brown, firm silty clay loam; and the lower part is brown, firm clay loam. The substratum to a depth of 60 inches is pale brown, friable gravelly sandy loam.

Permeability is moderate, and available water capacity is high. Organic-matter content is moderate, and natural fertility is medium. The root zone is limited by saturated soil during wet periods of the growing season.

Most areas of these soils are used for crops, but some are used for pasture and woodland.

Representative profile of Lamartine silt loam, 0 to 3 percent slopes, in a cultivated area, 720 feet west and 1,100 feet north of the southeast corner of sec. 15, T. 13 N., R. 21 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; weak medium subangular blocky structure parting to moderate medium granular; friable; mildly alkaline; abrupt smooth boundary.

B1—8 to 14 inches; dark grayish brown (10YR 4/2) heavy silt loam; moderate medium angular blocky structure; friable; mildly alkaline; gradual wavy boundary.

B21t—14 to 20 inches; brown (10YR 4/3) silty clay loam; few fine faint dark grayish brown (10YR 4/2) and few fine distinct brown (7.5YR 5/4) mottles; moderate medium subangular blocky structure parting to strong fine angular blocky; firm; thin patchy clay films; mildly alkaline; clear wavy boundary.

IIB22t—20 to 23 inches; brown (10YR 4/3) clay loam; common fine faint grayish brown (10YR 5/2) and common fine prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure parting to strong fine angular blocky; firm; thin continuous clay films; mildly alkaline; clear wavy boundary.

IIB3—23 to 28 inches; brown (10YR 4/3) clay loam; few fine faint grayish brown (10YR 5/2) and many fine prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; firm; few patchy clay films; slight effervescence; mildly alkaline; clear wavy boundary.

IIC—28 to 60 inches; pale brown (10YR 6/3) gravelly sandy loam; few medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; estimated 17 percent gravel by volume; strong effervescence; mildly alkaline.

The solum ranges from 24 to 40 inches in thickness. The silty upper layers range from 18 to 36 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is very dark grayish brown or very dark brown. The B horizon is 15 to 32 inches thick. It is silt loam or silty clay loam in the upper part and clay loam or loam in the lower part. The IIC horizon is loam, sandy loam, gravelly loam, or gravelly sandy loam. The B horizon ranges from slightly acid to mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Lamartine soils in this survey area have a higher percentage of carbonates in the C horizon within a depth of 40 inches than is defined as the range for the series, but this difference does not alter use or management.

Lamartine soils are near Barry and Theresa soils. They have more mottles than Theresa soils and are not so well drained as those soils. They are less gray and better drained than Barry soils.

LmA—Lamartine silt loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is along drainageways, on concave foot slopes of drumlins, and in depressions in ground moraines. Areas are irregularly shaped and range in size from 3 to more than 40 acres.

Included with this soil in mapping are small areas of Barry, Hochheim, Pella, and Theresa soils. Most areas of the wet Barry and Pella soils are identified on the soil map by spot symbols. Also included are small areas where slopes are more than 3 percent.

This soil dries slowly in spring and after periods of heavy rainfall. It is subject to ponding in places.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIw–2; woodland group 2o2; wildlife group 6.

Loamy Land, Seeped

Lo—Loamy land, seeped, is on wet foot slopes of drumlins, moraines and escarpments. It is generally adjacent to steeper soils. Slopes are 2 to 20 percent. This land consists of areas of both organic and mineral soils. The mineral soils range from sand and gravel to silty clay. The native vegetation was mostly white-cedar, tamarack, and water-tolerant herbaceous plants.

Included with this land in mapping are small areas of Barry, Nenno, Palms, and Sebewa soils. Many springs are in this unit. Most of the larger springs are identified on the soil map by spot symbols.

Loamy land, seeped, has a wide range in permeability and available water capacity. Organic-matter content is high or very high, and natural fertility is medium. The root zone is limited by the water table.

This land is too wet for crop production and is very difficult to drain. It is not suited to pasture. It is well suited as a water source for ponds. It is suited to some types of woodland. Capability unit Vw–16; woodland group 4w2; wildlife group 7.

Made Land

Ma—Made land is throughout the county, mostly in or near cities or villages. Areas are irregularly shaped and range in size from 3 to about 70 acres. Slopes are 0 to 6 percent.

This land consists of areas that are filled with nonsoil material, such as concrete, bricks, foundry sand, and ashes. Trash dumps and sanitary landfills are also part of this mapping unit. Some areas have a layer of soil on the top and support plants.

Included with this land in mapping are small areas of Cut and fill land, clayey; Cut and fill land, loamy; and Cut and fill land, sandy or gravelly.

Made land is not suited to crops. Some areas are subject to flooding. Many areas are still receiving fill material. Some are used for building sites, roads, parking lots, and storage areas. Capability unit VIIIs–10; woodland group 6sl; wildlife group 10.

Manawa Series

The Manawa series consists of nearly level and gently sloping, somewhat poorly drained soils formed in silty clay loam glacial till. They are in drainageways and depressions on till plains and old glacial lake basins. The native vegetation was a forest of mainly maple, oak, beech, ash, and white pine.

In a representative profile the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is mottled reddish brown. It is about 18 inches thick. The upper part is firm clay, and the lower part is firm heavy silty clay loam. The substratum to a depth of 60 inches is reddish brown, firm silty clay loam.

Permeability is slow, and available water capacity is moderate. Organic-matter content is also moderate. Natural fertility is medium. The root zone is limited by saturated soil during wet periods.

Most areas of these soils are used for crops, but some are used for pasture and woodland.

Representative profile of Manawa silt loam, 0 to 3 percent slopes, in a cultivated area, 1,570 feet north and 2,240 feet west of the southeast corner of sec. 29, T. 14 N., R. 23 E.

Ap—0 to 8 inches; very dark grayish brown (10 YR 3/2) silt loam; moderate medium granular structure; friable; slightly acid; abrupt smooth boundary.

IIB2t—8 to 18 inches; reddish brown (5YR 5/3) clay; common fine faint reddish gray (5YR 5/2) and few fine prominent yellowish red (5YR 5/6) mottles; weak medium prismatic structure parting to strong fine angular blocky; firm; thin continuous clay films; mildly alkaline; clear wavy boundary.

IIB3—18 to 26 inches; reddish brown (5YR 5/4) heavy silty clay loam; common fine distinct light brownish gray (2.5Y 6/2) and prominent yellowish red (5YR 5/6) mottles; weak medium prismatic structure parting to strong fine angular blocky; firm; thin discontinuous clay films; strong effervescence; mildly alkaline; clear wavy boundary.

IIC—26 to 60 inches; reddish brown (5YR 5/4) silty clay loam; massive; firm; root channels and crevices filled with gray (5Y 6/1) and pinkish gray (5YR 7/2) carbonates; violent effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is black, very dark gray, or very dark grayish brown. The B horizon ranges from 10 to 32 inches in thickness. The B2t horizon is silty clay or clay. The C horizon is silty clay loam or clay loam. The B horizon is neutral or mildly alkaline.

Manawa soils in this survey area have less clay in the C horizon within a depth of 40 inches than is defined as the range for the series, but this difference does not alter use or management.

Manawa soils are near Kewaunee, Poygan, and Waymor soils. They are not so well drained as Kewaunee and Waymor soils and also differ from those soils in having mottles. They are less gray than Poygan soils and are not so poorly drained as those soils.

MbA—Manawa silt loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is in drainageways and slight depressions. Areas are irregular or long in shape and range in size from 3 to more than 80 acres.

Included with this soil in mapping are small areas of Kewaunee, Mosel, Poygan, and Waymor soils. Many areas of the wet Poygan soils and some areas of the sandy Mosel soils are identified by spot symbols on the soil map. Also included in mapping are areas where the surface layer is sandy loam.

This soil dries slowly in spring and after periods of heavy rainfall. It is subject to ponding in places. The main concern of management is removing excess water.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIw–2; woodland group 2c2; wildlife group 6.

Marsh

Mf—Marsh is very poorly drained mixed mineral and organic material that is covered with water most of the year. It borders on lakes and streams and is in potholes in moraines and outwash plains. The native vegetation is mainly cattails, sedges, reeds, rushes, and other water-tolerant plants. Slopes are 0 to 2 percent. Included in mapping are small areas of open water and Boots and Houghton soils.

Marsh is not suited to commercial crop production, woodland, or pasture. Drainage is not economical or feasible in most areas. Marsh is well suited as wetland wildlife habitat. Capability unit VIIIw–15; woodland group 6wl; wildlife group 7.

Martinton Series

The Martinton series consists of somewhat poorly drained, nearly level and gently sloping soils formed in drainageways and depressions and shallow drainage basins on ground moraines and in old glacial lake basins. The native vegetation was a forest of maple, oak, beech, and ash and an undergrowth of grasses.

In a representative profile the surface layer is very dark brown silt loam about 10 inches thick. The subsoil is about 26 inches thick and is mottled throughout. The upper part is dark grayish brown, firm silty clay; the next part is brown, firm silty clay loam; and the lower part is light brownish gray, firm silty clay. The substratum to a depth of 60 inches is mottled light gray, firm, stratified silt loam and silty clay loam.

Permeability is moderately slow, and available water capacity is high. Organic-matter content is also high. Natural fertility is medium. The root zone is limited by saturated soil during wet periods of the growing season.

Most of the acreage is used for crops, but some is used for pasture and woodland.

Representative profile of Martinton silt loam, 0 to 3 percent slopes, in a cultivated area, 150 feet east and 675 feet north of the southwest corner of sec. 35, T. 13 N., R. 21 E.

Ap—0 to 10 inches; very dark brown (10YR 2/2) heavy silt loam; moderate medium subangular blocky structure parting to moderate medium granular; friable; mildly alkaline; abrupt smooth boundary.

B2t—10 to 15 inches; dark grayish brown (10YR 4/2) silty clay; few fine prominent strong brown (7.5YR 5/6) mottles; strong medium angular blocky structure; firm; continous clay films; mildly alkaline; clear wavy boundary.

B31—15 to 20 inches; brown (10YR 5/3) heavy silty clay loam; few fine distinct grayish brown (10YR 5/2) and prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin patchy clay films; slight effervescence; mildly alkaline; gradual wavy boundary.

B32—20 to 36 inches; light brownish gray (2.5YR 6/2) silty clay; common fine prominent yellowish brown (10YR 5/6 and 5/8) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; strong effervescence; mildly alkaline; gradual wavy boundary.

C—36 to 60 inches; light gray (10YR 7/2) stratified silt loam and silty clay loam; few fine faint pinkish gray (7.5YR 6/2) and common medium distinct brown (7.5 YR 5/4) mottles; massive; firm; segregated lime; strong effervescence; mildly alkaline.

The solum is 24 to 36 inches thick. The A horizon is 10 to 12 inches thick. It is black, very dark brown, very dark gray, or very dark grayish brown. The B horizon is 12 to 25 inches thick. It is silty clay loam or silty clay. The C horizon is stratified silt loam, silty clay loam, or silty clay and has a thin layer of sandy material in places. The B

horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Martinton soils in this survey area have a thinner, dark colored A horizon and a thinner B2t horizon and are shallower over carbonates than is defined as the range for the series, but these differences do not alter use or management.

Martinton soils are near Montgomery and Saylesville soils. They are not so well drained as Saylesville soils and also differ from those soils in having mottles. They are not so gray or so poorly drained as Montgomery soils.

MgA—Martinton silt loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is in drainageways and depressions. Areas are irregularly shaped and range in size from 3 to more than 50 acres.

Included with this soil in mapping are small areas of Montgomery and Saylesville soils. Some areas of the wet Montgomery soils are identified by spot symbols on the soil map. Also included are areas where the surface layer is sandy loam and areas where the surface layer is thinner or the subsoil is more red than is typical.

This soil dries slowly in spring and after periods of heavy rainfall. It is subject to ponding in places. In some areas fine sand in the substratum tends to flow easily and fill tile lines if the soil is saturated.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIw–2; woodland group 4o1; wildlife group 6.

Matherton Series

The Matherton series consists of somewhat poorly drained, nearly level and gently sloping soils formed in silty and loamy deposits that are underlain by sand and gravel. These soils are in drainageways and depressions on outwash plains and stream terraces. The native vegetation was deciduous forest and an undergrowth of grasses.

In a representative profile the surface layer is a very dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown, friable silt loam about 3 inches thick. The subsoil is about 18 inches thick and is mottled throughout. The upper part is brown, friable silt loam; the next part is dark yellowish brown, firm silty clay loam; and the lower part is brown, firm clay loam. The substratum to a depth of 60 inches is pale brown, loose, stratified sand and gravel.

Permeability is moderate in the subsoil and rapid in the substratum. Available water capacity is moderate. Organic-matter content is also moderate. Natural fertility is medium. The root zone is limited by saturated soil during wet periods of the growing season.

Most areas of these soils are used for crops, but some are used for pasture and woodland.

Representative profile of Matherton silt loam, 0 to 3 percent slopes, in a cultivated area, 50 feet east and 2,565 feet south of the northwest corner of sec. 2, T. 16 N., R. 20 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; moderate medium granular structure; friable; mildly alkaline; abrupt smooth boundary.

A2—8 to 11 inches; brown (10YR 5/3) silt loam; moderate medium platy structure; friable; many grayish brown (10YR 5/2) worm casts; neutral; abrupt smooth boundary.

B1—11 to 16 inches; brown (10YR 4/3) silt loam; common fine faint grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

B21t—16 to 21 inches; dark yellowish brown (10YR 4/4) light silty clay loam; common fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; mildly alkaline; clear smooth boundary.

B22t—21 to 29 inches; brown (10YR 4/3) clay loam; grayish brown (10YR 5/2) clay films on faces of most peds; moderate fine subangular blocky structure; firm; estimated 10 percent gravel by volume; mildly alkaline; clear smooth boundary.

IIC—29 to 60 inches; pale brown (10YR 6/3) stratified sand and gravel; single grained; loose; strong effervescence; mildly alkaline.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is generally silt loam, but in places is loam or sandy loam. It is very dark gray, very dark grayish brown, or very dark brown. The A2 horizon is silt loam or loam 3 to 5 inches thick. The B1 horizon is silt loam or loam 3 to 7 inches thick. The B2 horizon is 8 to 18 inches thick. It is silty clay loam, clay loam, sandy clay loam, or gravelly clay loam. The IIC horizon is stratified sand and gravel. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Matherton soils in this survey area are less gray in the subsoil than is defined as the range for the series, but this difference does not alter use or management.

Matherton soils are near Fox, Sebewa, and Wasepi soils. They are not so well drained as Fox soils and also differ from those soils in having mottles. They are not so gray or poorly drained as Sebewa soils. They have more clay in the B horizon than Wasepi soils.

MkA—Matherton silt loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is in drainageways and depressions on outwash plains and stream terraces. Areas are irregularly shaped and range in size from 3 to more than 30 acres. Included in mapping are small areas of Fox soils.

This soil dries slowly in spring and after periods of heavy rainfall. It is subject to ponding in places. Removing excess water is the main concern of management.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture or woodland. Capability unit IIw–5; woodland group 3o2; wildlife group 6.

Montgomery Series

The Montgomery series consists of nearly level, very poorly drained soils formed in old glacial lake basins. These soils are underlain by stratified clay, silt, and very fine sand. The native vegetation was a deciduous forest of ash, elm, and maple and an undergrowth of grasses.

In a representative profile the surface layer is about 12 inches thick. It is black silty clay loam in the upper part and black silty clay in the lower part. The subsoil is about 13 inches thick. It is dark gray, firm silty clay in the upper part and grayish brown, firm silty clay in the lower part. It is mottled. The substratum to a depth of 60 inches is mottled pale brown, firm, stratified silt, clay, and very fine sand.

Permeability is slow. Available water capacity is high. Organic-matter content is also high. Natural fertility is medium. The root zone is limited by the water table.

Most of the acreage is used for crops, but some areas are used for pasture or woodland.

Representative profile of Montgomery silty clay loam, slopes of 0 to 2 percent, in a cultivated field, 250 feet west and 1,670 feet south of the northeast corner of sec. 12, T. 14 N., R. 22 E.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A12—8 to 12 inches; black (10YR 2/1) silty clay; common fine distinct dark gray (10YR 4/1) mottles; moderate fine subangular blocky structure; firm; neutral; clear smooth boundary.

B2g—12 to 20 inches; dark gray (10YR 4/1) silty clay; few fine prominent strong brown (7.5YR 5/6) mottles; strong fine subangular blocky structure; firm; neutral; clear smooth boundary.

B3—20 to 25 inches; grayish brown (10YR 5/2) silty clay; common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; firm; less than ⅛-inch, light gray (10YR 7/1) strata of silt; strong effervescence; mildly alkaline; clear smooth boundary.

C—25 to 60 inches; brown (10YR 5/3), pale brown (10YR 6/3), and very pale brown (10YR 7/3) stratified silt, clay, and very fine sand; common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium platy structure; firm; strong effervescence; mildly alkaline.

The solum ranges from 24 to 32 inches in thickness. The A horizon is 10 to 15 inches thick. It is black, very dark brown, very dark gray, or very dark grayish brown. The B horizon is 12 to 28 inches thick. It is silty clay or heavy silty clay loam. The C horizon is stratified silt, clay, silty clay loam, or silty clay and has bands of fine and very fine sand in places. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Montgomery soils are near Martinton soils and are similar to Poygan soils. They are grayer and more poorly drained than Martinton soils and are not so red in the C horizon as Poygan soils.

Mo—Montgomery silty clay loam. This nearly level soil is in drainageways and drainage basins. Areas are irregular or long and range in size from 10 to more than 40 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Martinton soils. Also included are small areas where the surface layer is muck.

This soil dries slowly in spring and after periods of heavy rainfall. It is subject to ponding in places. Silt and very fine sand in the substratum tend to flow easily and fill tile lines.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture or woodland. Capability unit IIw–1; woodland group 4w2; wildlife group 7.

Mosel Series

The Mosel series consists of nearly level and gently sloping, somewhat poorly drained soils formed in loamy lacustrine deposits. These soils are in old glacial lake basins and in depressions on till plains. The native vegetation was a deciduous forest of maple, oak, beech, and ash.

In a representative profile the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is about 20 inches thick. It is brown, firm light clay loam in the upper part; grayish brown, friable gravelly sandy loam in the next part; and brown, firm silty clay loam in the lower part. The subsoil is mottled. The substratum to a depth of 60 inches is brown, firm silty clay loam. It is mottled.

Permeability is moderate to a depth of about 26 inches and moderately slow below. Available water capacity is high. Organic-matter content is moderate, and natural fertility is medium. The root zone is limited by saturated soil during wet periods of the growing season.

Most of the acreage is used for corn, small grain, vegetables, and other crops commonly grown in the county. Some areas are used for pasture and woodland.

Representative profile of Mosel loam, 0 to 3 percent slopes, in a cultivated area, 200 feet east and 2,300 feet south of the northwest corner of sec. 30, T. 13 N., R. 21 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam; weak medium granular structure; friable; neutral; clear smooth boundary.

B21t—9 to 16 inches; brown (10YR 5/3) light clay loam; few fine faint grayish brown (10YR 5/2) and few fine prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; estimated 10 percent gravel by volume; neutral; clear wavy boundary.

B22t—16 to 23 inches; brown (10YR 4/3) light clay loam; common medium distinct and prominent yellowish brown (10YR 5/6 and 10YR 5/8) and common medium faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thin patchy clay films on faces of peds; mildly alkaline; clear wavy boundary.

B31t—23 to 26 inches; grayish brown (10YR 5/2) gravelly sandy loam; weak medium subangular blocky structure; friable; clay bridging between sand grains; estimated 20 percent gravel by volume; mildly alkaline; abrupt wavy boundary.

IIB32t—26 to 29 inches; brown (10YR 5/3) heavy silty clay loam; few fine prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure parting to moderate fine angular blocky; firm; patchy clay films; slight effervescence; mildly alkaline; clear wavy boundary.

IIC—29 to 60 inches; brown (7.5YR 5/4) silty clay loam; common fine prominent pinkish white (7.5YR 8/2) and pinkish gray (7.5YR 6/2) mottles and common medium distinct strong brown (7.5YR 5/8) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is 6 to 9 inches thick. It is dark brown, very dark brown, or very dark grayish brown. It is typically loam, but is silt loam or sandy loam in places. In undisturbed areas there are a 3- to 5-inch, black or very dark brown A1 horizon and a 2- to 6-inch, brown or dark grayish brown A2 horizon. The B horizon is 15 to 34 inches thick. The upper part is clay loam, sandy clay loam, sandy loam, or loam. The lower part is silty clay, heavy silty clay loam, or heavy clay loam. The C horizon is silty clay loam or stratified silty clay, clay, silt, and silty clay loam and has some thin strata of fine sand in places. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Mosel soils are near Hebron Navan, and Hebron variant soils. They are less gray and better drained than Navan soils. They have more mottles than Hebron and Hebron variant soils and are not as well drained as those soils.

MsA—Mosel loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is in old glacial lake basins and on till plains. Areas are irregularly shaped and range in size from 3 to more than 100 acres.

Included with this soil in mapping are small areas of Hebron and Navan soils and the Hebron variant. In some areas the surface layer is sandy loam. Most of these areas are identified by spot symbols on the soil map. Also included in mapping are areas where a thin layer of sand or sand and gravel is between the upper and lower parts of the subsoil.

This soil dries slowly in spring and after periods of heavy rainfall. It is subject to ponding in some areas.

If adequately drained and well managed, this soil is moderately well suited to all crops commonly grown in the county. It is suited to woodland and pasture. Most of the acreage is used for crops, but a small acreage is used for woodland and pasture. Capability unit IIw–2; woodland group 2o2; wildlife group 6.

Muskego Series

The Muskego series consists of very poorly drained, nearly level soils formed in herbaceous organic material underlain by coprogenous material. These soils are in old glacial lake basins and drainageways. The native vegetation was elm, ash, and white cedar and an undergrowth of grasses and sedges.

In a representative profile the organic layer is black muck about 40 inches thick. The underlying layers to a depth of 60 inches are very dark grayish brown and gray sedimentary peat.

Permeability is moderately rapid in the organic layers and slow in the sedimentary peat layers. Available water capacity is very high. Organic-matter content is also very high. Natural fertility is low. The root zone is limited by the water table, which is at or near the surface.

Most areas of these soils are used for woodland, but some small areas are drained and used for crops.

Representative profile of Muskego muck, slopes of 0 to 2 percent, in a wooded area, 500 feet west and 1,440 feet south of the northeast corner of sec. 21, T. 13 N., R. 21 E.

Oa1—0 to 10 inches; black (10YR 2/1) sapric material; weak medium granular structure; friable; mildly alkaline; abrupt smooth boundary.

Oa2—10 to 40 inches; black (10YR 2/1) sapric material, very dark brown (10YR 2/2) rubbed; moderate medium subangular blocky structure; friable; few woody roots; mildly alkaline; abrupt smooth boundary.

Lco1—40 to 54 inches; very dark grayish brown (10YR 3/2) coprogenous material; weak medium granular structure; friable; mildly alkaline; clear wavy boundary.

Lco2—54 to 60 inches; gray (5Y 5/1) coprogenous material; massive; slightly plastic; estimated 50 percent very fine sand; mildly alkaline.

The depth to limnic material ranges from 12 to 50 inches. The upper tiers are black, very dark brown, very dark gray, or very dark grayish brown sapric material. The lower tiers are coprogenous material. The organic material is slightly acid to mildly alkaline. The coprogenous material is mildly alkaline or moderately alkaline.

Muskego soils are near Houghton, Palms, and Willette soils. They do not have the mineral material within a depth of 51 inches typical of Palms and Willette soils, and they have a larger amount of coprogenous limnic material than Houghton soils.

Mz—Muskego muck. This nearly level soil is in depressions in old glacial lake basins and drainage basins. Areas are irregularly shaped and range in size from 3 to more than 40 acres. Slopes are 0 to 2 percent. Included in mapping are small areas of Boots, Houghton, Palms, and Willette soils.

Wetness is the major limitation of this soil. If drained and cultivated, however, the soil is subject to soil blowing and subsidence.

If properly drained, this soil is suited to corn, small grain, and truck crops. It is also suited to some types of woodland. Most of the acreage is used for woodland and wildlife habitat, but some is drained and used for crops. Capability unit IVw–7; woodland group 3w3; wildlife group 8.

Navan Series

The Navan series consists of nearly level, poorly drained soils that are underlain by silty and clayey deposits. These soils are in old glacial lake basins and on till plains where water has deposited a thin layer of loamy material over the clayey material. The native vegetation was a deciduous forest of elm, ash, and maple.

In a representative profile the surface layer is black loam about 11 inches thick. The subsoil is about 25 inches thick and is mottled throughout. It is dark gray, friable heavy loam in the upper part; gray, friable sandy clay loam and firm clay loam in the next part; and brown, firm heavy silty clay loam in the lower part. The substratum is brown, light brown, and pale brown, firm, stratified silt and clay.

Permeability is moderate to a depth of about 30 inches and slow below. Available water capacity is high. Organic-matter content and natural fertility are high. The root zone is limited by the water table.

Most areas of these soils are used for corn, small grain, and other crops commonly grown in the county. Some are used for pasture and woodland.

Representative profile of Navan loam, slopes of 0 to 2 percent, in an idle field, 700 feet north and 650 feet east of the southwest corner of sec. 3, T. 15 N., R. 23 E.

Ap—0 to 8 inches; black (10YR 2/1) loam; moderate medium granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 11 inches; black (10YR 2/1) loam; few fine distinct dark gray (10YR 4/1) mottles; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.

B21tg—11 to 22 inches; dark gray (10YR 4/1) heavy loam; few fine faint dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; friable; thin discontinous clay films; neutral; clear smooth boundary.

B22tg—22 to 26 inches; gray (10YR 5/1) sandy clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; thin discontinous clay films; mildly alkaline; clear smooth boundary.

B23tg—26 to 30 inches; gray (10YR 5/1) clay loam; common medium prominent brown (7.5YR 4/4) mottles; moderate fine prismatic structure parting to moderate fine subangular blocky; firm; thin clay films on faces of most peds; mildly alkaline; abrupt smooth boundary.

IIB3t—30 to 36 inches; brown (7.5YR 5/4) heavy silty clay loam; common medium distinct strong brown (7.5YR 5/6) mottles and few fine distinct pinkish gray (7.5YR

6/2) mottles; moderate medium subangular blocky structure; firm; thin discontinuous clay films; strong effervescence; moderately alkaline; clear smooth boundary.

IIC1—36 to 50 inches; brown (7.5YR 5/2), light brown (7.5YR 6/4), and pale brown (10YR 6/3) stratified silt and clay; common medium distinct strong brown (7.5YR 5/6) mottles; massive; firm; strong effervescence; moderately alkaline; clear smooth boundary.

IIC2—50 to 60 inches; light brown (7.5YR 6/4) and brown (7.5YR 4/4) stratified silt and clay; massive; firm; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The A horizon is 10 to 18 inches thick. It is black or very dark gray. It is typically loam, but in places is silt loam or sandy loam. The B horizon is 12 to 30 inches thick. The upper part is loam, sandy loam, sandy clay loam, or clay loam and has gravel in places. The lower part is heavy silty clay loam or silty clay. The C horizon is stratified silt and clay or is massive silty clay or silty clay loam. The B horizon is neutral to moderately alkaline. The C horizon is mildly alkaline or moderately alkaline.

Navan soils are near Mosel and Poygan soils. They are more gray and are more poorly drained than Mosel soils. They have more sand and less clay in the upper part of the B horizon than Poygan soils.

Na—Navan loam. This nearly level soil is in drainageways and drainage basins. Areas are long or irregular in shape and range in size from 3 to more than 40 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Mosel and Sebewa soils. Also included are some small areas where the surface layer is sandy loam or silt loam and some areas where a thin layer of sand or sand and gravel is between the loamy upper part of the subsoil and the clayey lower part.

This soil dries slowly in spring and after periods of heavy rainfall, and ponding occurs in places. Unless adequately drained, the soil is too wet for crops commonly grown in the county.

If adequately drained, this soil is moderately well suited to crops commonly grown in the county. It is suited to pasture and some types of woodland. Most of the acreage is used for crops. Some undrained areas are used for woodland and pasture. Capability unit IIw-1; woodland group 4w2; wildlife group 7.

Nenno Series

The Nenno series consists of somewhat poorly drained, nearly level and gently sloping soils that are underlain by gravelly loam glacial till. These soils are in drainageways, in depressions of ground moraines, and on concave foot slopes of drumlins. The native vegetation was deciduous forest.

In a representative profile the surface layer is a very dark grayish brown silt loam about 8 inches thick. The subsoil is mottled and is about 12 inches thick. The upper part is dark brown, firm light clay loam, and the lower part is brown, friable heavy loam. The substratum to a depth of 60 inches is mottled pale brown, friable gravelly loam.

Permeability and available water capacity are moderate. Organic-matter content also is moderate. Natural fertility is medium. The root zone is limited by saturated soil during wet periods of the growing season.

Most of the acreage is used for crops. Some is used for pasture or woodland.

Representative profile of Nenno silt loam, 2 to 6 percent slopes, in a cultivated area, 900 feet east and 2,540 feet south of the northwest corner of sec. 7, T. 16 N., R. 21 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; moderate medium subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.

B2t—8 to 14 inches; dark brown (10YR 4/3) light clay loam; few fine faint grayish brown (10YR 5/2) mottles, common medium faint brown (10YR 5/3) mottles, and common fine faint yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; mildly alkaline; clear smooth boundary.

B3—14 to 20 inches; brown (10YR 5/3) heavy loam; common medium prominent yellowish brown (10YR 5/6) mottles, few fine prominent brownish yellow (10YR 6/6) mottles, and common medium faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; mildly alkaline; gradual smooth boundary.

C—20 to 60 inches; pale brown (10YR 6/3) gravelly loam; common medium prominent brownish yellow (10YR 6/6) mottles; massive; friable; estimated 25 percent gravel by volume; slight effervescence; mildly alkaline.

The solum is 12 to 24 inches thick. The Ap horizon is 6 to 10 inches thick. It is dark gray or very dark grayish brown. It is generally silt loam, but is loam in places. The B horizon is 8 to 14 inches thick. The upper part is clay loam, loam, or silty clay loam. The lower part is loam or sandy loam. The C horizon is sandy loam, loam, gravelly loam, or gravelly sandy loam. It is 18 to 30 percent gravel by volume. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Nenno soils are near Barry, Hochheim, and Theresa soils. They are not so well drained as Hochheim and Theresa soils and also differ from those soils in having mottles. They are better drained than Barry soils and are not so gray as those soils.

NnA—Nenno silt loam, 0 to 2 percent slopes. This nearly level soil is in drainageways and depressions on ground moraines. It is long or irregular in shape and ranges in size from 3 to more than 30 acres. This soil has a surface layer that is about 2 inches thicker than that of the soil described as representative of the series.

Included with this soil in mapping are small areas of Barry, Hochheim, and Theresa soils. Some wet areas of the Barry soils are identified by spot symbols on the soil map. Also included in mapping are some small areas where slopes are more than 2 percent.

This soil dries slowly in spring and after periods of heavy rainfall, and ponding occurs in places.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIw–2; woodland group 2o2; wildlife group 6.

NnB—Nenno silt loam, 2 to 6 percent slopes. This gently sloping soil is in drainageways and on the lower slopes of drumlins. Areas are long or irregular in shape and range in size from 3 to more than 30 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Barry, Hochheim, and Theresa soils. Some wet areas of the Barry soils are identified by spot symbols on the soil map. Also included in mapping are small areas of hillside seep and small nearly level areas.

This soil dries slowly in spring and after periods of heavy rainfall. In some areas where slopes are long, the erosion hazard is slight.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and woodland. Capability unit IIw–2; woodland group 2o2; wildlife group 6.

Oakville Series

The Oakville series consists of well drained and moderately well drained, nearly level to sloping soils on old glacial lake plains, old beach ridges, and stabilized sand dunes. The native vegetation was mixed deciduous and coniferous trees.

In a representative profile the surface layer is dark brown loamy fine sand about 8 inches thick. The subsoil is about 16 inches thick. The upper part is dark brown, very friable loamy fine sand, and the lower part is strong brown, very friable and loose fine sand. The substratum to a depth of 60 inches is yellowish brown sand and fine sand. It has some mottles below a depth of 40 inches.

Permeability is very rapid. Available water capacity is low. Organic-matter content and natural fertility are low.

Most of the acreage is used for woodland. Some areas are used for crops and pasture.

Representative profile of Oakville loamy fine sand, 0 to 6 percent slopes, in a cultivated area, 20 feet north and 2,490 feet east of the southwest corner of sec. 34, T. 16 N., R. 23 E.

Ap—0 to 8 inches; dark brown (10YR 3/3) loamy fine sand; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

B21—8 to 12 inches; dark brown (7.5YR 4/4) loamy fine sand; weak fine subangular blocky structure; very friable; few ortstein fragments ⅛ to ¾ inch in diameter; slightly acid; clear smooth boundary.

B22—12 to 20 inches; strong brown (7.5YR 5/6) fine sand; very weak medium subangular blocky structure, single grained where disturbed; very friable; slightly acid; clear wavy boundary.

B3—20 to 24 inches; strong brown (7.5YR 5/8) fine sand; single grained; loose; slightly acid; gradual wavy boundary.

C1—24 to 40 inches; yellowish brown (10YR 5/6) sand and fine sand; single grained; loose; slightly acid; gradual wavy boundary.

C2—40 to 60 inches; yellowish brown (10YR 5/6) sand and fine sand; few medium distinct strong brown (7.5YR 5/6 and 5/8) mottles; single grained; loose; medium acid.

The solum ranges from 18 to 40 inches in thickness. The Ap horizon is 6 to 9 inches thick. It is generally loamy fine sand, but in places is loamy sand or fine sand. It is very dark grayish brown, dark brown, dark yellowish brown, dark grayish brown, or very dark gray. In uncultivated areas there are a black or very dark brown A1 horizon that is 2 to 4 inches thick and a brown or dark grayish brown A2 horizon that is 6 to 10 inches thick. The B horizon ranges from 11 to 31 inches in thickness. It is fine sand or loamy fine sand. The C horizon is fine sand and sand. In some places the C horizon does not have mottles. The B and C horizons range from medium acid to neutral.

Oakville soils are near Adrian, Granby, and Hebron soils. They are better drained than Granby soils and are not so gray as those soils. They do not have the clay within the upper 60 inches typical of Hebron soils. Oakville soils lack the muck surface layer typical of Adrian soils.

OaB—Oakville loamy fine sand, 0 to 6 percent slopes. This nearly level and gently sloping soil is on stabilized sand dunes and beach ridges. Areas are irregularly shaped and range in size from 3 to more than 120 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Boyer, Granby, and Hebron soils. Also included are some small areas where clay is at a depth of less than 60 inches, areas of Dune land, and gently sloping areas.

The soil is droughty. It is subject to soil blowing and erosion if used for crops.

This soil is poorly suited to crops and pasture. It is suited to certain types of woodland. Most of the acreage is used for woodland, but some is used for pasture and crops. Capability unit IVs–3; woodland group 3sl; wildlife group 3.

OaC—Oakville loamy fine sand, 6 to 12 percent slopes. This sloping soil is on stabilized sand dunes and beach ridges. Areas are irregularly shaped and range in size from 3 to 120 acres.

Included with this soil in mapping are small areas of Boyer and Hebron soils. Also included are small areas of Dune land and areas where clay is at a depth of less than 60 inches.

This soil is droughty. It is subject to soil blowing and erosion if used for crops.

This soil is generally not suited to crops and pasture. It is suited to certain types of woodland. Most of the acreage is used for woodland, but some is used for pasture and crops. Capability unit VIs–3; woodland group 3sl; wildlife group 3.

Otter Series

The Otter series consists of poorly drained, nearly level soils formed in alluvium. These soils are on flood plains of rivers and streams and in depressional areas. The native vegetation was deciduous forest.

In a representative profile the surface layer is 36 inches thick. It is, in sequence downward, 9 inches of black silt loam, 7 inches of very dark grayish brown silt loam, 8 inches of very dark gray heavy silt loam, and 12 inches of black silty clay loam. The substratum to a depth of 60 inches is grayish brown, mottled silt loam.

Permeability is moderate, and available water capacity is very high. Organic-matter content and natural fertility are high. The root zone is limited by the water table.

Most of the acreage is used for pasture and woodland. Some is used for crops.

Representative profile of Otter silt loam, slopes of 0 to 2 percent, in a cultivated area, 150 feet south and 600 feet east of the northwest corner of sec. 10, T. 13 N., R. 20 E.

Ap—0 to 9 inches; black (10YR 2/1) silt loam; weak medium subangular blocky structure parting to moderate medium granular; friable; mildly alkaline; abrupt smooth boundary.

A12—9 to 16 inches; very dark grayish brown (10YR 3/2) silt loam; common fine distinct dark yellowish brown (10YR 3/4) organic stains; weak medium granular structure; friable; mildly alkaline; clear smooth boundary.

A13—16 to 24 inches; very dark gray (10YR 3/1) heavy silt loam; common fine prominent dark yellowish brown (10YR 3/4) organic stains; weak fine prismatic structure parting to moderate fine angular blocky; friable; mildly alkaline; clear smooth boundary.

A14—24 to 36 inches; black (10YR 2/1) silty clay loam; common fine prominent dark yellowish brown (10YR 3/4) organic stains; moderate medium angular blocky structure; firm; mildly alkaline; gradual wavy boundary.

C—36 to 60 inches; grayish brown (2.5Y 5/2) heavy silt loam; common fine distinct and prominent yellowish brown (10YR 5/4 and 5/6) mottles along old root channels; massive; firm; mildly alkaline.

The A horizon ranges from 24 to 40 inches in thickness. It is generally silt loam, but in places is mucky silt loam or silty clay loam. It is black, very dark grayish brown, or very dark gray. The C horizon is silt loam, loam, sandy loam, or silty clay loam and is stratified in places. The A and C horizons are neutral or mildly alkaline.

Otter soils are similar to Elvers soils, but are not underlain by sapric material.

Ot—Otter silt loam. This nearly level soil is on flood plains. Areas are irregularly shaped and range in size from 3 to more than 80 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Alluvial land, wet. Also included are some somewhat poorly drained areas.

This soil dries slowly in spring and after periods of heavy rainfall, and flooding and ponding occur in places. The main concern of management is removing excess water to prevent ponding and reduce the risk of flooding.

If adequately drained and protected from flooding, this soil is moderately well suited to all crops commonly grown in the county. Most of the acreage is used for pasture and woodland, but some is used for crops. Capability unit IIw–1; woodland group 2w1; wildlife group 7.

Palms Series

The Palms series consists of nearly level, very poorly drained soils formed in herbaceous organic material underlain by loamy mineral layers. These soils are in drainage basins and depressions. The native vegetation was marsh grasses, sedges, and cattails and some elm, soft maple, ash, white cedar, and tamarack.

In a representative profile the organic layer is about 36 inches thick. It is black, very dark brown, dark brown, or very dark grayish brown muck. The substratum to a depth of 60 inches is dark gray and light gray, friable silt loam.

Permeability is moderately rapid in the organic layer and moderate in the underlying loamy layers. Available water capacity is very high. Organic-matter content is also very high. Natural fertility is low. The root zone is limited by the water table, which is at or near the surface.

Most of the acreage is used for woodland. Some small areas are used for pastured woodland.

Representative profile of Palms muck, slopes of 0 to 2 percent, in a wooded area, 250 feet south and 400 feet east of the northwest corner of sec. 22, T. 13 N., R. 21 E.

Oa1—0 to 8 inches; black (10YR 2/1) and very dark brown (10YR 2/2 broken face and rubbed) sapric material; moderate fine granular structure; friable; estimated 20 percent woody material; mildly alkaline; clear smooth boundary.

Oa2—8 to 18 inches; dark brown (10YR 3/3) sapric material changing to very dark brown (10YR 2/2 broken face and rubbed) on exposure to air; moderate medium subangular blocky structure; friable; estimated 20 percent woody material; mildly alkaline; gradual wavy boundary.

Oa3—18 to 36 inches; very dark grayish brown (10YR 3/2 broken face and rubbed) sapric material; weak medium subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

IIC1g—36 to 44 inches; dark gray (5Y 4/1) silt loam; massive; friable; mildly alkaline; gradual smooth boundary.

IIC2—44 to 60 inches; light gray (10YR 7/2) silt loam; few coarse distinct light olive brown (2.5Y 5/6) mottles; massive; friable; slight effervescence; mildly alkaline.

The organic material ranges from 16 to 50 inches in thickness. It is 1 to 50 percent fiber, less than 5 percent after rubbing. Some pedons have thin layers of fibric material less than 5 inches thick. In places the organic layers contain some woody fragments. The IIC horizon is fine sandy loam, sandy loam, silt loam, loam, or clay loam. The organic material is slightly acid to mildly alkaline. The IIC horizon is mildly alkaline or moderately alkaline.

Palms soils are similar to Adrian, Houghton, and Willette soils. They differ from Houghton soils in having loamy mineral material within a depth of 50 inches. They have less sand than Adrian soils and less clay than Willette soils.

Pa—Palms muck. This nearly level soil is in drainage basins and depressions. Areas are irregularly shaped and range in size from 3 to more than 160 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Adrian, Boots, Edwards, Houghton, Muskego, and Willette soils. Also included are areas where slopes are more than 2 percent.

Wetness is the major limitation of this soil. If drained and cultivated, however, the soil is subject to soil blowing.

If drained and well managed, this soil is moderately well suited to corn, small grain, and truck crops commonly grown in the county. It is suited to pasture and some types of woodland. Most of the acreage is used for woodland, but some is used for pasture and crops. Capability unit IIw–8; woodland group 3w3; wildlife group 8.

Pella Series

The Pella series consists of nearly level, poorly drained soils underlain by loamy lacustrine material or gravelly sandy loam or gravelly loam glacial till. These soils are in old glacial lake basins and on till plains. The native vegetation was deciduous forest and an undergrowth of grasses.

In a representative profile the surface layer is about 16 inches thick. The upper part is very dark brown silt loam, and the lower part is very dark gray heavy silt loam. The subsoil is about 19 inches thick. It is mottled grayish brown, firm silty clay loam. The substratum to a depth of 60 inches is mottled olive gray heavy silt loam.

Permeability is moderate, and available water capacity is high. Organic-matter content and natural fertility are high. The root zone is limited by the water table.

Most of the acreage is used for crops. Some is used for pasture and woodland.

Representative profile of Pella silt loam, slopes of 0 to 2 percent, 240 feet east and 600 feet south of the northwest corner of sec. 13, T. 13 N., R. 21 E.

Ap—0 to 12 inches; very dark brown (10YR 2/2) silt loam; moderate fine subangular blocky structure; friable; neutral; abrupt smooth boundary.
A12—12 to 16 inches; very dark gray (10YR 3/1) heavy silt loam; weak coarse prismatic structure parting to moderate very fine subangular blocky; friable; neutral; gradual wavy boundary.
B1g—16 to 22 inches; grayish brown (2.5YR 5/2) silty clay loam; many medium distinct dark brown (7.5YR 4/4) and prominent strong brown (7.5YR 5/6 and 7.5YR 5/8) mottles; weak coarse prismatic structure parting to moderate fine angular and subangular blocky; firm; neutral; clear wavy boundary.
B2g—22 to 35 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium distinct dark brown (7.5YR 4/4) and prominent strong brown (7.5YR 5/6 and 7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; neutral; clear wavy boundary.
C—35 to 60 inches; olive gray (5Y 5/2) heavy silt loam; many fine and medium distinct strong brown (7.5 YR 5/6 and 7.5YR 5/8) mottles; massive; friable; slight effervescence; mildly alkaline.

The solum ranges from 24 to 42 inches in thickness. The A horizon is 12 to 24 inches thick. It is generally silt loam, but in places is silty clay loam. It is very dark brown, black, or very dark gray. The B horizon is 14 to 27 inches thick. The C horizon is silt loam, sandy loam, fine loamy sand loam, or clay loam. The B horizon is slightly acid to mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Pella soils are near Barry and Kendall soils. They are not so gray or so well drained as Kendall soils. They have a thicker silt mantle and have less sand than Barry soils.

Ph—Pella silt loam. This nearly level soil is in old glacial lake basins and on till plains. Areas are irregularly shaped and range in size from 3 to more than 60 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Kendall soils. Also included are some areas where slopes are more than 2 percent.

This soil dries slowly in spring and after periods of heavy rainfall, and ponding occurs in places. The main concern of management is removing excess water.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability group IIw–1; woodland group 3w2; wildlife group 7.

Poygan Series

The Poygan series consists of nearly level, poorly drained soils formed in silty clay loam and silty clay lacustrine deposits or glacial till. These soils are in drainageways, drainage basins, and depressions. The native vegetation was a deciduous forest of elm, ash, and maple and an undergrowth of grasses.

In a representative profile the surface layer is very dark gray silty clay loam about 11 inches thick. The subsoil is about 13 inches thick and is mottled. The upper 3 inches is grayish brown, firm silty clay; the next 6 inches is olive gray, firm heavy silty clay loam; and the lower 4 inches is gray, firm heavy silty clay loam. The substratum to a depth of 60 inches is reddish brown, firm silty clay.

Permeability is slow, and available water capacity is moderate. Organic-matter content is high and natural fertility is medium. The root zone is limited by the seasonal high water table.

Most of the acreage is used for crops. Some is used for pasture and woodland.

Representative profile of Poygan silty clay loam, slopes of 0 to 2 percent, in a cultivated area, 1,080 feet east and 1,350 feet south of the northwest corner of sec. 2, T. 13 N., R. 21 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silty clay loam; weak medium and fine granular structure; friable; mildly alkaline; abrupt smooth boundary.
B21g—11 to 14 inches; grayish brown (2.5Y 5/2) silty clay; moderate medium subangular blocky structure; firm; thin continuous dark grayish brown (2.5Y 4/2) clay films on faces of peds; mildly alkaline; clear wavy boundary.
B22g—14 to 20 inches; olive gray (5Y 5/2) heavy silty clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure parting to moderate fine angular blocky; firm; thin patchy clay films; mildly alkaline; clear wavy boundary.
B3g—20 to 24 inches; gray (5Y 5/1) heavy silty clay loam; common medium prominent brown (7.5YR 5/4) mottles; weak coarse prismatic structure parting to strong medium angular blocky; firm; mildly alkaline; clear wavy boundary.
C1—24 to 40 inches; reddish brown (5YR 5/3) silty clay; many medium prominent olive gray (5Y 5/2) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; slight effervescence; mildly alkaline.

The solum ranges from 20 to 36 inches in thickness. The A horizon is 9 to 12 inches thick. It is black or very dark gray. The B horizon is 11 to 20 inches thick. It is silty clay loam, silty clay, or clay. The C horizon is silty clay, or heavy clay loam. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Poygan soils are near Kewaunee, Manawa, and Waymor soils. They are more gray and more poorly drained than those soils.

Py—Poygan silty clay loam. This nearly level soil is in drainageways and depressions. Areas are irregular or long in shape and range in size from 3 to more than 80 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Kewaunee and Manawa soils. Also included are small areas where slopes are more than 2 percent, small areas where the surface layer is silt loam or loam, and some small areas where the surface layer is muck less than 16 inches thick.

This soil dries slowly in spring and after periods of heavy rainfall, and ponding occurs in places. The main concern of management is removing excess water.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and certain types of woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIw–1; woodland group 2w1; wildlife group 7.

Rodman Series

The Rodman series consists of excessively drained, sloping to very steep soils formed in sand and gravel

outwash. These soils are on outwash plains, kames, and eskers. The native vegetation was deciduous forest and grasses.

In a representative profile the surface layer is very dark gray gravelly sandy loam about 5 inches thick (fig. 5). The subsoil is dark brown, friable gravelly sandy loam about 4 inches thick. The substratum to a depth of 60 inches is pale brown, stratified, loose gravel and sand.

Permeability is very rapid, and available water capacity is very low. Organic-matter content and natural fertility are low. The root zone is limited by the underlying sand and gravel.

These soils are better suited to woodland and recreation than to crops. Most of the acreage is used for woodland and recreation, but some is used for pasture and crops.

Rodman soils in this survey area are mapped only with Casco soils.

Representative profile of Rodman gravelly sandy loam, in an area of Casco-Rodman complex, 20 to 30 percent slopes, 400 feet south and 960 feet east of the northwest corner of sec. 31, T. 13 N., R. 21 E.

A1—0 to 5 inches; very dark gray (10YR 3/1) gravelly sandy loam; weak fine granular structure; friable; common fibrous roots; estimated 20 percent gravel by volume; mildly alkaline; clear wavy boundary.

B2—5 to 9 inches; dark brown (10YR 3/3) gravelly sandy loam; weak fine subangular blocky structure; friable; common fibrous roots; estimated 22 percent gravel by volume; mildly alkaline; abrupt wavy boundary.

C—9 to 60 inches; pale brown (10YR 6/3) stratified gravel and sand; single grained; loose; estimated 60 percent gravel by volume; strong effervescence; moderately alkaline.

The solum is 8 to 15 inches thick. The A horizon is 4 to 8 inches thick. It is very dark brown, very dark gray, or very dark grayish brown and is generally gravelly sandy loam or gravelly loam. The B horizon is 4 to 8 inches thick. It is gravelly loam or gravelly sandy loam. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Rodman soils have a darker B horizon than is defined as the range for the series, but this difference does not alter their use or management.

Rodman soils are similar to Casco and Fox soils. They are shallower over gravel and sand than Casco and Fox soils. They lack the Bt horizon typical of those soils.

Rough Broken Land

Ry—Rough broken land is on lake banks, riverbanks, and escarpments. It is well drained. Areas are long and range in size from 3 to more than 25 acres. Slopes are 20 to 45 percent. This land is mostly reddish brown silty clay loam or clay loam glacial till.

This land is not suited to crops. It is best used as wildlife sanctuary. Capability unit VIIe–6; woodland group 6s1; wildlife group 2.

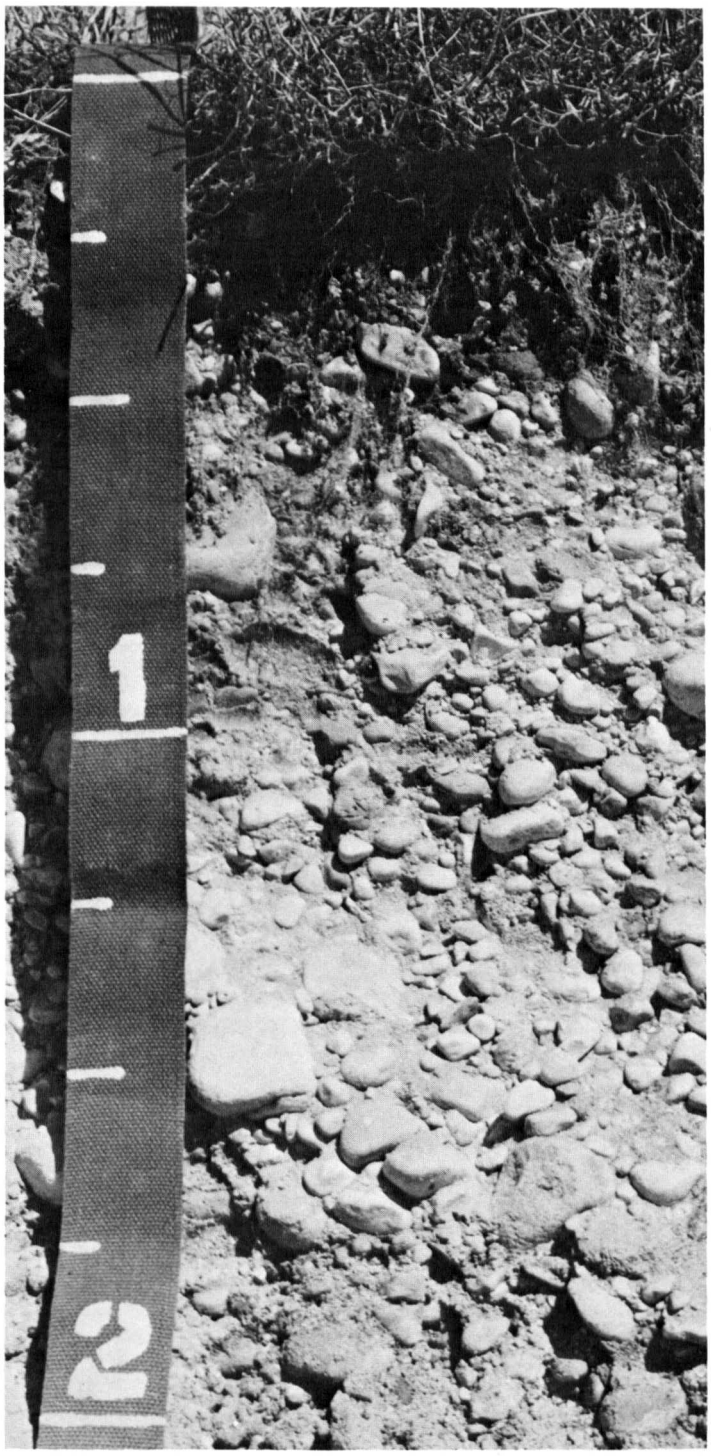

Figure 5.—Profile of Rodman gravelly sandy loam underlain by gravel and sand at a depth of about 9 inches.

St. Charles Series

The St. Charles series consists of well drained and moderately well drained, nearly level and gently sloping soils that are underlain by loamy lacustrine material or gravelly sandy loam and gravelly loam glacial till. These soils are on till and outwash plains. The native vegetation was deciduous trees.

In a representative profile the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 46 inches thick. The upper part is brown,

friable silt loam; the next part is dark brown, firm silty clay loam and friable silt loam; and the lower part is pale brown, friable loam. The substratum to a depth of 60 inches is pale brown, stratified silt loam and loam.

Permeability is moderate, and available water capacity is high. Organic-matter content is moderate, and natural fertility is high.

Most areas are used for crops. Some are used for woodland and pasture.

Representative profile of St. Charles silt loam, 0 to 2 percent slopes, 110 feet west and 1,340 feet south of the northeast corner of sec. 29, T. 15 N., R. 21 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; neutral; abrupt smooth boundary.
B1—8 to 15 inches; brown (10YR 5/3) silt loam; moderate medium subangular blocky structure; friable; neutral; clear smooth boundary.
B21t—15 to 22 inches; dark brown (10YR 4/3) silty clay loam; moderate medium subangular blocky structure; firm; few patchy clay films on vertical faces of peds; slightly acid; clear smooth boundary.
B22t—22 to 33 inches; dark brown (10YR 4/3) silty clay loam; moderate coarse subangular blocky structure; firm; common thick continuous clay films on faces of peds; firm; medium acid; gradual smooth boundary.
B31—33 to 42 inches; dark brown (10YR 4/3) heavy silt loam; weak medium subangular blocky structure; friable; medium acid; clear smooth boundary.
IIB32—42 to 54 inches; pale brown (10YR 6/3) loam; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.
IIC—54 to 60 inches; pale brown (10YR 6/3) stratified silt loam and loam; few fine faint yellowish brown (10YR 5/4) mottles; weak very thin platy structure; friable; medium acid.

The solum ranges from 44 to 60 inches in thickness. The upper silty layers are 40 to 60 inches thick. The A horizon is 6 to 14 inches thick. It is dark grayish brown. The B horizon ranges from 30 to 50 inches in thickness. The upper part is heavy silt loam or silty clay loam, and the lower part is loam, sandy loam, or sand. The C horizon is generally stratified sand and gravel or stratified silt loam and loam. In places it is sandy loam or loam. The B horizon is medium acid to neutral. The C horizon ranges from medium acid to mildly alkaline.

St. Charles soils are near Fox, Kendall, and Theresa soils. They are better drained than Kendall soils and have fewer mottles. They have a thicker solum than Theresa and Fox soils.

ScA—St. Charles silt loam, 0 to 2 percent slopes. This nearly level soil is on outwash and till plains. Areas are irregularly shaped and range in size from 3 to more than 40 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Fox, Kendall, and Theresa soils. Some areas of the wet Kendall soils are identified by spot symbols on the soil map. Also included in mapping are small gently sloping areas.

This soil has no major limitations for crops, pasture, or woodland. It is well suited to all crops commonly grown in the county. It is also well suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit I–3; woodland group 1o1; wildlife group 1.

ScB—St. Charles silt loam, 2 to 6 percent slopes. This gently sloping soil is on outwash and till plains. Areas are irregularly shaped and range in size from 3 to more than 20 acres. This soil is 4 to 6 inches thinner than the soil described as representative of the series.

Included with this soil in mapping are small areas of Fox, Kendall, and Theresa soils. Some areas of the wet Kendall soils are identified by spot symbols on the soil map. Also included in mapping are small nearly level or sloping areas.

The hazard of erosion is slight. Reducing runoff and increasing the organic-matter content help to control erosion.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIe–1; woodland group 1o1; wildlife group 1.

Saylesville Series

The Saylesville series consists of well drained and moderately well drained, nearly level to sloping soils that are underlain by stratified silt loam and silty clay loam. These soils are in old glacial lake basins and on terraces. The native vegetation was a forest of mainly maple, oak, beech, basswood, and white pine.

In a representative profile the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown, firm silty clay, and the lower part is brown, firm heavy silty clay loam. The substratum to a depth of 60 inches is pale brown, stratified silt loam and silty clay loam.

Permeability is moderately slow, and available water capacity is high. Organic-matter content is moderate, and natural fertility is medium.

Most of the acreage is used for crops. Some is used for pasture and woodland.

Representative profile of Saylesville silt loam, 2 to 6 percent slopes, in a cultivated area, 50 feet east of State Highway 32, 960 feet west and 1,560 feet north of the southeast corner of sec. 10, T. 15 N., R. 20 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.
B21t—7 to 14 inches; dark brown (7.5YR 4/4) silty clay; strong fine and very fine subangular blocky structure; firm; thin continuous clay films; mildly alkaline; clear smooth boundary.
B22t—14 to 20 inches; brown (10YR 5/3) heavy silty clay loam; strong fine angular blocky structure; firm; very dark grayish brown (10YR 3/2) patchy clay films on faces of most peds; mildly alkaline; clear smooth boundary.
B3—20 to 29 inches; brown (10YR 5/3) heavy silty clay loam; strong fine angular blocky structure; firm; few clay films on faces of peds; slight effervescence; mildly alkaline; gradual smooth boundary.
C—29 to 60 inches; pale brown (10YR 6/3) stratified silt loam and silty clay loam; massive; friable and firm; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is grayish brown or dark grayish brown. It is generally silt loam or silty clay loam, but in places is loam. The B horizon ranges from 14 to 30 inches in thickness. It is heavy silty clay loam or silty clay. The C horizon is typically stratified silty clay loam and silt loam, but in places it has thin layers of silt, very

fine sandy loam, silty clay, and clay. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Saylesville soils are near Martinton, Montgomery, and Sisson soils. They are better drained and have fewer mottles than Martinton and Montgomery soils. They have more clay in the B and C horizons than Sisson soils.

ShA—Saylesville silt loam, 0 to 2 percent slopes. This nearly level soil is in old glacial lake basins and on terraces. Areas are irregularly shaped and range in size from 3 to more than 20 acres. This soil has a surface layer about 2 inches thicker than that of the soil described as representative of the series.

Included with this soil in mapping are small areas of Martinton, Montgomery, Sisson, and Zurich soils. Some areas of the wet Martinton and Montgomery soils are identified by spot symbols on the soil map. Also included in mapping are some small gently sloping areas.

Runoff is slow. Because this soil has moderately slow permeability in the substratum, water does not readily move through the soil and the soil dries slowly in spring and after periods of heavy rainfall. Removing surface water and preventing the entry of runoff from surrounding areas reduce the time required for the soil to dry.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIs–7; woodland group 2c1; wildlife group 2.

ShB—Saylesville silt loam, 2 to 6 percent slopes. This gently sloping soil is on the slopes of old glacial lake basins and on terraces. Areas are irregularly shaped and range in size from 3 to more than 80 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Martinton, Sisson, and Zurich soils. Some areas of the wet Martinton soils are identified by spot symbols on the soil map. Also included in mapping are small nearly level and sloping areas.

The hazard of erosion is slight. In some areas this soil dries slowly in spring and after periods of heavy rainfall. Controlling runoff and improving tilth help to control erosion. Diversions that prevent the entry of runoff from surrounding areas decrease wetness.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIe–6; woodland group 2c1; wildlife group 2.

SkC2—Saylesville silty clay loam, 6 to 12 percent slopes, eroded. This sloping soil is on side slopes and ridges in old glacial lake basins and on terraces. Areas are irregularly shaped and range in size from 3 to more than 20 acres. This soil has a profile similar to the one described as representative of the series, but 3 or 4 inches of the surface layer has been removed by erosion and the surface layer is therefore more clayey.

Included with this soil in mapping are small areas of Martinton, Sisson, and Zurich soils. Also included are small gently sloping areas and small severely eroded areas.

The hazard of erosion is moderate. Reducing runoff and improving tilth help to control further erosion.

If runoff is reduced, this soil is suited to all crops commonly grown in the county. It is also suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIIe–6; woodland group 2c1; wildlife group 2.

Sebewa Series

The Sebewa series consists of poorly drained, nearly level soils that are underlain by sand and gravel. These soils are on outwash plains. The native vegetation was deciduous forest and an understory of grasses.

In a representative profile the surface layer is very dark gray silt loam about 10 inches thick. The subsoil is about 23 inches thick and is mottled throughout. The upper 10 inches is grayish brown, firm silty clay loam; the next 9 inches is light gray, firm gravelly clay loam; and the lower 4 inches is grayish brown, friable gravelly sandy loam. The substratum to a depth of 60 inches is light brownish gray, stratified loose sand and gravel.

Permeability is moderate in the subsoil and rapid in the substratum. Available water capacity is moderate. Organic-matter content is high, and natural fertility is medium. The root zone is limited by the water table.

Most of the acreage is used for crops and pasture. Some is used for woodland.

Representative profile of Sebewa silt loam, slopes of 0 to 2 percent, in a cultivated area, 200 feet east and 1,040 feet north of the southwest corner of sec. 18, T. 15 N., R. 20 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silt loam; weak fine subangular blocky structure; friable; few roots; neutral; abrupt smooth boundary.

B21t—10 to 15 inches; grayish brown (10YR 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) mottles and many fine prominent yellowish brown (10YR 5/8) mottles; moderate fine subangular blocky structure; firm organic stains along root channels; few roots; neutral; abrupt smooth boundary.

B22t—15 to 20 inches; grayish brown (10YR 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/8) mottles and many fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin continuous clay films on faces of peds; few roots; neutral; clear smooth boundary.

IIB23tg—20 to 29 inches; light gray (10YR 6/1) gravelly clay loam; many medium prominent yellowish brown (10YR 5/6) mottles and medium fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; estimated 16 percent gravel by volume; clay films on faces of peds; mildly alkaline; gradual smooth boundary.

IIB3—29 to 33 inches; grayish brown (10YR 5/2) gravelly sandy loam; few fine prominent olive yellow (5Y 6/6) mottles and few medium prominent yellow (2.5Y 8/6) mottles; massive; friable; estimated 45 percent gravel by volume; slight effervescence; mildly alkaline; gradual smooth boundary.

IIC—33 to 60 inches; light brownish gray (10YR 6/2) stratified sand and gravel; single grained; loose; slight effervescence; mildly alkaline.

The solum ranges from 20 to 40 inches in thickness. The

A horizon is black, very dark brown, or very dark gray. It is typically 10 or more inches thick. It is generally silt loam, but in places is loam, clay loam, or sandy loam. The B horizon is 12 to 27 inches thick. It is silty clay loam or clay loam in the upper part and gravelly sandy loam or gravelly clay loam in the lower part. The IIC horizon is stratified sand and gravel. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Sebewa soils are near the Granby variant and Matherton and Navan soils. They are more gray than Matherton soils and are not so well drained as those soils. They are deeper and have more clay than the Granby variant. They have less clay in the lower part of the B horizon and in the C horizon than Navan soils.

Sm—Sebewa silt loam. This nearly level soil is along drainageways and in depressional areas on outwash plains. Areas are long or irregular in shape and range in size from 3 to more than 40 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Navan soils. Also included are some areas where the surface layer is muck.

This soil dries slowly in spring and after periods of heavy rainfall, and ponding occurs in places. Removing excess water is a major concern of management.

If adequately drained, this soil is moderately well suited to crops. It is suited to pasture and some types of woodland. Most of the acreage is used for crops and pasture, but some is used for woodland. Capability unit IIw–5; woodland group 4w2; wildlife group 7.

Sisson Series

The Sisson series consists of well drained, nearly level to steep soils that are underlain by stratified silt and very fine sand. These soils are in old glacial lake basins and on outwash plains. The native vegetation was deciduous forest and some white pine.

In a representative profile the surface layer is dark grayish brown very fine sandy loam about 8 inches thick. The subsurface layer is brown, friable very fine sandy loam about 2 inches thick. The subsoil is about 17 inches thick. The upper 13 inches is yellowish brown, firm clay loam, and the lower 4 inches is light yellowish brown, friable fine sandy loam. The substratum to a depth of 60 inches is light yellowish brown, stratified silt and very fine sand.

Permeability and available water capacity are moderate. Organic-matter content is moderate. Natural fertility is medium.

Most of the acreage is used for crops. Some is used for pasture and woodland.

Representative profile of Sisson very fine sandy loam, 2 to 6 percent slopes, in a cultivated area, 265 feet east and 2,175 feet south of the northwest corner of sec. 16, T. 16 N., R. 21 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) very fine sandy loam; moderate fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A2—8 to 10 inches; brown (10YR 5/3) very fine sandy loam; weak fine subangular blocky structure parting to weak thin platy; friable; yellowish brown (10YR 5/4) and dark grayish brown (10YR 4/2) worm casts; neutral; abrupt wavy boundary.

B21t—10 to 13 inches; yellowish brown (10YR 5/4) light clay loam; moderate medium subangular blocky structure; firm; thin patchy clay films on faces of peds; neutral; clear smooth boundary.

B22t—13 to 23 inches; yellowish brown (10YR 5/6) clay loam; moderate medium subangular blocky structure; firm; thin discontinuous clay films on faces of peds; neutral; clear smooth boundary.

B3—23 to 27 inches; light yellowish brown (10YR 6/4) fine sandy loam; weak fine subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

IIC—27 to 60 inches; light yellowish brown (10YR 6/4) stratified silt and very fine sand; massive; friable; slight effervescence; mildly alkaline.

The solum ranges from 24 to 42 inches in thickness. The A horizon is 6 to 20 inches thick. It is generally very fine sandy loam, but in places is loam. It is dark grayish brown, brown, or dark brown. The B horizon is 16 to 30 inches thick. The IIC horizon is stratified silt and very fine sand, but has thin lenses of sand or clay in places. The B horizon is slightly acid to mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Sisson soils are near Kibbie, Saylesville, and Yahara soils. They are better drained and have fewer mottles than Kibbie and Yahara soils. They have less silt in the B horizon than Saylesville soils.

SrA—Sisson very fine sandy loam, 0 to 2 percent slopes. This nearly level soil is in old glacial lake basins and on outwash plains. Areas are irregularly shaped and range in size from 3 to more than 100 acres. This soil is about 4 inches thicker than the soil described as representative of the series.

Included with this soil in mapping are small areas of Boyer, Hebron, Kibbie, and Yahara soils. Also included are small gently sloping areas, moderately well drained areas, and areas where the surface layer is loam or loamy sand.

This soil is well suited to all crops commonly grown in the county. It is also well suited to pasture and woodland. Most of the acreage is used for crop production, but some is used for pasture and woodland. Capability unit I–4; woodland group 1o1; wildlife group 1.

SrB—Sisson very fine sandy loam, 2 to 6 percent slopes. This gently sloping soil is in old glacial basins and on outwash plains. Areas are irregularly shaped and range in size from 3 to more than 60 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Boyer, Hebron, and Kibbie soils. Also included are areas where the surface layer is loam and small nearly level and sloping areas. In some areas clay is below a depth of 5 feet.

The hazards of soil blowing and erosion are slight. Reducing runoff helps to control soil blowing and erosion.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIe–1; woodland group 1o1; wildlife group 1.

SrC2—Sisson very fine sandy loam, 6 to 12 percent slopes, eroded. This sloping soil is on the sides of old glacial lake basins and on outwash plains. Areas are irregular or long in shape and range in size from 3 to more than 20 acres. This soil has a profile similar to the one described as representative of the series, but 3 to 6 inches of the original surface layer has been removed by erosion. Some of the subsoil is mixed in the plow layer.

Included with this soil in mapping are small areas of Boyer, Hebron, Kibbie, and Zurich soils. Also included are small gently sloping areas, areas where the surface layer is loam, and some areas where clay is below a depth of 5 feet.

This soil is subject to soil blowing in places. The hazard of erosion is moderate. Reducing runoff helps to control soil blowing and erosion.

If well managed, this soil is suited to all crops commonly grown in the county. It is also suited to pasture and hay. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIIe–1; woodland group 1o1; wildlife group 1.

Stony Land, Wet

Sw—Stony land, wet, is in drainageways and on foot slopes of drumlins. It is poorly drained loamy soil material that is very stony. Areas are irregularly shaped and range in size from 3 to more than 25 acres. Slopes are 2 to 6 percent. Included in mapping are small areas of Barry soils.

This land is not suited to crops because it is stony and wet. It is better suited to pasture and woodland. Capability unit Vw–16; woodland group 4w2; wildlife group 7.

Theresa Series

The Theresa series consists of nearly level to sloping, well drained soils that are underlain by gravelly sandy loam or gravelly loam glacial till. These soils are on glacial till plains. The native vegetation was a deciduous forest of mainly maple, oak, basswood, beech, and hickory.

In a representative profile the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 27 inches thick. The upper 3 inches is brown, friable silt loam; the next 5 inches is yellowish brown, firm light silty clay loam; and the lower 19 inches is brown, firm clay loam and gravelly clay loam. The substratum to a depth of 60 inches is very pale brown, friable gravelly sandy loam.

Permeability is moderate, and available water capacity is high. Organic-matter content is moderate, and natural fertility is medium.

Almost all of the acreage is used for crops. Some is used for woodland and pasture.

Representative profile of Theresa silt loam, 2 to 6 percent slopes, in a cultivated area, 130 feet west and 1,300 feet south of the northeast corner of sec. 13, T. 16 N., R. 20 E.

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

B1—8 to 11 inches; brown (10YR 4/3) silt loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; few roots; neutral; clear smooth boundary.

B21t—11 to 16 inches; yellowish brown (10YR 5/4) light silty clay loam; moderate fine subangular blocky structure; firm; thin discontinuous clay films on faces of peds; neutral; clear smooth boundary.

IIB22t—16 to 30 inches; brown (7.5YR 4/4) clay loam; weak coarse subangular blocky structure parting to moderate medium subangular blocky; firm; thin continuous clay films on faces of peds; neutral; gradual smooth boundary.

IIB3t—30 to 35 inches; brown (7.5YR 4/4) gravelly clay loam; weak medium subangular blocky structure; firm; estimated 16 percent gravel by volume; thick patchy clay films on faces of peds; slight effervescence; mildly alkaline; gradual wavy boundary.

IIC—35 to 60 inches; very pale brown (10YR 7/3) gravelly sandy loam; massive; friable; estimated 20 percent gravel by volume; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The silty material in the upper part is 10 to 22 inches thick. The B1 horizon is 3 to 6 inches thick. The B2t horizon is 4 to 10 inches thick. It is heavy silt loam or silty clay loam. The IIB2t and IIB3t horizons have a combined thickness of 11 to 20 inches. They are clay loam, gravelly clay loam, or heavy loam. The IIC horizon is loam, gravelly loam, or gravelly sandy loam. The IIC horizon has a calcium carbonate equivalent of 40 to 60 percent. The horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Theresa soils are near Hochheim, Lamartine, and Pella soils. They are not so gray as Lamartine and Pella soils and are better drained than those soils. They have more silt and a thicker solum than Hochheim soils.

ThA—Theresa silt loam, 0 to 2 percent slopes. This nearly level soil is on ground moraines. Areas are irregular or long in shape and range in size from 3 to more than 25 acres. This soil has a thicker surface layer than is representative for the series.

Included with this soil in mapping are small areas of Hochheim, Lamartine, Pella, and St. Charles soils. Many wet areas of the Lamartine and Pella soils are identified by spot symbols on the soil map. Also included in mapping are small gently sloping areas and moderately well drained areas.

This soil has no major limitations for crops. If fertility, organic-matter content, and good tilth are maintained, this soil can be cropped intensively. It is well suited to all crops commonly grown in the county. It is also well suited to woodland and pasture. Most of the acreage is used for crops. Capability unit I–4; woodland group 1o1; wildlife group 1.

ThB—Theresa silt loam, 2 to 6 percent slopes. This gently sloping soil is on ground moraines and the lower slopes of drumlins. Areas are irregular or long in shape and range in size from 3 to more than 100 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Lamartine soils. Many wet areas of the Lamartine soils are identified by spot symbols on the soil map. Also included in mapping are small nearly level and sloping areas and moderately well drained areas.

The hazard of erosion is slight. Controlling runoff and improving tilth help to control erosion.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops, but some is used for woodland and pasture. Capability unit IIe–1; woodland group 1o1; wildlife group 1.

ThC2—Theresa silt loam, 6 to 12 percent slopes, eroded. This sloping soil is on ground moraines and the sides of drumlins. Areas are long or irregular in shape and range in size from 3 to more than 20 acres. This soil has a profile similar to the one described as repre-

sentative of the series, but 3 or 4 inches of the surface layer has been removed by erosion.

Included with this soil in mapping are small areas of Lamartine soils. Also included are small gently sloping areas.

The hazard of erosion is moderate. Controlling runoff and increasing the organic-matter content help to control further erosion and improve tilth.

If well managed, this soil is suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops, but some is used for woodland and pasture. Capability unit IIIe–1; woodland group 1o1; wildlife group 1.

Wasepi Series

The Wasepi series consists of somewhat poorly drained, nearly level soils formed in sandy and loamy deposits underlain by sandy glacial outwash. These soils are in depressions and low-lying areas. The native vegetation was water-tolerant grasses and deciduous trees.

In a representative profile the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsoil is about 21 inches thick and is mottled throughout. The upper part is dark brown, very friable loamy sand; the next part is brown firm sandy clay loam; and the lower part is dark yellowish brown and brown, friable sandy loam. The substratum to a depth of 60 inches is brown and light brownish gray, loose sand and fine sand.

Permeability is moderately rapid in the subsoil and rapid in the substratum. Available water capacity is low. Organic-matter content is moderate, and natural fertility is low. The root zone is limited by the water table.

Most of the acreage is used for pasture and woodland. Some is used for crops.

Representative profile of Wasepi sandy loam, slopes of 0 to 2 percent, in an idle area, 850 feet south and 1,880 feet east of the northwest corner of sec. 32, T. 14 N., R. 22 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam; weak medium subangular blocky structure parting to moderate medium granular; friable; neutral; abrupt smooth boundary.

B1—8 to 14 inches; dark brown (10YR 4/3) loamy sand; common fine faint grayish brown (10YR 5/2) and prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; neutral; clear wavy boundary.

B21t—14 to 19 inches; brown (10YR 4/3) sandy clay loam; common medium distinct grayish brown (10YR 5/2) and prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin discontinuous clay films; neutral; clear wavy boundary.

B22t—19 to 22 inches; dark yellowish brown (10YR 4/4) sandy loam; common fine prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; few thin discontinuous brown (10YR 5/3) clay films; neutral; clear wavy boundary.

B3—22 to 29 inches; brown (10YR 4/3) sandy loam; few faint dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

IIC1—29 to 54 inches; brown (10YR 5/3) sand; single grained; loose; strong effervescence; mildly alkaline; clear smooth boundary.

IIC2—54 to 60 inches; light brownish gray (10YR 6/2) fine sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is generally sandy loam, but includes loamy sand or loam. It is very dark grayish brown or very dark brown. The B horizon ranges from 14 to 30 inches in thickness. It is gravelly in places. The IIC horizon is sand or stratified sand and gravel. The B horizon ranges from medium acid to mildly alkaline.

Wasepi soils are near Boyer, Granby, and Matherton soils. They are more gray than Boyer soils and are not so well drained as those soils. They are less gray than Granby soils and are not so poorly drained as those soils. They have less clay in the subsoil than Matherton soils.

Wa—Wasepi sandy loam. This nearly level soil is on old glacial lake plains and outwash plains. Areas are irregularly shaped and range in size from 3 to more than 40 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Boyer and Matherton soils. Also included are small gently sloping areas and areas where silt and clay are below a depth of 40 inches.

This soil has a high water table in spring and after periods of heavy rainfall. Removing excess water is the major concern of management.

This soil is poorly suited to crops commonly grown in the county. It is suited to pasture and some types of woodland. Most of the acreage is used for pasture and woodland, but some is used for crops. Capability unit IVw–5; woodland group 3o2; wildlife group 6.

Waymor Series

The Waymor series consists of well drained, nearly level to sloping soils formed in a thin silty and loamy layer over calcareous loamy glacial till. These soils are on glacial till plains. The native vegetation was deciduous forest and some white pine.

In a representative profile the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 22 inches thick. The upper 12 inches is reddish brown, firm silty clay loam, and the lower 10 inches is brown, firm light clay loam. The substratum to a depth of 60 inches is brown, friable loam.

Permeability is moderate, and available water capacity is high. Organic-matter content is moderate, and natural fertility is medium.

Most areas are used for cropland. Some are used for pasture and woodland.

Representative profile of Waymor silt loam, 2 to 6 percent slopes, in an idle area, 1,690 feet south and 2,450 feet west of the northeast corner of sec. 8, T. 15 N., R. 23 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam; moderate medium subangular blocky structure parting to moderate fine granular; friable; neutral; abrupt smooth boundary.

B2t—9 to 21 inches; reddish brown (5YR 4/3) silty clay loam; strong medium subangular blocky structure parting to strong fine angular blocky; firm; thin continuous clay films; some dark brown (7.5YR 4/2) worm casts; estimated 3 percent gravel by volume below 13 inches; neutral; gradual wavy boundary.

IIB3—21 to 31 inches; brown (7.5YR 4/4) light clay loam; moderate medium subangular blocky structure; firm; estimated 5 percent gravel by volume; slight effervescence; mildly alkaline; gradual wavy boundary.

IIC—31 to 60 inches; brown (7.5YR 5/4) loam; massive; friable; few fine distinct mottles of strong brown (7.5YR

5/6) between 42 and 48 inches; estimated 5 percent gravel by volume; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. The silty material in the upper part is 20 to 30 inches thick. The Ap horizon is 6 to 10 inches thick and is dark grayish brown or very dark grayish brown. The B horizon is 18 to 30 inches thick. The upper part is silt loam or silty clay loam, and the lower part is clay loam or loam. The IIC horizon is loam that is 5 to 15 percent gravel by volume. The B horizon is neutral to mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Waymor soils are near Kewaunee, Manawa, and Poygan soils. They have less clay in the B horizon than Kewaunee soils. They are better drained than Manawa and Poygan soils.

WbA—Waymor silt loam, 0 to 2 percent slopes. This nearly level soil is on broad glacial till plains. Areas are irregularly shaped and range in size from 3 to more than 25 acres. This soil has a thicker surface layer than is representative for the series.

Included with this soil in mapping are small areas of Hebron, Kewaunee, Manawa, and Poygan soils. Many areas of the wet Manawa and Poygan soils and some areas of the sandy Hebron soils are identified by spot symbols on the soil map. Also included in mapping are small sloping areas and some areas where the subsoil and substratum of this Waymor soil have more clay than is typical of the series.

This soil is well suited to all crops commonly grown in the county. It is also well suited to pasture and woodland. Most areas are used for crops. Some are used for pasture and woodland. Capability unit I–4; woodland group 1o1; wildlife group 1.

WbB—Waymor silt loam, 2 to 6 percent slopes. This gently sloping soil is on broad glacial till plains. Areas are irregularly shaped and range in size from 3 to more than 120 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Hebron, Kewaunee, and Poygan soils. Many areas of the wet Manawa and Poygan soils and some areas of the sandy Hebron soils are identified by spot symbols on the soil map. Also included in mapping are small nearly level and sloping areas and areas where the subsoil of this Waymor soil has more clay than is typical of the series.

The hazard of erosion is slight. Reducing runoff and increasing the organic-matter content help to control erosion and improve tilth.

This soil is moderately well suited to all the crops commonly grown in the county. It is well suited to pasture and woodland. Most of the acreage is used for crops. Some is used for pasture and woodland. Capability unit IIe–1; woodland group 1o1; wildlife group 1.

WbC2—Waymor silt loam, 4 to 12 percent slopes, eroded. This gently sloping and sloping soil is on breaks on glacial till plains. Areas are irregularly shaped and range in size from 3 to more than 20 acres. This soil has a profile similar to the one described as representative of the series, but one-third to two-thirds of the original surface layer has been removed by erosion. Some of the subsoil is mixed in the plow layer.

Included with this soil in mapping are small areas of Hebron and Kewaunee soils. Also included are small moderately steep areas, small severely eroded areas, and areas where the subsoil and substratum of this Waymor soil have a higher clay content than is typical of the series.

The hazard of erosion is moderate. Reducing runoff and increasing the organic-matter content help to reduce the risk of further erosion and improve tilth.

If well managed, this soil is suited to all crops commonly grown in the county. It is well suited to pasture and woodland. Most of the acreage is used for crops. Some is used for pasture and woodland. Capability unit IIIe–1; woodland group 1o1; wildlife group 1.

Willette Series

The Willette series consists of very poorly drained, nearly level soils formed in herbaceous organic material underlain by clayey sediments. These soils are in old glacial lake basins and depressions. The natural vegetation was marsh grasses, sedges, and cattails; elm and ash; and some white cedar and tamarack.

In a representative profile the organic layers are black and very dark gray muck about 24 inches thick. The next layer is olive gray sedimentary peat about 5 inches thick. The underlying mineral soil to a depth of about 60 inches is grayish brown, firm light silty clay.

Permeability is moderately rapid in the organic layers and slow in the clayey layer. Available water capacity is very high. Organic matter content is also very high. Natural fertility is low. The root zone is limited by the water table, which is at or near the surface.

Most of the acreage is used for woodland. Some is used for crops and pasture.

Representative profile of Willette muck, slopes of 0 to 2 percent, in a cultivated area, 700 feet south and 30 feet west of the northweast corner of sec. 15, T. 15 N., R. 22 E.

Oa1—0 to 6 inches; black (10YR 2/1 broken face and rubbed) sapric material; moderate fine subangular blocky structure; friable; many roots; neutral; abrupt smooth boundary.

Oa2—6 to 18 inches; black (10YR 2/1 broken face and rubbed) sapric material; moderate coarse subangular blocky structure; friable; many roots; neutral; clear smooth boundary.

Oa3—18 to 24 inches; very dark gray (10YR 3/1 broken face and rubbed) sapric material; weak very thick platy structure parting to moderate coarse subangular blocky; friable; common roots; neutral; abrupt smooth boundary.

Lco—24 to 29 inches; olive gray (5Y 5/2) coprogenous material; few fine distinct olive (5Y 5/4) mottles and few fine prominent light olive brown (2.5Y 5/4) mottles; massive; friable; slightly plastic; mildly alkaline; clear smooth boundary.

IICg—29 to 60 inches; grayish brown (2.5Y 5/2) light silty clay; common medium distinct light olive brown (2.5Y 5/4) mottles; massive; firm; strong effervescence; moderately alkaline.

The organic material ranges for 16 to 50 inches in thickness. It is 1 to 50 percent fiber, but is less than 5 percent after rubbing. The Lco horizon, if it occurs, is less than 6 inches thick. The IICg horizon is silty clay loam, silty clay, heavy clay loam, or clay. The organic material is slightly acid to mildly alkaline. The underlying mineral soil is mildly alkaline or moderately alkaline.

Willette soils are similar to Adrian, Houghton, and Palms soils. They have more clay in the underlying mineral material than Adrian and Palms soils. They differ from Houghton soil in having underlying clayey material within 51 inches of the surface.

We—Willette muck. This nearly level soil is in drainage basins and depressions. Areas are irregularly shaped and range in size from 3 to more than 100 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Adrian, Boots, Houghton, Palms, and Poygan soils. Also included are small gently sloping areas.

Wetness is the major limitation of this soil. If the soil is drained and cultivated, however, the hazard of soil blowing is slight and the soil is subject to subsidence and burning.

If adequately drained, this soil is suited to most crops commonly grown in the county. Most of the acreage is used for woodland, but some is drained and used for crops and pasture. Capability unit IIIw–8; woodland group 3w3; wildlife group 8.

Yahara Series

The Yahara series consists of somewhat poorly drained, nearly level and gently sloping soils that are underlain by lacustrine silt, very fine sand, and loam. These soils are in old glacial lake basins. The native vegetation was a deciduous forest of mainly soft maple, ash, elm, and red oak.

In a representative profile the surface layer is black very fine sandy loam about 7 inches thick. The subsoil is friable very fine sandy loam about 7 inches thick. It is brown in the upper part and yellowish brown in the lower part. It is mottled throughout. The substratum to a depth of 60 inches is light yellowish brown, stratified, very friable silt and very fine sand over brown, friable heavy loam.

Permeability is moderate. Available water capacity is high. Organic-matter content also is high. Natural fertility is medium. The root zone is limited by saturated soil during wet periods of the growing season.

Most of the acreage is used for crops. Some is used for pasture and woodland.

Representative profile of Yahara very fine sandy loam, 0 to 3 percent slopes, in a wooded area, 1,900 feet west and 1,100 feet south of the northeast corner of sec. 4, T. 16 N., R. 23 E.

A1—0 to 7 inches; black (10YR 2/1) very fine sandy loam; moderate medium granular structure; friable; common roots; mildly alkaline; gradual smooth boundary.

B21—7 to 10 inches; brown (10YR 4/3) very fine sandy loam; many fine faint grayish brown (10YR 5/2) mottles and few fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; many black (10YR 2/1) worm casts; common roots; mildly alkaline; clear wavy boundary.

B22—10 to 14 inches; yellowish brown (10YR 5/4) very fine sandy loam; few medium distinct brownish yellow (10YR 6/6) mottles and common fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; common roots; slight effervescence; mildly alkaline; clear wavy boundary.

C1—14 to 54 inches; light yellowish brown (10YR 6/4) stratified silt and very fine sand; few fine distinct brownish yellow (10YR 6/6) mottles; massive; very friable; strong effervescence; moderately alkaline; abrupt wavy boundary.

C2—54 to 60 inches; brown (7.5YR 5/4) heavy loam; common medium distinct reddish yellow (7.5YR 6/6) mottles, common medium prominent light gray (5Y 6/1) mottles, and few medium prominent pale olive (5Y 6/3) mottles; massive; friable; violent effervescence; moderately alkaline.

The solum ranges from 12 to 30 inches in thickness. The A1 or Ap horizon is 7 to 11 inches thick. It is black, very dark brown, very dark gray, or very dark grayish brown. It is generally very fine sandy loam, but in places is loam or silt loam. The B horizon is 7 to 19 inches thick. It is very fine sandy loam, loam, or silt loam. The C horizon is stratified silt and very fine sand and in places has very fine sandy loam. The B horizon ranges from slightly acid to mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Yahara soils in this survey area have a thinner solum and are shallower over free carbonates than is defined as the range for the series, but these differences do not alter use or management.

Yahara soils are similar to Colwood, Kibbie, and Sisson soils. They have less clay in the B horizon than Sisson soils and are not so well drained as those soils. They are better drained and have less clay in the B horizon than Colwood soils. They have less clay in the B horizon than Kibbie soils.

YhA—Yahara very fine sandy loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is in old glacial lake basins. Areas are irregularly shaped and range in size from 3 to more than 80 acres.

Included with this soil in mapping are small areas of Colwood, Hebron, Kibbie, and Sisson soils. Also included are some areas where strata of clay or clay loam are below a depth of 40 inches and some small well drained or poorly drained areas.

This soil dries slowly in spring and after periods of heavy rainfall, and ponding occurs in places. The soil is difficult to drain because the silt and very fine sand in the substratum tend to flow easily and fill tile lines.

If adequately drained, this soil is moderately well suited to most crops grown in the county. It is suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIw–4; woodland group 1o2; wildlife group 6.

Zurich Series

The Zurich series consists of well drained and moderately well drained, nearly level and gently sloping soils formed in silty sediments and stratified silt and very fine sand. These soils are in lacustrine basins and on outwash plains. The native vegetation was deciduous forest and some white pine.

In a representative profile the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 15 inches thick. The upper 13 inches is mainly dark yellowish brown, firm silty clay loam, and the lower 2 inches is pale brown, stratified, friable silt and very fine sand. The substratum to a depth of 60 inches is pale brown, stratified silt and very fine sand.

Permeability is moderate, and available water capacity is high. Organic-matter content is moderate, and natural fertility is medium.

Most of the acreage is used for crops. Some is used for pasture and woodland.

Representative profile of Zurich silt loam, 0 to 2 percent slopes, in a cultivated field, 1,300 feet west and 400 feet north of the southeast corner of sec. 31, T. 14 N., R. 21 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; weak medium subangular blocky structure parting to moderate medium granular; friable; neutral; abrupt smooth boundary.

B1—9 to 11 inches; yellowish brown (10YR 5/4) heavy silt

loam; moderate medium subangular blocky structure; friable; neutral; clear wavy boundary.

B2t—11 to 22 inches; dark yellowish brown (10YR 4/4) silty clay loam; strong fine subangular blocky structure; firm; thin clay films on faces of most peds; neutral; clear wavy boundary.

IIB3—22 to 24 inches; pale brown (10YR 6/3) stratified silt and very fine sand; few fine faint light gray (10YR 7/2) mottles and common fine prominent brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; friable; strong effervescence; mildly alkaline; abrupt wavy boundary.

IIC—24 to 60 inches; pale brown (10YR 6/3) stratified silt and very fine sand; few medium prominent brownish yellow (10YR 6/6) mottles; massive; very friable; slight effervescence; mildly alkaline.

The solum ranges from 20 to 40 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is very dark gray, very dark grayish brown, or dark grayish brown. The B horizon ranges from 10 to 30 inches in thickness. It is silt loam or silty clay loam in the upper part and loam or stratified silt and very fine sand in the lower part. The IIC horizon is stratified silt and very fine sand, and it has strata of silt loam or loam in places. The B horizon is slightly acid to mildly alkaline.

Zurich soils are similar to Sisson and Saylesville soils. They have less sand in the B horizon than Sisson soils and less clay in the B horizon than Saylesville soils.

ZuA—Zurich silt loam, 0 to 2 percent slopes. This nearly level soil is on old glacial lake plains. Areas are irregularly shaped and range in size from 3 to more than 20 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Kibbie, Saylesville, and Sisson soils. Also included are small gently sloping areas.

This soil has no major limitations for crops. It is well suited to all crops commonly grown in the county. It is also well suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit I-3; woodland group 1o1; wildlife group 1.

ZuB—Zurich silt loam, 2 to 6 percent slopes. This gently sloping soil is on old glacial lake plains. Areas are irregularly shaped and range in size from 3 to more than 20 acres. This soil is about 2 inches thinner than the soil described as representative of the series.

Included with this soil in mapping are small areas of Kibbie and Saylesville soils. Also included are small nearly level and sloping areas.

The hazard of erosion is slight. Reducing runoff helps to reduce erosion.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to pasture and woodland. Most of the acreage is used for crops. Capability unit IIe–1; woodland group 1o1; wildlife group 1.

Use and Management of the Soils

The following pages define general principles of management that apply to all soils used for farming in Sheboygan County. They explain the system of capability classification and list estimated yields per acre of the principal crops under a high level of management. Also on the pages that follow is information on woodland, wildlife habitat, and engineering and on selected uses of soils to be considered in planning recreational facilities.

Crops and Pasture

The crops commonly grown in the survey area are corn, oats, hay, forage crops, and such specialty crops as sweet corn and peas. In addition, a fairly large acreage is used for pasture.

The soils of Sheboygan County vary in their suitability for specific crops, and they require widely different management. Some management is needed for nearly all the soils. The following paragraphs define the management needed for maintaining fertility, providing drainage, controlling erosion, and renovating pastures. Specific management is suggested in the descriptions of capability units. Technical assistance in planning and applying management suitable for the soils on a particular farm can be obtained from a local representative of the Soil Conservation Service or the Extension Service.

Maintaining fertility.—Fertility can be maintained or increased by the use of a cropping system that provides for regular additions of organic matter and commercial fertilizer to the soils. Organic matter can be supplied by crop residue, green manure crops, or barnyard manure. Controlling erosion also helps to maintain fertility.

The organic-matter content of the soils in Sheboygan County ranges from less than 1 percent to more than 20 percent. Well decomposed organic matter, or humus, greatly affects the ability of a soil to hold fertility elements. The organic-matter content also influences the infiltration rate, tilth, and available water capacity of the surface layer. Suggested rates of application for many of the newer herbicides are based on the organic-matter content of the surface layer. Crop damage and weeds result where the rates have not been followed.

The general level of organic matter is listed for each soil series in the section "Descriptions of the Soils." A rating of very low indicates an organic-matter content of less than 0.5 percent; low, 0.5 to 1.0 percent; moderately low, 1.0 to 2.0 percent; medium, 2.0 to 4.0 percent; high, 4.0 to 8.0 percent; and very high, greater than 8.0 percent.

The amount and kind of commercial fertilizer to apply depends on the supply of plant nutrients in the soil, the ability of the soil to hold nutrients, the available water capacity, the kinds of crops to be grown, and the crop rotation. Where the need for lime and fertilizer is indicated in the suggestions for management, the amount of lime and the kind and amount of fertilizer to apply should be determined by soil tests. Indirect benefits from higher levels of soil fertility include the production of more plant litter and organic matter, which reduce the risk of erosion and promote good soil tilth.

Any given field may contain several soils that differ in reaction. Generally, the deep, well drained, permeable soils, such as those of the St. Charles series, require the heaviest applications of lime. Shallow soils, such as those of the Casco or Hochheim series, require

lesser amounts. Poorly drained soils, such as those of the Pella series, generally require little or no lime.

Available water capacity is important in determining levels of fertilization and population of plants where no irrigation is planned. As an example, assuming that alfalfa and corn require 0.30 inch of water per day during their peak use period, the number of days that a given soil supports these crops without rainfall can be determined. Soils that have a high available water capacity (between 9 and 12 inches) support these crops for 30 to 40 days without rainfall if the moisture content of the soils is at field capacity at the start of this period. In contrast, soils that have a low available water capacity (between 3 and 6 inches) support these crops for only 10 to 20 days without rainfall under similar conditions. A high level of fertilization is generally not justified on soils that have very low or low available water capacity because crop growth is limited by the available water capacity. In addition, these soils are coarse textured or have a thin solum. Excessive nitrate fertilizer added to these soils can be quickly leached from the soil and can contaminate surface or ground water.

Ratings of available water capacity to a depth of 5 feet or to bedrock are given in the capability unit descriptions and in the section "Descriptions of the Soils." These ratings are defined in the Glossary.

Providing drainage.—Drainage can be improved in most of the wet soils in the county if there are suitable outlets. Surface drains, tile drains, open ditch drains, or a combination of these are used. Diversions can be used in places to protect soils from runoff from adjacent areas. Soils on flood plains require protection from flooding.

Barry, Kendall, Manawa, Pella, Poygan, and other soils respond well to both surface and tile drainage. Colwood, Granby, Kibbie, Yahara, and other soils generally are not suited to tile drainage unless the entry of silt and fine sand into the tile lines is prevented. These soils respond well to surface and open ditch drainage. The organic Adrian and Edwards soils generally are not suited to tile drainage because Adrian soils contain loose sand and Edwards soils have slow permeability. Both soils respond well to open ditch drainage. The organic Houghton, Muskego, Palms, and Willette soils respond well to both tile and open ditch drainage.

Several hazards result when organic soils are drained. One is subsidence, or the loss of surface elevation. This loss is approximately ½ to 1 inch per year in Wisconsin. The subsidence potential is high in Adrian, Edwards, Palms, and Willette soils and very high in Boots, Houghton, and Muskego soils. Subsidence is attributed mainly to four factors: loss of ground water buoyancy, consolidation, compaction, and biochemical activity. Elevation loss from the first three factors, which is termed *initial subsidence,* normally occurs about 3 years after the lowering of the water table. Initial subsidence typically results in a reduction by about one-half of the thickness of the organic material above the water table. After initial subsidence, shrinkage continues at a fairly uniform rate because of biochemical oxidation of the organic material. This shrinkage, which is termed *continued subsidence,* goes on until mineral material or the water table is reached. The rate of continued subsidence depends upon the height of the water table. Subsidence can be stopped by maintaining the water level at the surface. It can be slowed by maintaining the water level as high as possible for the intended land use.

Controlling erosion.—Many of the soils in the county are moderately eroded. Examples are Hochheim silt loam and Kewaunee silty clay loam. Most of the soil loss is the result of sheet and rill erosion, although some gullying also occurs.

Terracing, grassed waterways, stripcropping (fig. 6), contour tillage, sod crops or cover crops in rotations, and mulching with crop residue help to control erosion.

Also effective in controlling erosion is minimum tillage. On soils used for row crops, this practice reduces the risk of erosion to a minimum. In the latest refinement of minimum tillage, a minimum area of soil is disturbed. Special no-till planters knives open the seedbed, place the seed and starter fertilizer, close the seedbed, and apply a herbicide all in one operation. The use of the proper kind and amount of herbicide is very important in minimum tillage. If not controlled by the herbicide, weeds must be controlled by cultivation, thus reducing the effectiveness of the original minimum tillage operation.

Some soils in the county are subject to soil blowing. Soil blowing is especially evident in well drained sandy soils, such as Boyer and Oakville soils. It is also evident in drained areas of organic soils, such as Houghton soils, and wet sandy soils, such as Granby soils. Stripcropping at right angles to the direction of prevailing winds, stubble mulching, leaving crop residue on the surface, growing cover crops or meadow crops, establishing shelterbelts, and controlling drainage in organic soils and wet sandy soils help to control soil blowing. Many of these practices also help to catch snow and add moisture to the soil.

Renovating pastures.—Renovation is needed on most upland pastures on well drained soils assigned to capability classes II, III, IV, and VI. A good seedbed should be prepared and seeded with a suitable mixture of grasses and legumes. Examples of suitable mixtures for seeding are alfalfa mixed with bromegrass or birdsfoot trefoil mixed with bromegrass.

Large amounts of phosphorus and potassium are needed at the time of seeding. Nitrogen should be applied as a topdressing, especially if grasses are dominant in the pasture. Annual applications of fertilizer or renovation of permanent pasture every 5 years helps to maintain good quality forage. Rotation of grazing protects and extends the life of the forage plants.

In Sheboygan County the soils assigned to capability class V have a high water table and are subject to flooding or seepage or are stony. Tillage is not practical, and renovation is not feasible. These soils are generally in pastures of Kentucky bluegrass, reed canarygrass, or bromegrass. These pastures should be grazed only in dry periods; hummocks, which hinder surface drainage, form if the pastures are grazed when the soil is wet.

Figure 6.—Stripcropping on gently sloping Hochheim soils.

Pastures on soils assigned to capability class VI are difficult to renovate, and those assigned to class VII are not suitable for renovation. Where tillage is not practical, the soils are generally in native vegetation. Controlled grazing and the addition of commercial fertilizer help to maintain plant cover.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops (*28*). The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for forest trees or engineering.

In the capability system, all kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These levels are described 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, defined as follows:

Class I soils have few limitations that restrict their use.

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

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

Class IV soils have very severe limitations that reduce the choice of plants, 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 largely to pasture, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to pasture, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial crop

production and restrict their use to recreation, wildlife, or water supply or to esthetic purposes.

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 but not in Sheboygan County, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–6 or IIIe–1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

On the following pages, the capability units in Sheboygan County are described and suggestions for use and management of the soils in each unit are given. The capability units are not numbered consecutively, because not all of the units used in Wisconsin are in this county. To find the names of all the soils in any given capability unit, refer to the Guide to Mapping Units at the back of this survey.

CAPABILITY UNIT I–2

Juneau silt loam, 0 to 3 percent slopes, is the only soil in this unit. It is nearly level and gently sloping and well drained or moderately well drained. Permeability is moderate, and available water capacity is very high. Natural fertility is high. Runoff is slow, and the hazard of erosion is slight. The soil is subject to occasional overflow of short duration.

This soil is well suited to corn, soybeans, small grain, legumes, and vegetables and can be used intensively for these crops. It can support a large population of plants. It is also well suited to pasture. Response to fertilization is good. If the soil is protected from overflow and adequately fertilized and minimum tillage is used to return the crop residue, row crops can be grown year after year without deterioration of soil tilth or serious decrease in organic-matter content.

CAPABILITY UNIT I–3

This unit consists of nearly level, well drained and moderately well drained silty soils. These soils are moderately permeable. Available water capacity is high. Natural fertility is medium or high. Runoff is slow, and the hazard of erosion is slight. In some areas the soils are saturated at a depth of 3 to 5 feet during wet periods. These soils are easily worked and have few limitations.

These soils are well suited to corn, soybeans, small grain, legumes, and vegetables and can be used intensively for these crops. They can support a large population of plants. They are also well suited to pasture. Response to fertilization is good. If these soils are properly fertilized and minimum tillage is used to return the crop residue, row crops can be grown year after year without deterioration of soil tilth or serious decrease in organic-matter content.

CAPABILITY UNIT I–4

This unit consists of nearly level, well drained silty or loamy soils. These soils are moderately permeable. Available water capacity is moderate or high. Natural fertility is medium. Runoff is slow, and the hazard of erosion is slight. These soils are easily worked and have few limitations.

These soils are well suited to corn, soybeans, small grain, legumes, and vegetables and can be used intensively for these crops. They can support a large population of plants. They are also well suited to pasture. Response to fertilization is generally good, but the soils that have moderate available water capacity do not respond so well as the other soils. If these soils are properly fertilized and minimum tillage is used to return the crop residue, row crops can be grown year after year without deterioration of soil tilth or serious decrease in organic-matter content.

CAPABILITY UNIT IIe–1

This unit consists of nearly level and gently sloping, well drained and moderately well drained silty and loamy soils. These soils are moderately permeable. Available water capacity is low, moderate, or high. Natural fertility is medium to high.

In some areas these soils are saturated at a depth of 3 to 5 feet during wet periods. In most areas they are subject to only slight erosion, but in some cultivated areas they have lost as much as 4 inches of the original surface layer. Crop rotations, contour farming, stripcropping, diversions, terraces, minimum tillage, and good management of residue help to control erosion and maintain good tilth. These soils are easily worked if they are not eroded.

If well managed, these soils are moderately well suited to corn, soybeans, small grain, legumes, and vegetables. They are well suited to pasture. These soils can support a large population of plants. Response to heavy applications of fertilizer is good, but the soils that have low available water capacity do not respond so well as the other soils.

CAPABILITY UNIT IIe-2

Fox silt loam, 2 to 6 percent slopes, is the only soil in this unit. It is well drained. It is moderately permeable in the subsoil and very rapidly permeable in the substratum. Available water capacity is moderate. Natural fertility is medium.

This soil is not saturated long enough for the excess water to adversely affect plant growth. The root zone is generally limited by gravel and sand. In most areas the soil is subject to only slight erosion, but in some areas it has lost as much as 4 inches of the original surface layer. Crop rotations, contour stripcropping, diversions, terraces, minimum tillage, and good management of residue help to control erosion and maintain tilth. This soil is easily worked if it is not eroded.

If well managed, this soil is moderately well suited to corn, soybeans, small grain, legumes, and vegetables. It is well suited to pasture.

CAPABILITY UNIT IIe-6

This unit consists of gently sloping, well drained and moderately well drained silty and loamy soils. These soils are moderately slowly permeable. Available water capacity is moderate or high. Natural fertility is medium.

In some areas these soils are saturated at a depth of 3 to 5 feet during wet periods. They are subject to slight or moderate erosion. In some cultivated areas they have lost as much as 6 inches of the original surface layer through erosion. Rainwater does not readily enter the soils that have a clayey subsoil, and the surface layer is easily eroded. Tilth is poor where erosion has removed the surface layer and exposed the subsoil. These soils dry slowly in spring and are ponded in low spots after heavy rainfall. Crop rotations, contour stripcropping, diversions, surface drainage, terraces, minimum tillage, and good management of residue help to control erosion, remove excess water, and maintain good tilth. These soils are easily worked if they are not eroded.

If well managed, these soils are moderately well suited to corn, soybeans, small grain, legumes, and vegetables. They are well suited to pasture.

CAPABILITY UNIT IIe-7

Hebron sandy loam, sandy subsoil variant, 2 to 6 percent slopes, is the only soil in this unit. It is well drained and moderately well drained. It is moderately rapidly permeable in the upper part and moderately slowly permeable in the lower part of the clayey subsoil and in the substratum. Available water capacity is moderate. Natural fertility is low.

In some areas this soil is saturated at a depth of 3 to 5 feet during wet periods. This soil is subject to only slight erosion and soil blowing, but in some cropped areas it has lost as much as 4 inches of the original surface layer. Because of the clayey subsoil, rainwater does not readily pass through the soil. The soil dries slowly in spring and is ponded in low spots after heavy rainfall. Crop rotations, contour stripcropping, windbreaks, diversions, surface drainage, terraces, minimum tillage, and good management of residue help to control erosion and soil blowing, remove excess water, and maintain good tilth. The soil is easily worked if it is not eroded.

If well managed, this soil is moderately well suited to corn, soybeans, small grain, legumes, and vegetables. It is well suited to pasture.

CAPABILITY UNT IIw-1

This unit consists of nearly level, poorly drained and very poorly drained silty and loamy soils. These soils are moderately permeable or slowly permeable. Available water capacity is moderate, high, or very high.

Unless these soils are drained, ground water is at or near the surface throughout the year. The soils receive runoff from adjoining areas and are subject to overflow and ponding unless protected. Tile drains and deep ditches can be used to lower the water table if suitable outlets are available. If tile drains are installed in the soils that are underlain by stratified coarse silt and very fine sand, precautions must be taken to prevent loose sand from entering and clogging the tile lines.

If drained and protected from flooding, these soils are moderately well suited to corn, soybeans, small grain, legumes, and certain vegetables. They can support a large population of plants. Response to heavy applications of fertilizer is good. If the soils are properly fertilized and minimum tillage is used to return the crop residue, row crops can be grown year after year without deterioration of soil tilth or serious decrease in organic-matter content. Undrained areas are suited to pasture or wetland wildlife habitat.

CAPABILITY UNIT IIw-2

This unit consists of nearly level and gently sloping, somewhat poorly drained silty and loamy soils. These soils are moderately permeable, moderately slowly permeable, or slowly permeable. Available water capacity is moderate or high. Natural fertility is medium or high.

Unless drained, these soils are saturated at a depth of 1 foot to 3 feet during wet periods. They receive runoff from adjoining areas. Some areas are subject to ponding during wet periods and after heavy rainfall. Tile drains and deep ditches can be used to remove excess water if suitable outlets are available. Where tile drains are installed in the soils that are underlain by stratified silt and very fine sand, precautions must be taken to prevent loose silt and sand from entering and clogging the tile lines. Diversions and grassed waterways intercept and safely remove runoff from adjoining areas. Surface drainage prevents ponding. Cultivation at the proper moisture content, minimum tillage, and good management of residue help to maintain good tilth.

If drained and protected from flooding, these soils are moderately well suited to corn, soybeans, small grain, legumes, and certain vegetables. They can support a large population of plants. Response to heavy applications of fertilizer is good. If the soils are properly fertilized and minimum tillage is used to return the crop residue, row crops can be grown year after year without deterioration of soil tilth or serious decrease in organic-matter content. Undrained areas are suited to pasture or wetland wildlife habitat.

CAPABILITY UNIT IIw-4

Yahara very fine sandy loam, 0 to 3 percent slopes, is the only soil in this unit. It is somewhat poorly

drained. It is moderately permeable. Available water capacity is high. Natural fertility is medium.

Unless drained, this soil is saturated at a depth of 1 to 3 feet during wet periods. It dries slowly in spring and after periods of heavy rainfall. It receives runoff from adjoining areas. Some areas are subject to ponding during wet periods and after heavy rainfall. Deep ditches can be used to lower the water table if suitable outlets are available. Tile drainage is questionable. If tile drains are installed, precautions must be taken to prevent loose silt and very fine sand from entering and clogging the tile lines. Diversions and grassed waterways intercept and safely remove runoff from adjoining areas. Surface drainage prevents ponding. Cultivation at the proper moisture content, minimum tillage, and good management of residue help to maintain good tilth.

If drained and protected from flooding, this soil is moderately well suited to corn, soybeans, small grain, legumes, and certain vegetables. If the soil is properly fertilized and minimum tillage is used to return the crop residue, row crops can be grown year after year without deterioration of soil tilth or serious decrease in organic-matter content. Undrained areas can be used for crops, but wetness often delays planting in spring and harvesting in fall. Poor seedbed preparation because of wetness and the shallow root zone caused by seasonal saturation generally result in crop yields that are considerably lower than for drained areas. Undrained areas are suited to pasture or wetland wildlife habitat.

CAPABILITY UNIT IIw–5

This unit consists of nearly level and gently sloping, somewhat poorly drained or poorly drained silty and loamy soils. These soils are moderately permeable or moderately rapidly permeable in the subsoil and moderately rapidly permeable, rapidly permeable, or very rapidly permeable in the substratum. Available water capacity is low or moderate. Natural fertility is low or medium.

Unless these soils are drained, they have ground water at or near the surface throughout the year in some areas and in other areas are saturated at a depth of 1 foot to 3 feet during wet periods. The soils receive runoff from adjoining areas. Some areas are subject to flooding and ponding during wet periods and after heavy rainfall. Deep ditches can be used to lower the water table if suitable outlets are available. Tile drainage is questionable. If tile drains are installed, precautions must be taken to prevent loose sand from entering the tile lines. Diversions and grassed waterways intercept and safely remove runoff from adjoining areas. Surface drainage prevents ponding. Cultivation at the proper moisture content, minimum tillage, and good management of residue help to maintain good tilth.

If drained and protected from flooding, these soils are moderately well suited to corn, soybeans, small grain, legumes, and certain vegetables. If the soils are properly fertilized and minimum tillage is used to return the crop residue, row crops can be grown year after year without deterioration of soil tilth or serious decrease in organic-matter content. Undrained areas of the somewhat poorly drained soils can be used for crops, but poor seedbed preparation because of wetness and the shallow root zone caused by seasonal saturation generally result in crop yields that are considerably lower than for drained areas. Undrained areas are suited to pasture or wetland wildlife habitat.

CAPABILITY UNIT IIw–8

Palms muck is the only soil in this unit. It is a nearly level, very poorly drained organic soil. It is moderately rapidly permeable in the muck layer and moderately permeable in the substratum. Available water capacity is very high. Natural fertility is low.

Unless this soil is drained, ground water is at or near the surface throughout the year. The soil receives runoff from adjoining areas and is subject to ponding and overflow. Tile drains and deep ditches can be used to lower the water table if suitable outlets are available. Diversions and grassed waterways intercept and safely remove runoff from adjoining areas. Surface drainage prevents ponding. Where drained, this soil is subject to soil blowing, burning, and subsidence.

If properly drained and protected from flooding and soil blowing, this soil is moderately well suited to corn and certain vegetables. This soil can support a large population of plants. Response to fertilization is good. If the soil is properly fertilized and well managed, row crops can be grown for many years but oxidation and subsidence eventually destroy the organic layer. Undrained areas can be used for pasture, but they are better suited to wetland wildlife habitat.

CAPABILITY UNIT IIw–11

Bellevue silt loam is the only soil in this unit. It is nearly level and is well drained and moderately well drained. It is moderately permeable. Available water capacity is high. Natural fertility is high.

In some areas this soil is saturated at a depth of 3 to 5 feet during wet periods. The soil receives runoff from surrounding areas and is subject to occasional flooding and streambank cutting during wet periods and after heavy rainfall. Diversions and grassed waterways intercept and safely remove runoff from adjoining areas. Surface drainage prevents ponding. Cultivation at the proper moisture content, minimum tillage, and good management of residue help to maintain good tilth.

If protected from flooding, this soil is moderately well suited to corn, soybeans, small grain, legumes, and certain vegetables. It is well suited to pasture. The soil can support a large population of plants. Response to heavy applications of fertilizer is good. If the soil is properly fertilized and minimum tillage is used to return the crop residue, row crops can be grown year after year without deterioration of soil tilth or serious decrease in organic-matter content.

CAPABILITY UNIT IIw–13

This unit consists of poorly drained silty soils and well drained and moderately well drained loamy and sandy alluvial land. The silty soils are moderately permeable in the upper part and rapidly permeable and moderately rapidly permeable in the lower part. Available water capacity is very high. Natural fertility is high. The alluvial land is too variable to be rated for permeability, available water capacity, or natural fertility.

In some areas the soils are saturated at the surface or at a depth of 1 foot during wet periods. The soils and the land type receive runoff from surrounding areas and are subject to flooding and ponding during wet periods and after heavy rainfall. Diversions and grassed waterways intercept and safely remove surface water and prevent ponding. Cultivation at the proper moisture content, minimum tillage, and management of residue help to maintain good tilth.

If properly drained and protected from flooding, the soils and the land type are moderately well suited to corn and hay. Undrained areas can be used for pasture, but they are better suited to wetland wildlife habitat.

CAPABILITY UNIT IIs–1

Fox silt loam, 0 to 2 percent slopes, is the only soil in this unit. It is well drained. It is moderately permeable in the subsoil and very rapidly permeable in the substratum. Available water capacity is moderate. Natural fertility is medium.

This soil is not saturated long enough for the excess water to adversely affect plant growth. The root zone is generally limited by gravel and sand. The soil is slightly droughty. It is not subject to erosion.

If well managed, this soil is moderately well suited to corn, soybeans, small grain, legumes, and vegetables. It is well suited to pasture. Response to fertilization is limited by the moderate available water capacity. If the soil is properly fertilized and minimum tillage is used to return the crop residue, row crops can be grown year after year without deterioration of soil tilth or serious decrease in organic-matter content.

CAPABILITY UNT IIs–7

This unit consists of nearly level, well drained and moderately well drained silty and loamy soils. These soils are moderately permeable, moderately rapidly permeable, or moderately slowly permeable in the upper part and moderately slowly permeable in the substratum. Available water capacity is moderate or high. Natural fertility is medium or low.

In some areas these soils are saturated at a depth of 3 to 5 feet during wet periods. Rainwater does not readily pass through the soils that have a clayey subsoil. The soils dry slowly in spring and are ponded in low spots after heavy rainfall. They are not subject to erosion.

If well managed, these soils are moderately well suited to corn, soybeans, small grain, legumes, and vegetables. They are well suited to pasture. The soils that have moderate available water capacity do not respond to fertilization so well as the other soils. If the soils are properly fertilized and minimum tillage is used to return the crop residue, row crops can be grown year after year without deterioration of soil tilth or serious decrease in organic-matter content.

CAPABILITY UNIT IIIe–1

This unit consists of nearly level to sloping, well drained silty and loamy soils. These soils are mostly moderately permeable or moderately rapidly permeable. The soils underlain by stratified gravel and sand are very rapidly permeable in the substratum. Available water capacity is low, moderate, or high. Natural fertility is low or medium.

These soils are subject to moderate erosion and in many cropped areas have lost as much as 4 inches of the original surface layer. Crop rotations, close growing crops, contour farming, stripcropping, diversions, terraces, grassed waterways, minimum tillage, and good management of residue help to control erosion and maintain good tilth.

If well managed, these soils are suited to corn, soybeans, small grain, and legumes. They are well suited to pasture. The soils that have low or moderate available water capacity do not respond to fertilization so well as the other soils.

CAPABILITY UNIT IIIe–2

Fox silt loam, 6 to 12 percent slopes, eroded, is the only soil in this unit. It is well drained. It is moderately permeable in the subsoil and very rapidly permeable in the substratum. Available water capacity is moderate. Natural fertility is medium.

This soil is not saturated long enough for the excess water to adversely affect plant growth. The root zone is generally limited by gravel and sand. The soil is subject to moderate erosion and in some areas has lost as much as 4 inches of the original surface layer. Crop rotations, close growing crops, contour farming, stripcropping, diversions, terraces, grassed waterways, minimum tillage, and good management of residue help to control erosion and maintain good tilth.

If well managed, this soil is suited to corn, soybeans, small grain, and legumes. It is well suited to pasture.

CAPABILITY UNIT IIIe–3

Casco loam, 2 to 6 percent slopes, is the only soil in this unit. It is well drained. It is moderately permeable in the subsoil and very rapidly permeable in the substratum. Available water capacity is low. Natural fertility is low.

This soil is not saturated long enough for the excess water to adversely affect plant growth. In most areas it is subject to only slight erosion, but in some cultivated areas it has lost as much as 4 inches of the original surface layer. Crop rotations, contour farming, stripcropping, diversions, terraces, grassed waterways, minimum tillage, and good management of residue help to control erosion, increase infiltration, and maintain good tilth. Tillage is limited by gravel in some areas. The suitability of this soil for crops is limited by the low available water capacity and the need for heavy fertilization.

If well managed, this soil is suited to corn, soybeans, small grain, and hay. It is also suited to pasture.

CAPABILITY UNIT IIIe–6

This unit consists of nearly level to sloping silty and clayey soils. These soils are poorly drained to well drained. Permeability is moderately slow. Available water capacity is moderate or high. Natural fertility is low or medium.

Some areas are saturated at or near the surface. The soils are generally saturated at a depth of 3 to 5 feet during wet periods. The soils are subject to moderate erosion and in some cultivated areas have lost as much as 6 inches of the original surface layer. Rainwater does not readily enter the soils that have a clayey subsoil, and the surface layer is easily eroded. Tilth is poor

where erosion has removed the surface layer and exposed the subsoil. The soils dry slowly in spring and after heavy rainfall. Crop rotations, contour stripcropping, diversions, surface drainage, terraces, minimum tillage, and good management of residue help to control erosion, remove excess water, and maintain good tilth. These soils are easily worked if they are not eroded.

If well managed, these soils are suited to corn, soybeans, small grain, legumes, and vegetables. They are well suited to pasture.

CAPABILITY UNIT IIIe-7

Boyer loamy sand, 6 to 12 percent slopes, eroded, is the only soil in this unit. It is well drained. Permeability is moderately rapid in the subsoil and very rapid in the substratum. Available water capacity is low. Natural fertility is low.

This soil is not saturated long enough for the excess water to adversely affect plant growth. It is subject to moderate erosion and in some cultivated areas has lost as much as 6 inches of the original surface layer. The soil is also subject to soil blowing. Crop rotations, close growing crops, contour farming, stripcropping, diversions, terraces, windbreaks, minimum tillage, and good management of residue help to control erosion and soil blowing and maintain available water capacity and organic-matter content. The suitability of this soil for crops is limited by the low available water capacity and the need for heavy fertilization.

If well managed, this soil is suited to corn, soybeans, small grain, and hay. It is also suited to pasture.

CAPABILITY UNIT IIIw-8

Willette muck is the only soil in this unit. It is a nearly level, very poorly drained organic soil. It is moderately rapidly permeable in the muck layer and slowly permeable in the substratum. Available water capacity is very high. Natural fertility is low.

Unless this soil is drained, ground water is at or near the surface throughout the year. The soil receives runoff from adjoining areas and is subject to overflow and ponding. Tile drains and deep ditches can be used to lower the water table if suitable outlets are available. Where tile drainage is used, the tile should be placed in the organic material because of the slow permeability in the clayey substratum. If the tile must be placed in the clayey substratum, backfilling with porous material helps the tile to function. Diversions and grassed waterways intercept and safely remove runoff from adjoining areas. Surface drains prevent ponding. Where drained, this soil is subject to soil blowing, burning, and subsisdence.

If properly drained and protected from flooding and soil blowing, this soil is well suited to corn and certain vegetables. It can support a large population of plants. Response to fertilization is good. If the soil is properly fertilized and well managed, row crops can be grown for many years, but oxidation and subsidence eventually destroy the organic layer. Undrained areas can be used for pasture, but they are better suited to wetland wildlife habitat.

CAPABILITY UNIT IIIw-9

This unit consists of nearly level, very poorly drained organic soils. These soils are moderately rapidly permeable. Available water capacity is very high. Natural fertility is low.

Unless these soils are drained, ground water is at or near the surface throughout the year. The soils receive runoff from adjoining areas, and some areas are subject to ponding and overflow. Tile drains and deep ditches can be used to lower the water table if suitable outlets are available. Diversions and grassed waterways intercept and safely remove runoff from adjoining areas. Surface drainage prevents ponding. If drained, the soils are subject to soil blowing, burning, and subsidence. If the water table is lowered excessively, they are subject to rapid subsidence.

If properly drained and protected from flooding and soil blowing, these soils are moderately well suited to corn and certain vegetables. They can support a large population of plants. Response to fertilization is good. If the soils are properly fertilized and well managed, row crops can be grown for many years, but oxidation and subsidence reduce the thickness of the organic layer. Undrained areas can be used for pasture, but they are better suited to wetland wildlife habitat.

CAPABILITY UNIT IIIw-12

Bellevue fine sandy loam, sandy subsoil variant, is the only soil in this unit. It is nearly level and well drained and moderately well drained. It is moderately rapidly permeable. Available water capacity is moderate. Natural fertility is medium.

In some areas this soil is saturated at a depth of 3 to 5 feet during wet periods. The soil receives runoff from adjoining areas and is subject to flooding and streambank cutting during wet periods and after heavy rains. Diversions and grassed waterways can be used to intercept and safely remove runoff from adjoining areas. Surface drainage prevents ponding. Cultivation at the proper moisture content, minimum tillage, and good management of residue help to maintain good tilth.

If protected from flooding, this soil is moderately well suited to corn, soybeans, small grain, legumes, and certain vegetables. It is well suited to pasture. Response to heavy applications of fertilizer is limited by the moderate available water capacity. If the soil is properly fertilized and minimum tillage is used to return the crop residue, row crops can be grown year after year without deterioration of soil tilth or serious decrease in organic-matter content.

CAPABILITY UNIT IIIs-4

Boyer loamy sand, 2 to 6 percent slopes, is the only soil in this unit. It is well drained. Permeability is moderately rapid in the subsoil and very rapid in the substratum. Available water capacity is low. Natural fertility is low.

This soil is not saturated long enough for the excess water to adversely affect plant growth. In most areas it is subject to only slight erosion, but in some cultivated areas it has lost as much as 4 inches of the original surface layer. The soil is also subject to soil blowing. Crop rotations, close growing crops, contour farming, stripcropping, diversions, terraces, windbreaks, minimum tillage, and good management of residue help to control erosion and soil blowing and

maintain available water capacity and organic-matter content. The suitability of this soil for crops is limited by the low available water capacity and the need for heavy fertilization.

If well managed, this soil is suited to corn, soybeans, small grain, and hay. It is also suited to pasture.

CAPABILITY UNIT IIIs-8

Casco loam, 0 to 2 percent slopes, is the only soil in this unit. It is well drained. It is moderately permeable in the subsoil and very rapidly permeable in the substratum. Available water capacity and natural fertility are low.

This soil is not saturated long enough for the excess water to adversely affect plant growth. The root zone is generally limited by gravel and sand. The soil is subject to slight erosion. Crop rotations, contour farming, stripcropping, diversions, terraces, grassed waterways, minimum tillage, and good management of residue help to control erosion, increase infiltration, and maintain good tilth. The suitability of this soil for crops is limited by the low available water capacity and the expense of heavy fertilization.

If well managed, this soil is suited to corn, soybeans, small grain, and hay. It is also suited to pasture.

CAPABILITY UNIT IVe-1

This unit consists of moderately steep, well drained silty and loamy soils. The soils underlain by stratified gravel and sand are rapidly permeable in the substratum. The rest are moderately permeable. Available water capacity is low or moderate. Natural fertility is low or medium.

These soils are not saturated long enough for the excess water to adversely affect plant growth. They are subject to severe erosion and are difficult to till because of slope and the poor tilth in eroded areas. In some cultivated areas they have lost as much as 6 inches of the original surface layer through erosion. Crop rotations, close growing crops, contour farming, stripcropping, diversions, grassed waterways, minimum tillage, and good management of residue help to control erosion and maintain good tilth.

These soils are poorly suited to row crops, but if well managed they are suited to a cropping system of small grain and legumes and some corn or soybeans. They are suited to pasture.

CAPABILITY UNIT IVe-3

This unit consists of sloping, well drained and excessively drained loamy soils. These soils are moderately permeable in the subsoil and very rapidly permeable in the substratum or are very rapidly permeable throughout. Available water capacity is low or very low. Natural fertility is low.

These soils are droughty and are not saturated long enough for the excess water to adversely affect plant growth. They are subject to moderate erosion, and in many cultivated areas they have lost as much as 4 inches of the original surface layer. Crop rotations, close growing crops, contour farming, stripcropping, grassed waterways, minimum tillage, and good management of residue help to control erosion and maintain good tilth.

These soils are poorly suited to row crops, but if well managed, they are suited to a cropping system of small grain and hay and some corn or soybeans. They are also suited to pasture.

CAPABILITY UNIT IVe-6

This unit consists of sloping and moderately steep, well drained silty and clayey soils. Permeability is moderately slow. Available water capacity is moderate. Natural fertility is medium.

These soils are not saturated long enough for the excess water to adversely affect plant growth. They are subject to moderate or severe erosion, and in some cultivated areas they have lost as much as 6 inches of the original surface layer. Rainwater does not readily enter the soils that have a clayey subsoil, and the surface layer is easily eroded. Tilth is poor where erosion has removed the surface layer and exposed the subsoil. The soils dry slowly in spring and after rainfall. Crop rotations, contour stripcropping, diversions, surface drainage, terraces, minimum tillage, and good management of residue help to control erosion, remove excess water, and maintain good tilth.

Even if well managed, these soils are poorly suited to corn, soybeans, small grain, legumes, and vegetables. They are suited to pasture.

CAPABILITY UNIT IVw-5

This unit consists of nearly level, very poorly drained and somewhat poorly drained sandy and loamy soils. Permeability is moderately rapid and rapid. Available water capacity is low. Natural fertility is low.

Unless these soils are drained, they have ground water at or near the surface throughout the year in some areas and in other areas are saturated at a depth of 1 foot to 3 feet during wet periods. These soils receive runoff from adjoining areas. Many areas are subject to flooding and ponding during wet periods and after heavy rains. Deep ditches can be used to lower the water table if suitable outlets are available. Diversions and grassed waterways intercept and safely remove runoff from adjoining areas. Surface drainage prevents ponding. If drained, the sandy soils are subject to soil blowing. If excessively drained, these soils lose the beneficial effects of free water in the lower part of the soil.

Controlled drainage, windbreaks, minimum tillage, and good management of residue help to control soil blowing and maintain organic-matter content and available water capacity. Adequate fertilization helps to control soil blowing by maintaining plant cover. The suitability of these soils for crops is limited by the low available water capacity and the need for heavy fertilization. Pollution of ground water by the leaching of fertilizer elements, especially nitrates, is a hazard where the subsoil is sandy.

If adequately drained and well managed, these soils are suited to row crops, small grain, and hay. Most areas are too wet to crop unless artificially drained. Undrained areas are suited to pasture or wetland wildlife habitat.

CAPABILITY UNIT IVw-7

This unit consists mainly of nearly level, very poorly drained organic soils. Some of these soils are mapped with sandy soils. The sandy soils are poorly drained

or well drained and moderately well drained. Permeability is moderately rapid, rapid, or very rapid, but is slow in the marl and sedimentary peat. Available water capacity is very high in the organic soils and low in the sandy soils. Natural fertility is low.

Unless these soils are drained, ground water is at or near the surface throughout the year in most areas. The sandy soils are saturated at a depth ranging from 0 to more than 60 inches during wet periods. The wet soils receive runoff from adjoining areas and in some areas are subject to ponding and overflow. Both deep ditches and tile drains can be used to lower the water table if suitable outlets are available. If tile drainage is used in the soils underlain by sand, precautions must be taken to prevent loose sand from entering and clogging the tile lines. If it is used in the soils underlain by marl or sedimentary peat, the tile should be placed in the organic material because of the slow permeability in the marl and sedimentary peat. If the tile must be placed in the marl and sedimentary peat, backfilling with porous material helps the tile to function. Diversions and grassed waterways intercept and safely remove runoff from adjoining areas. Surface drainage prevents ponding.

If drained, these soils are subject to soil blowing, burning, and subsidence. The sandy soils become droughty unless drainage is controlled. The well drained and moderately well drained sandy soils are droughty and are subject to soil blowing.

If properly drained and protected from flooding and soil blowing, these soils can be used for corn and certain vegetables. They can support a large population of plants. Response to fertilization is good in the organic soils. If the soils are properly fertilized and well managed, row crops can be grown for many years, but oxidation and subsidence eventually destroy the organic layer. Undrained areas are suited to pasture, but they are better suited to wetland wildlife habitat.

CAPABILITY UNIT IVs–3

Oakville loamy fine sand, 0 to 6 percent slopes, is the only soil in this unit. It is well drained and moderately well drained. Permeability is very rapid. Available water capacity is low. Natural fertility is low.

In some areas this soil is saturated at a depth of 3 to 5 feet during wet periods. The soil is subject to soil blowing and in gently sloping areas is subject to slight erosion. Close growing crops, stripcropping, windbreaks, minimum tillage, good management of residue, and cover crops help to control soil blowing and maintain organic-matter content and available water capacity. Contour farming and contour stripcropping help to control erosion. Adequate fertilization helps to control soil blowing and erosion by helping to maintain plant cover. The suitability of this soil for crops is limited by the low available water capacity and the need for heavy fertilization. Pollution of ground water by the leaching of fertilizer elements, especially nitrates, is a hazard.

This soil is poorly suited to cultivated crops and pasture. Early spring plantings, before the soil has a chance to dry, are best. Crops planted later, especially small seeded crops, are not likely to survive. The soil is suited to irrigation, but water moves through it rapidly. If irrigated, the soil is suited to more intensive cropping.

CAPABILITY UNIT Vw–14

Only Alluvial land, wet, is in this unit. This nearly level, poorly drained or very poorly drained land is on flood plains. The meandering stream channels, oxbows, and sloughs and the frequent flooding limit the use of this land. These sediments are too variable to be rated for permeability, natural fertility, and available water capacity. Unless this land is drained, ground water is at or near the surface throughout the year.

This land is unsuited to cultivated crops. Providing drainage and protection from flooding is generally impractical. Many areas are wooded or in unimproved pasture. This land is also used for wetland wildlife habitat.

CAPABILITY UNIT Vw–16

This unit consists of gently sloping to moderately steep, poorly drained soils. The unit includes sandy, loamy, clayey, or organic soil material that is very stony in places. The soils are too variable to be rated for permeability. Available water capacity is very high or is not determined because the material is too variable. Natural fertility is low or medium.

Unless these soils are drained, ground water is at or near the surface throughout the year. Stones on the surface and throughout the soil hinder drainage and cultivation in some areas. Seepage from surrounding soils keeps these soils wet. Because of the stones in some areas and the lack of suitable drainage outlets, drainage is not practical.

These soils are not suited to crops. Some areas are used for unimproved pasture, woodland, or wetland wildlife habitat.

CAPABILITY UNIT VIe–1

This unit consists of steep, well drained silty and loamy soils. The soils underlain by stratified gravel and sand are very rapidly permeable in the substratum. The rest are moderately permeable. Available water capacity is low or moderate. Natural fertility is low or medium.

These soils are not saturated long enough for the excess water to adversely affect plant growth. They are subject to very severe erosion. They are difficult to till because of slope and the poor tilth in eroded areas. Pasture and hay fields are difficult to renovate. Controlled grazing, renovation, and fertilization help to maintain adequate plant cover and control erosion.

Because of the very severe erosion hazard, these soils are generally not suited to crops. If well managed, they are suited to pasture and hay. They are used mostly for woodland and wildlife habitat.

CAPABILITY UNIT VIe–3

Only the Casco-Rodman complex, 12 to 20 percent slopes, eroded, is in this unit. These soils are well drained or excessively drained. They are moderately

permeable in the subsoil and very rapidly permeable in the substratum or are very rapidly permeable throughout. Available water capacity is very low or low. Natural fertility is low.

These soils are not saturated long enough for the excess water to adversely affect plant growth. They are subject to severe erosion. Pasture and hay fields are difficult to renovate. Controlled grazing, renovation, and fertilization help to maintain adequate plant cover and control erosion.

Because of the severe erosion hazard and the low available water capacity, these soils are generally not suited to crops. If well managed, they are suited to hay and pasture, but yields are low. These soils are used mostly for woodland and wildlife habitat.

CAPABILITY UNIT VIe–6

Kewaunee silt clay, 12 to 20 percent slopes, severely eroded, is the only soil in this unit. It is well drained and moderately well drained. Permeability is moderately slow. Available water capacity is moderate. Natural fertility is medium.

This soil is not saturated long enough for the excess water to adversely affect plant growth. It is subject to very severe erosion. It is difficult to till because of slope and poor tilth. The surface layer is clayey because of severe erosion. Small seeded crops have poor emergence because of crusting or a rough seedbed. Pasture and hay fields are difficult to renovate. Controlled grazing, renovation, and fertilization help to maintain adequate plant cover and control erosion.

Because of the severe erosion hazard, this soil is generally not suited to hay and pasture. It is used mostly for woodland and wildlife habitat.

CAPABILITY UNIT VIs–3

Oakville loamy fine sand, 6 to 12 percent slopes, is the only soil in this unit. It is well drained and moderately well drained. It is very rapidly permeable. Available water capacity is low. Natural fertilty is low.

This soil is not saturated long enough for the excess water to adversely affect plant growth. It is subject to moderate erosion and severe soil blowing. Establishing plant cover is difficult. Early spring plantings for pasture and hay, before the soil has a chance to dry, are best. Later plantings are likely to have a poor survival rate. Controlled grazing, renovation, and fertilization help to maintain plant cover and control erosion and soil blowing. Pollution of ground water by the leaching of fertilizer elements, especially nitrates, is a hazard.

Because of the low available water capacity and the hazard of soil blowing, this soil is generally not suited to crops. If well managed, it is suited to pasture and hay, but yields are low. It is used mostly for woodland and wildlife habitat.

CAPABILITY UNIT VIIe–3

This unit consists of steep or very steep, well drained or excessively drained soils. These soils are moderately permeable in the subsoil and very rapidly permeable in the substratum or are very rapidly permeable throughout. Available water capacity is very low or low. Natural fertility is low.

These soils are not saturated long enough for the excess water to adversely affect plant growth. They are subject to very severe erosion. Some areas that have been grazed are eroded. Controlled grazing and topdressing with fertilizer help to maintain plant cover and control erosion. In many areas these soils are gravelly.

Because of the very low available water capacity, the shallow root zone, the gravel, and the very severe erosion hazard, this soil is not suited to crops. If well managed, some of the less sloping areas are suited to pasture, but yields are low. Improved pasture is difficult to establish and maintain. Many pastures are in native bluegrass. This soil is used mostly for woodland and wildlife habitat.

CAPABILITY UNIT VIIe–6

Only Rough broken land is in this unit. This land is steep and very steep and is well drained. It is on escarpments, generally adjacent to lakes and rivers. Permeability is moderately slow. Available water capacity is low. Natural fertility is low. The hazard of erosion is very severe. Because of slope and the hazard of erosion, this land is not suited to crops. It is used for unimproved pasture, woodland, or wildlife habitat.

CAPABILITY UNIT VIIIw–15

Only Marsh is in this unit. It is very poorly drained. It is in depressions and areas bordering lakes and rivers. It is flooded most of the year and is covered by cattails, bulrushes, and other plants that grow in shallow water.

Marsh is too wet for commonly grown crops and for pasture, but is generally not suited to drainage because of a lack of suitable outlets. It is suited to food and cover for wetland wildlife. In dry periods it requires protection from grazing and fires. Areas that are completely filled with sediments and are entirely grown over with cattails can be blasted out with explosives to form potholes for waterfowl and other wildlife.

CAPABILITY UNIT VIIIs–10

This unit consists of mostly well drained or excessively drained, nearly level to very steep land types. These land types are sandy, loamy, or gravelly or are nonsoil material, such as foundry sand and ashes, bricks, and broken concrete. Permeability is mostly rapid or very rapid, but some land types are too variable to be rated. Available water capacity is very low or is not determined because the material is too variable.

These land types are not suited to crops or woodland. Some can be vegetated if topsoil is added to the surface. Some are used for recreational purposes or building sites.

Predicted yields

Table 2 lists predicted average yields per acre for the principal crops grown in Sheboygan County under a high level of management. Predictions are based on results obtained by the agricultural experiment station

TABLE 2.—*Predicted average yields per acre of principal crops*

[Yields are those obtained under improved, or high level, management. Absence of a yield figure indicates that the crop is not suited to the soil or is not ordinarily grown on the soil. Only arable soils are listed]

Map symbol	Soil name	Corn		Oats [1]	Alfalfa-brome hay [2] (dry weight)
		Grain	Silage		
		Bu	*Tons*	*Bu*	*Tons*
Ag	Adrian muck [3]	90	15	50	
Ak	Adrian-Granby-Oakville complex				
	Adrian soil [3]	90	15	50	
	Granby soil [3]	60	10	50	3.0
	Oakville soil	50	8	40	2.5
Am	Alluvial land	50	8	40	2.25
Ba	Barry silt loam [3]	105	18	65	4.00
Be	Bellevue silt loam [3]	100	17	70	4.50
Bf	Bellevue fine sandy loam, sandy subsoil variant [3]	50	8	40	2.25
Bk	Boots muck [3]	115	19	60	
BmB	Boyer loamy sand, 2 to 6 percent slopes	55	9	40	2.25
BmC2	Boyer loamy sand, 6 to 12 percent slopes, eroded	50	8	35	2.00
CeA	Casco loam, 0 to 2 percent slopes	75	12	60	2.75
CeB	Casco loam, 2 to 6 percent slopes	70	12	55	2.75
CeC2	Casco loam, 6 to 12 percent slopes, eroded	65	11	50	2.50
CrC	Casco-Rodman complex, 6 to 12 percent slopes	50	8	50	2.50
CrD2	Casco-Rodman complex, 12 to 20 percent slopes, eroded			40	2.00
CrE	Casco-Rodman complex, 20 to 30 percent slopes				1.25
CrF	Casco-Rodman complex, 30 to 45 percent slopes				
Cw	Colwood silt loam [3]	100	17	65	2.50
Ed	Edwards muck [3]	80	13	50	
Ev	Elvers silt loam [3]	100	17	60	
FaA	Fabius loam, 0 to 3 percent slopes [3]	65	11	50	2.50
FsA	Fox silt loam, 0 to 2 percent slopes	90	15	65	3.50
FsB	Fox silt loam, 2 to 6 percent slopes	85	14	60	3.25
FsC2	Fox silt loam, 6 to 12 percent slopes, eroded	75	12	55	3.00
Gb	Granby loamy fine sand [3]	60	10	50	3.00
Gg	Granby silt loam, gravelly variant [3]	85	14	60	4.00
HeA	Hebron loam, 0 to 2 percent slopes	110	18	70	4.00
HeB	Hebron loam, 2 to 6 percent slopes	105	17	65	3.75
HfA	Hebron sandy loam, sandy subsoil variant, 0 to 2 percent slopes	75	12	55	3.25
HfB	Hebron sandy loam, sandy subsoil variant, 2 to 6 percent slopes	70	12	50	3.00
HmB2	Hochheim silt loam, 2 to 6 percent slopes, eroded	100	17	65	4.00
HmC2	Hochheim silt loam, 6 to 12 percent slopes, eroded	95	16	60	3.50
HmD2	Hochheim silt loam, 12 to 20 percent slopes, eroded	85	14	50	3.00
HmE	Hochheim silt loam, 20 to 30 percent slopes				2.50
HsC2	Hochheim-Casco-Sisson complex, 6 to 12 percent slopes, eroded	85	14	60	3.00
HsD2	Hochheim-Casco-Sisson complex, 12 to 20 percent slopes, eroded	75	12	55	2.50
HsE	Hochheim-Casco-Sisson complex, 20 to 30 percent slopes				2.00
HtB	Hochheim-Knowles silt loams, 1 to 6 percent slopes	105	17	70	4.50
Hu	Houghton muck [3]	120	20	60	
JuA	Juneau silt loam, 0 to 3 percent slopes [3]	110	18	80	5.00
KlA	Kendall silt loam, 0 to 3 percent slopes [3]	115	19	75	4.00
KnA	Kewaunee silt loam, 0 to 2 percent slopes	122	20	80	5.00
KnB	Kewaunee silt loam, 2 to 6 percent slopes	120	20	80	5.00
KpB2	Kewaunee silty clay loam, 2 to 6 percent slopes, eroded	115	19	75	4.75
KpC2	Kewaunee silty clay loam, 6 to 12 percent slopes, eroded	105	17	70	4.50
KpD2	Kewaunee silty clay loam, 12 to 20 percent slopes, eroded	95	16	60	3.75
KsC3	Kewaunee silty clay, 6 to 12 percent slopes, severely eroded	80	13	60	3.75
KsD3	Kewaunee silty clay, 12 to 20 percent slopes, severely eroded			55	3.50
KuA	Kibbie silt loam, 0 to 3 percent slopes [3]	95	16	65	3.50
LmA	Lamartine silt loam, 0 to 3 percent slopes [3]	115	19	65	4.00
MbA	Manawa silt loam, 0 to 3 percent slopes [3]	100	17	65	3.50
MgA	Martinton silt loam, 0 to 3 percent slopes [3]	105	17	70	3.75
MkA	Matherton silt loam, 0 to 3 percent slopes [3]	75	12	55	3.00
Mo	Montgomery silty clay loam [3]	100	17	70	3.50
MsA	Mosel loam, 0 to 3 percent slopes [3]	105	17	60	3.50
Mz	Muskego muck [3]	80	13	60	
Na	Navan loam	85	14	60	3.50
NnA	Nenno silt loam, 0 to 2 percent slopes [3]	105	17	70	4.00
NnB	Nenno silt loam, 2 to 6 percent slopes	100	17	65	4.00
OaB	Oakville loamy fine sand, 0 to 6 percent slopes	50	8	40	2.50
OaC	Oakville loamy fine sand, 6 to 12 percent slopes			35	2.25
Ot	Otter silt loam [3]	100	17	65	3.50

See footnotes at end of table.

TABLE 2.—*Predicted average yields per acre of principal crops—Continued*

Map symbol	Soil name	Corn		Oats [1]	Alfalfa-brome hay [2] (dry weight)
		Grain	Silage		
		Bu	*Tons*	*Bu*	*Tons*
Pa	Palms muck [3]	80	13	60	
Ph	Pella silt loam [3]	110	18	65	4.00
Py	Poygan silty clay loam [3]	100	17	70	4.00
ScA	St. Charles silt loam, 0 to 2 percent slopes	122	20	75	5.50
ScB	St. Charles silt loam, 2 to 6 percent slopes	120	20	75	5.25
ShA	Saylesville silt loam, 0 to 2 percent slopes	122	20	75	5.25
ShB	Saylesville silt loam, 2 to 6 percent slopes	120	20	70	5.00
SkC2	Saylesville silty clay loam, 6 to 12 percent slopes, eroded	100	17	65	4.50
Sm	Sebewa silt loam [3]	95	16	65	4.00
SrA	Sisson very fine sandy loam, 0 to 2 percent slopes	110	18	70	4.75
SrB	Sisson very fine sandy loam, 2 to 6 percent slopes	100	17	65	4.50
SrC2	Sisson very fine sandy loam, 6 to 12 percent slopes, eroded	90	15	55	3.75
ThA	Theresa silt loam, 0 to 2 percent slopes	120	20	75	5.00
ThB	Theresa silt loam, 2 to 6 percent slopes	115	19	75	5.00
ThC2	Theresa silt loam, 6 to 12 percent slopes, eroded	105	17	65	4.25
Wa	Wasepi sandy loam [3]	60	10	50	2.50
WbA	Waymor silt loam, 0 to 2 percent slopes	120	20	75	5.00
WbB	Waymor silt loam, 2 to 6 percent slopes	115	19	75	5.00
WbC2	Waymor silt loam, 4 to 12 percent slopes, eroded	100	17	60	4.00
We	Willette muck [3]	90	15	60	
YhA	Yahara very fine sandy loam, 0 to 3 percent slopes [3]	95	16	70	4.00
ZuA	Zurich silt loam, 0 to 2 percent slopes	115	19	70	4.50
ZuB	Zurich silt loam, 2 to 6 percent slopes	110	18	70	4.50

[1] Yields are for oats seeded with a grass-legume mixture. Higher yields may be obtained, but a poorer stand of grass-legumes usually results.
[2] Yields are for hay cut during the first or second year after the stand is adequately established.
[3] Yields are for areas that are protected from flooding or ponding.

on experimental test plots and on observations made by soil scientists and farmers who are familiar with the soils (*4*). All yields are based on averages obtained over a long period under average amounts of rainfall. By using improved crop varieties and management, higher yields than those shown in the table are being obtained by many farmers, and this trend can be expected to continue. Table 2 also shows the relative productivity of the soils, which will be useful as the general level of crop yields increases. Future improvements in technology, however, may affect some soils more than others. Also, some soils that have only low to medium yields because of low available water capacity may be well suited to intensive specialty crop production if irrigated.

Yields of oats shown in the table are for oats seeded with a legume-grass mixture. Higher yields of oats result in a poor stand of the grass-legume mixture. Yields of alfalfa-brome hay are for well established, first year and second year stands.

The management needed to obtain the yields shown in table 2 is considerably above the average for the county. Under this level of management, acid soils are limed to about pH 6.5, according to recommendations resulting from soil tests. Fertilizer is also applied according to recommendations based on soil tests. Adequate surface or internal drainage is provided, and the soils are protected from flooding if necessary. Seedbed preparation is adequate and timely. Proper planting methods are used. Harvesting of crops is timely and carefully performed. Necessary erosion control is installed and maintained. Cropping systems are suitable for soil and slope conditions. Annual and perennial weeds are controlled by timely use of mechanical and chemical methods. Insects that damage crops are controlled.

Woodland [2]

Before settlement, Sheboygan County was covered with forest. The forest was mainly a mixture of oaks and northern hardwoods, but in the eastern part of the county some conifers, mostly white pine, were mingled with the hardwoods. In addition to red oak and white oak, the common hardwoods were sugar maple, red maple, silver maple, American beech, white ash, green ash, basswood, quaking aspen, shagbark hickory, bitternut hickory, American elm, tamarack, and northern white cedar (*6*).

The present pattern of woody vegetation of the county follows soil association boundaries on the general soil map. The Mosel-Oakville-Hebron association and the Kewaunee-Waymor-Manawa association support stands of red oak and sugar maple and some white pine and American beech and other hardwoods. The Hochheim-Theresa association supports sugar maple and American beech and some red oak, white ash, and other hardwoods. The Casco-Fox-Rodman association is forested with a cover of oak and hickory

[2] By GEORGE W. ALLEY, forester, Soil Conservation Service, Madison, Wis.

and a few other hardwoods (fig. 7). The Boots-Houghton association supports a stand of tamarack and northern white cedar and considerable red maple, silver maple, green ash, white ash, and American elm. The elm is badly infected with Dutch elm disease and will probably be unimportant in future timber stands.

According to the latest published inventory of forest resources (*30*), about 17 percent, or 56,000 acres, of the county is in forest. Although nearly all of this acreage is commercial forest, about half is poorly stocked or grazed. According to this inventory, forest types are northern hardwoods, 25.5 percent; lowland hardwoods, 24 percent; conifers, 9.5 percent; oak, 8 percent; aspen, 3 percent; upland brush, 10.5 percent; and lowland brush, 19.5 percent.

Woodland groups

In table 3, the soils of Sheboygan County have been assigned to woodland groups to assist owners in planning the use of their soils for wood crops. Each group is made up of soils that are suited to the same kinds of trees, that need approximately the same kind of management when the vegetation on them is similar, and that have about the same potential productivity. The woodland group for each soil in the county is listed in the Guide to Mapping Units at the back of this survey.

Each woodland group is identified by a three-part symbol, such as 2c1 or 4w2. The first part, a number, indicates the potential productivity of the soil for trees. Numeral 1 means high; 2, moderately high; 3, moderate; 4, moderately low; 5, low; and 6, unproductive.

The potential productivity is expressed as a site index, or the average height of dominant and codominant trees of a given species at age 50 years. The site index for some of the more important species has been measured; for others it is estimated from measurements of the species on similar soils.

Site indexes used in Sheboygan County are based on recognized site index curves for silver maple and red maple, green ash, red oak and other upland oaks, sugar maple, black cherry,[3] aspen, swamp white oak, eastern white pine, basswood, tamarack, northern white cedar, red pine, and jack pine (*7,10,11,12,13, 14,15,16,17,22*).

[3] DEFLER, S. E. Black cherry—characteristics, germination, growth, and yield. 1937. [Unpublished thesis. Copy on file N. Y. Coll. of For., Dep. of Siliculture]

Figure 7.—Hickory and oak on the moderately steep Casco-Fox-Rodman association.

Annual yields for tree species were estimated from yields based on site indexes for silver maple, upland oak, northern hardwoods, aspen, white pine, tamarack, red pine, and jack pine (*3,8,9,18,19,20,21,22*).

The second part of the symbol identifying a woodland group is a small letter. This letter shows the subclass, which indicates an important soil property that imposes a slight to severe limitation in managing the soils of the group for wood crops. The subclasses are defined as follows:

Subclass w (excessive wetness). Soils in which excessive water, either seasonally or year around, causes significant limitations for woodland use or management. These soils have restricted drainage, a high water table, or an overflow hazard, all of which adversely affect either stand development or management.

Subclass d (restricted root depth). Soils that have limitations for woodland use or management because of restricted root depth. These soils are shallow over hard rock, a hardpan, or other layers that restrict roots.

Subclass c (clayey soils). Soils that have limitations for woodland use or management because of the kind or amount of clay in the upper part of the profile.

Subclass s (sandy soils). Dry sandy soils that have little or no textural B horizon and have moderate to severe limitations for woodland use or management. These soils impose equipment limitations, have low available water capacity, and normally are low in available plant nutrients.

Subclass f (fragmental or skeletal soils). Soils that have limitations for woodland use or management because they contain large amounts of coarse fragments more than 2 millimeters but less than 10 inches in size. Flaggy soils are included.

Subclass r (relief or slope). Soils that have limitations for woodland use or management because of steepness of slope.

Subclass o (slight or no limitations). Soils that have no significant limitations for woodland use or management.

The third part of the woodland group symbol, another number, identifies the kind of management needed. All soils in a group have a similar level of productivity and have the same soil-related hazards.

The hazards or limitations that affect management of soils for woodland in Sheboygan County are the hazard of erosion, the limitation to use of equipment, and the hazard of seedling mortality. In table 3 these hazards or limitations are expressed as *slight, moderate,* or *severe.*

The hazard of erosion refers to the potential hazard of soil losses in areas used for woodland. The hazard is *slight* if expected soil losses are small; *moderate* if some soil losses are expected and care is needed during logging and construction to reduce the losses; and *severe* if special methods of operation are needed to prevent excessive soil losses.

Equipment limitations are rated on the basis of soil characteristics that restrict or prohibit the use of equipment commonly used in tending and harvesting the trees. In Sheboygan County, the soil characteristics having the most limiting effects are excessive soil wetness, slope, and texture of the surface layer. *Slight* indicates there is no restriction in the kind of equipment or in the time of year it is used; *moderate* means that use of equipment is restricted for less than 3 months of the year; and *severe* means that special equipment is needed and its use is restricted for more than 3 months of the year.

Seedling mortality refers to the expected degree of mortality of planted seedlings as influenced by the kinds of soil. Considered in the ratings are excessive soil wetness, hazard of flooding, slope and aspect, texture and structure, and plant competition. Normal rainfall, good planting stock, and proper planting are assumed. A rating of *slight* indicates an expected loss of less than 25 percent of the planted seedlings; *moderate,* a loss of 25 to 50 percent; and *severe,* a loss of more than 50 percent.

Landscaping and windbreak plantings

This section provides information about some of the trees, shrubs, and vines used in landscaping sites for homes, schools, industry, and recreational areas. It also provides information on species suitable for windbreaks around farmsteads or open fields.

Trees and shrubs vary widely in suitability to different soils and to site conditions. Soils are assigned to four tree and shrub groups, mainly on the basis of the degree and length of time that the soil is saturated with water and on the available water capacity. Each of the soils in a specific group has similar suitability for trees, shrubs, and vines.

The tree and shrub group of each soil can be learned by referring to the Guide to Mapping Units at the back of this survey. A brief general description of the features of the soils in each tree and shrub group is provided in tables 4 and 5. Table 4 lists trees suitable for specified uses and provides information on the shape and height of trees at maturity. Table 5 lists shrubs and vines suitable for specified uses and indicates the potential height of these plants. Plants listed in the tables make up only a partial list of the plants suited to the soils in the county. Many of the plants serve a dual purpose of landscaping and of providing food and cover for wildlife.

The following soils were not assigned to tree and shrub groups: Beaches, sandy (Bd); Cut and fill land, sandy and gravelly (Cx); Cut and fill land, loamy (Cy); Cut and fill land, clayey (Cz); Dune land (Dn); Gravel pit (Gp); Made land (Ma); Marsh (Mf); Rough broken land (Ry); and Stony land, wet (Sw).

Wildlife [4]

The soils of Sheboygan County differ widely in physical and chemical characteristics that affect the kinds and amounts of plants and wildlife the soils can support. Research has shown a relationship between soil fertility and the abundance and vigor of

[4] By LAVERNE C. STRICKER, biologist, Soil Conservation Service, Madison, Wis.

TABLE 3.—*Productivity and soil-related*

Woodland group and map symbol	Potential productivity			
	Tree species	Average site index	Number of plots	Yearly growth per acre
				Board feet
Group 1w1: Cw	Silver maple	80	2	190
	Red maple	76	2	170
	Green ash	81	2	—
	Northern red oak	79	2	310
Group 1o1: ScA, ScB, SrA, SrB, SrC2, ThA, ThB, ThC2, WbA, WbB, WbC2, ZuA, ZuB.	Northern red oak	72±6.8	8	265
	Sugar maple	64±2.0	7	100
	White and green ash	81	2	—
	Black cherry	74	2	—
	Quaking aspen	76	1	270
Group 1o2: KuA, YhA	Red oak	74	1	280
	Sugar maple	69	2	120
	Red maple	73	2	160
	White and green ash	66	2	—
Group 2w1: Ot, Py	Silver maple	80	2	19
	Red maple	79	1	190
	Green ash	77	2	—
	Red oak	75	1	285
	Swamp white oak	73	1	280
Group 2c1: KnA, KnB, KpB2, KpC2, ShA, ShB, SkC2.	Northern red oak	67±7.0	9	230
	Sugar maple	57±6.2	4	80
	White ash	60	2	—
	Eastern white pine	42	2	150
Group 2c2: MbA	Sugar maple	58	1	85
	White and green ash	78	2	—
	Basswood	72	1	—
Group 2c3: KpD2	Northern red oak	67	(1)	230
	Sugar maple	57	(1)	80
	Eastern white pine	42	(1)	150
Group 2o1: FsA, FsB, FsC2, HeA, HeB, HfA, HfB, HmB2, HmC2, HsC2, HtB, JuA.	Northern red oak	61	3	195
	Sugar maple	62	2	95
Group 2o2: KlA, LmA, MsA, NnA, NnB	Northern red oak	65	(1)	220
	Sugar maple	60	(1)	90
Group 2r1: HmD2, HmE, HsD2, HsE	Red oak [2]	59±4.5	7	185
	Sugar maple	59±3.6	9	90
	White ash	57	2	—
Group 3w1: Gb, Gg	Red maple	65	1	115
	White pine	58	2	380
	White and green ash	60	(1)	—
Group 3w2: Ph	Silver maple	80	(1)	190
	White ash	60	(1)	—
Group 3w3[3]: Ag, Ak, Bk, Ed, Hu, Mz, Pa, We.	Tamarack	46±8.3	6	350
	Northern white cedar	34	2	—
	Silver maple	78	2	180
	Red maple	65	1	115
Group 3d1: CeA, CeB, CeC2, CrC	Red oak, northern pin oak, black oak	58	(1)	180
	Eastern white pine	45	2	180
Group 3d2–3d3: CrD2, CrE, CrF	Red oak [2]	58±5.8	5	180
	Eastern white pine	49	1	180

See footnotes at end of table.

limitations by woodland groups

Species for reforestation	Limitations		
	Equipment	Erosion	Seedling mortality
Red maple, silver maple, green ash, white ash, white spruce	Severe	Slight	Moderate to severe.
Eastern white pine, red pine, white spruce	Slight	Slight	Slight.
White and green ash, red and silver maple, white spruce, eastern white pine.	Slight	Slight	Slight.
White and green ash, red and silver maple, white spruce.	Severe	Slight	Moderate to severe.
Eastern white pine, red pine, white spruce, white ash.	Slight	Slight	Moderate.
Eastern white pine, red pine, white spruce, white and green ash.	Slight	Slight	Moderate.
Eastern white pine, red pine, white spruce, white ash.	Moderate	Moderate	Slight on north-and east-facing slopes. Moderate on south- and west-facing slopes.
Red pine, eastern white pine, white spruce	Slight	Slight	Slight.
Red pine, eastern white pine, white spruce	Slight	Slight	Slight.
Eastern white pine, red pine, white spruce	Moderate	Moderate	Slight on north-and east-facing slopes. Moderate on south- and west-facing slopes.
Red and silver maple, white and green ash, white spruce.	Severe	Slight	Moderate to severe.
White and green ash, red and silver maple	Severe	Slight	Moderate to severe.
Not suitable for planting	Severe	Slight	Severe.
Red pine, eastern white pine, eastern red cedar, jack pine.	Slight	Slight	Moderate.
Red pine, eastern white pine, eastern red cedar, jack pine.	Moderate to severe	Moderate to severe	Moderate on north- and east-facing slopes. Moderate to severe on south- and west-facing slopes.

TABLE 3.—*Productivity and soil-related*

Woodland group and map symbol	Potential productivity			
	Tree species	Average site index	Number of plots	Yearly growth per acre
				Board feet
Group 3c1: KsC3	Red oak	58	(1)	180
	Sugar maple	55	(1)	75
Group 3c2: KsD3	Red oak	58	(1)	180
	Sugar maple	55	(1)	75
Group 3s1: OaB, OaC	Red oak [2]	50	1	130
	Red pine	43	1	170
	Eastern white pine	39	1	140
	Jack pine	50	1	60
Group 3o1: BmB, BmC2, Be, Bf	Red oak	60	(1)	190
	Sugar maple	55	(1)	75
Group 3o2: Am, FaA, MkA, Wa	Red oak	60	(1)	190
	White ash	55	(1)	—
Group 4w2: An, Ba, Ev, Lo, Mo, Na, Sm, Sw.	White and green ash	50	(1)	—
	Silver maple	70	(1)	140
Group 4o1: MgA	Silver maple	70	(1)	140
	White ash			
	American elm			
Group 6w1: Mf. Nonproductive, poorly drained loamy soils; not suitable for woodland.				
Group 6s1: Cx, Cy, Cz, Dn, Bd, Gp, Ma, Ry. Nonproductive sandy and droughty, or rocky soils or land types; not suitable for woodland.				

[1] Estimated.
[2] Includes northern red oak, northern pin oak, and black oak.

limitations by woodland groups—Continued

Species for reforestation	Limitations		
	Equipment	Erosion	Seedling mortality
Red pine, eastern white pine, white spruce	Slight	Severe	Moderate.
Red pine, eastern white pine, white spruce	Severe	Severe	Moderate on north- and east-facing slopes. Severe on south- and west-facing slopes.
Red pine, eastern white pine, jack pine	Slight	Slight	Moderate.
Red pine, eastern white pine, white spruce	Slight	Slight	Slight.
Eastern white pine, red pine, white spruce	Slight	Slight	Slight.
White and green ash, red and silver maple, white spruce.	Severe	Slight	Moderate to severe.
Silver maple, white ash	Slight	Slight	Slight.

[3] Trees on soils in this group are generally limited to tamarack, northern white cedar, willow, or elm. Occasionally silver maple, red maple, or white ash becomes established and grows rapidly.

TABLE 4.—*Landscape and windbreak planting guide*

[The first letter in parentheses following species name indicates tree height: S is less than 30 feet; M, 30 to 60; L, more than 60. The second letter indicates shape; C is columnar; O, oval; P, pyramidal; Pe, pendulous; R, round]

Tree and shrub group series, and map symbols	Trees suitable for—				
	Shade	Street borders	Lawns	Hedges and screens	Windbreaks
Group 1: Moderately well drained and well drained, medium textured soils; moderate to very high available water capacity. Alluvial land: Am. Bellevue: Be, Bf. Fox: FsA, FsB, FsC2. Hebron: HeA, HeB HfA, HfB. Hochheim: HmB2, HmC2, HmD2, HmE, HsC2, HsD2, HsE, HtB. Juneau: JuA. Kewaunee: KnA, KnB, KpB2, KpC2, KpD2, KsC3, KsD3. St. Charles: ScA, ScB. Saylesville: ShA, ShB, SkC2. Sisson: SrA, SrB, SrC2. Theresa: ThA, ThB, ThC2. Waymor: WbA, WbB, WbC2. Zurich: ZuA, ZuB.	SUNNY SITES				
	American beech (LO) Sugar maple (LO) Red maple (MO) Red oak (LR) White oak (LR) Basswood (LO) Hackberry (MR) White ash (LO) Sycamore (LO) Bur oak (LR) Norway maple (MR). Silver maple (LO) Thornless honeylocust (MO).	Norway maple (MR) Southern pin oak (MP). Thornless honeylocust (MO). Basswood (LO) White ash (LO) Sugar maple (LO) Hackberry (MR) Red maple (MO)	Flowering crab (SR) Mountain ash (SO) Blue beech (SR) Paper birch (MO) River birch (MO) Russian-olive (SR) Southern pin oak (MP). Serviceberry (SR) Horsechestnut (LR) Norway spruce (LP) Red pine (LP) White pine (LP) White spruce (MP) Black cherry (LO) Blue spruce (LP) Norway spruce (LP) Hawthorn (SR)	Redcedar (SP) White-cedar (MC,P) White pine (LP) White spruce (MP) Lombardy poplar (LC). Russian-olive (SR) Upright yew (SP)	White spruce (MP). White-cedar (MC,P). White pine (LP). Red pine (LP). Norway spruce (LP).
	PARTIAL SHADE				
	American beech (LO) Sugar maple (LO) Red maple (MO) Red oak (LR) Hackberry (MR) White ash (LO) Basswood (Lo)	Norway maple (MP) White ash (LO) Basswood (LO) Sugar maple (LO)	Blue beech (SP) Serviceberry (SR) White pine (LP) White spruce (MP) Blue spruce (LP) Norway spruce (LP)	White-cedar (MC) White pine (LP) White spruce (MP) Upright yew (SP)	White-cedar (MC,P). White pine (LP). White spruce (MP).
Group 2: Moderately well drained to excessively drained, coarse textured or thin soils over sand and gravel; low or very low available water capacity. Boyer: BmB, BmC2. Casco: CeA, CeB, CeC2, CrC, CrD2, CrE, CrF. Oakville: OaB, OaC.	SUNNY SITES				
	Bur oak (LR) Hackberry (MR) Black oak (LR) Silver maple (LO) Green ash (MO) Thornless honeylocust (MO).	Green ash (MO) White ash (LO) Hackberry (MR) Thornless honeylocust (MO).	Flowering crab (SR) Paper birch (MO) Redcedar (SP) White pine (LP) White spruce (MP) Red pine (LP) Russian olive (SR)	Redcedar (SP) Russian-olive (SR) Red pine (LP) White pine (LP) Upright yew (SP) White spruce (MP)	Red pine (LP). White pine (LP). Redcedar (SP).
	PARTIAL SHADE				
	Hackberry (MR)	Hackberry (MR)	White pine (LP) White spruce (MP)	Upright yew (SP) White pine (LP) White spruce (MP)	White pine (LP).
Group 3: Somewhat poorly drained to very poorly drained mineral soils. Alluvial land, wet: An. Barry: Ba. Colwood: Cw. Elvers: Ev. Fabius: FaA. Granby: Gb, Gg. Kendall: KlA. Kibbie: KuA.	SUNNY SITES				
	Swamp white oak (LR). Hackberry (MR) Red maple (MO) Basswood (LO) Green ash (MO) White ash (LO) Silver maple (LO) Cottonwood (LO)	Green ash (MO) Basswood (LO) Red maple (MO)	White spruce (MP) Paper birch (MO) Mountainash (SO) Weeping willow (MPe). White-cedar (MP) River birch (MO)	White-cedar (MC) White spruce (MP) Lombardy poplar (LC). Laurel willow (MO)	White-cedar (MC). White spruce (MP). White pine (LP).

TABLE 4.—*Landscape and windbreak planting guide—Continued*

Tree and shrub group series, and map symbols	Trees suitable for—				
	Shade	Street borders	Lawns	Hedges and screens	Windbreaks
Lamartine: LmA. Loamy land, seeped: Lo. Manawa: MbA. Martinton: MgA. Matherton: MkA. Montgomery: Mo. Mosel: MsA. Navan: Na. Nenno: NnA, NnB. Otter: Ot. Pella: Ph. Poygan: Py. Sebewa: Sm. Wasepi: Wa. Yahara: YhA.	PARTIAL SHADE				
	Swamp white oak (LR). Hackberry (MR) Red maple (MO) Basswood (LL) Green ash (MO) White ash (LO)	Green ash (MO) Basswood (LO) Red maple (MO)	White spruce (MP) Mountainash (SO)	White-cedar (MC) White spruce (MP)	White-cedar (MC). White spruce (MP).
Group 4: Mainly very poorly drained organic soils; some sandy areas. Adrian: Ag, Ak. Boots: Bk. Edwards: Ed. Houghton: Hu. Muskego: Mz. Palms: Pa. Willette: We.	SUNNY SITES				
	Silver maple (LO) Red maple (MO)	Red maple (MO) Laurel willow (MO)	White-cedar (MC) White spruce (MP) Weeping willow (MPe)	White-cedar (MC) Laurel willow (MO)	Laurel willow (MO). Poplar (LP). Tree lilac (SO). White-cedar (MC).
	PARTIAL SHADE				
	Red maple (MO)	None	White-cedar (MC) White spruce (MP)	White-cedar (MC)	White-cedar (MC).

TABLE 5.—*Shrub and vine planting guide*

[The letter X means that the plant has the kind of characteristics, features or suitability indicated by the column heading]

Tree and shrub group [1]	Plant species	Type of plant	Potential height	Suitable for—				
				Landscaping	Hedge, screen, and windbreak	Wildlife food and cover	Roadside planting	Ground cover
			Feet					
Group 1: Moderately well drained and well drained, medium textured soils; moderate to very high available water capacity.	Arborvitae (shrub type)	Shrub	3–7	X	X	X		
	Barberry, Japanese	Shrub	6	X	X	X		
	Bittersweet	Vine		X		X	X	X
	Blackberry, dewberry, blackcap raspberry.	Bramble	1–5			X	X	X
	Chokeberry, black	Shrub	1–3	X		X	X	X
	Cotoneaster	Shrub	4–8	X	X	X		
	Crabapple	Shrub	10–25	X	X	X	X	
	Currant, alpine	Shrub	6–7	X	X			
	Dogwood, gray	Shrub	6–10			X	X	
	Dogwood, pagoda	Shrub	10–15			X	X	
	Dogwood, redosier	Shrub	3–9					
	Dogwood, roundleaf	Shrub	3–9			X	X	X
	Dogwood, silky	Shrub	6–10		X	X	X	
	Elder, American	Shrub	3–10			X	X	X

See footnotes at end of table.

TABLE 5.—*Shrub and vine planting guide—Continued*

Tree and shrub group [1]	Plant species	Type of plant	Potential height	Suitable for—				
				Landscaping	Hedge, screen, and windbreak	Wildlife food and cover	Roadside planting	Ground cover
			Feet					
	Filbert (hazelnut)	Shrub	5–8			X	X	
	Forsythia	Shrub	4–8	X				
	Grape, wild	Vine				X	X	X
	Hawthorn or thornapple	Shrub	5–15			X	X	
	Honeysuckle (shrub type)	Shrub	6–12	X	X	X		
	Juniper, creeping	Shrub	1–2	X		X	X	X
	Juniper, Pfitzer	Shrub	8–10	X		X		
	Lilac	Shrub	8–10	X	X		X	
	Maple, Amur	Shrub	1	X	X			
	Mockorange	Shrub	6–9	X	X			
	Myrtle or periwinkle	Vine	1	X			X	X
	Ninebark, common	Shrub	6–9	X	X		X	
	Olive, autumn	Shrub	10–15	X	X	X		
	Peashrub, Siberian	Shrub	10–15		X	X	X	
	Pine, mugho	Shrub	6–9	X		X		
	Plum, American	Shrub	10–15			X	X	
	Privet, Amur	Shrub	10		X	X		
	Privet, Regels border	Shrub	6–9		X	X		
	Redcedar, eastern	Shrub	6–9		X	X	X	
	Rose (rugosa and horticultural varieties)	Shrub	2–6	X		X	X	
	Russian-olive	Shrub	10–15+	X	X	X		
	Snowberry	Shrub	3–4	X		X	X	X
	Spirea, Anthony Waterer	Shrub	2–3	X				
	Spirea, Vanhoutte	Shrub	5–6	X	X			
	Sumac, fragrant	Shrub	3	X		X	X	X
	Sumac, smooth	Shrub	6–10			X	X	
	Sumac, staghorn	Shrub	10–15			X	X	
	Viburnum, American cranberrybush	Shrub	7–9	X	X	X	X	
	Viburnum, arrowwood	Shrub	10–12	X	X	X		
	Viburnum, blackhaw	Shrub	8–10		X	X	X	
	Viburnum, mapleleaf	Shrub	3–5			X	X	
	Viburnum, nannyberry	Shrub	9–12		X	X	X	
	Viburnum, Rafinesque	Shrub	2–4			X	X	
	Viburnum, wayfaringtree	Shrub	4–9	X		X	X	
	Virginia creeper	Vine				X	X	X
	Wahoo, eastern	Shrub	4–9	X		X	X	
	Weigela	Shrub	4–8	X	X			
	Willows (shrub types, including pussywillow).	Shrub	2–8	X	X	X	X	
	Winterberry, common	Shrub	6–9			X	X	
	Yew (shrub type)	Shrub	3–10	X		X		
Group 2: Moderately well drained to excessively drained, coarse textured or thin soils over sand and gravel; low or very low available water capacity.	Arborvitae (shrub type)	Shrub	3–7	X	X	X		
	Barberry, Japanese	Shrub	6	X	X	X		
	Bayberry or waxmyrtle	Shrub	5–9	X		X		X
	Bittersweet	Vine		X		X	X	X
	Blackberry, dewberry, blackcap raspberry.	Bramble	1–5			X	X	X
	Cotoneaster	Shrub	4–8	X	X	X		
	Crabapple	Shrub	10–25	X	X	X	X	
	Currant, alpine	Shrub	6–7	X	X			
	Dogwood, gray	Shrub	6–10			X	X	
	Filbert (hazelnut)	Shrub	5–8			X	X	
	Forsythia	Shrub	4–8	X				
	Grape, wild	Vine				X	X	X
	Hawthorn or thornapple	Shrub	5–15			X	X	
	Honeysuckle (shrub type)	Shrub	6–12	X	X	X		
	Juniper, creeping	Shrub	1–2	X		X	X	X
	Juniper, Pfitzer	Shrub	8–10	X		X		
	Lilac	Shrub	8–10	X	X		X	
	Maple, Amur	Shrub	1	X	X			
	Mockorange	Shrub	6–9	X	X			
	Myrtle or periwinkle	Vine	1	X			X	X
	Ninebark, common	Shrub	6–9	X	X		X	

See footnotes at end of table.

TABLE 5.—*Shrub and vine planting guide—Continued*

Tree and shrub group [1]	Plant species	Type of plant	Potential height	Suitable for—				
				Landscaping	Hedge, screen, and windbreak	Wildlife food and cover	Roadside planting	Ground cover
			Feet					
	Olive, autumn	Shrub	10–15	X	X	X		
	Peashrub, Siberian	Shrub	10–15		X	X	X	
	Pine, mugho	Shrub	6–9	X		X		
	Plum, American	Shrub	10–15			X	X	
	Privet, Amur	Shrub	10		X	X		
	Privet, Regels border	Shrub	6–9		X	X		
	Redcedar, eastern	Shrub	6–9		X	X	X	
	Russian-olive	Shrub	15+	X	X	X		
	Snowberry	Shrub	3–4	X		X	X	X
	Spirea, Anthony Waterer	Shrub	2–3	X				
	Spirea, Vanhoutte	Shrub	5–6	X	X			
	Sumac, fragrant	Shrub	3	X		X	X	X
	Sumac, smooth	Shrub	6–10			X	X	
	Sumac, staghorn	Shrub	10–15			X	X	
	Viburnum, blackhaw	Shrub	8–10		X	X	X	
	Viburnum, nannyberry	Shrub	9–12		X	X	X	
	Viburnum, Rafinesque	Shrub	2–4			X	X	
	Viburnum, wayfaringtree	Shrub	4–9	X		X	X	
	Virginia creeper	Vine				X	X	X
	Willows (shrub types, including pussywillow).	Shrub	2–8	X	X	X	X	
Group 3: Somewhat poorly drained to very poorly drained mineral soils.	Arborvitae (shrub type)	Shrub	3–7	X	X	X		
	Bayberry or waxmyrtle	Shrub	5–9	X		X		X
	Chokeberry, black	Shrub	1–3	X		X	X	X
	Dogwood, gray	Shrub	6–10			X	X	
	Dogwood, pagoda	Shrub	10–15			X	X	
	Dogwood, redosier	Shrub	3–9					
	Dogwood, roundleaf	Shrub	3–9			X	X	X
	Dogwood, silky	Shrub	6–10		X	X	X	
	Elder, American	Shrub	3–10			X	X	X
	Hawthorn or thornapple	Shrub	5–15			X	X	
	Honeysuckle (shrub type)	Shrub	6–12	X	X	X		
	Ninebark, common	Shrub	6–9	X	X		X	
	Olive, autumn	Shrub	10–15	X	X	X		
	Plum, American	Shrub	10–15			X	X	
	Russian-olive	Shrub	15+	X	X	X		
	Spirea, narrowleaf	Shrub	3–4				X	
	Spirea, Vanhoutte	Shrub	5–6	X	X			
	Viburnum, American cranberrybush	Shrub	7–9	X	X	X	X	
	Viburnum, mapleleaf	Shrub	3–5			X	X	
	Viburnum, nannyberry	Shrub	9–12		X	X	X	
	Viburnum, wayfaringtree	Shrub	4–9	X		X	X	
	Willows (shrub types, including pussywillow).	Shrub	2–8	X	X	X	X	
	Winterberry, common	Shrub	6–9			X	X	
Group 4: Mainly very poorly drained organic soils; sandy areas in places.	Arborvitae (shrub type)	Shrub	3–7	X	X	X		
	Dogwood, redosier	Shrub	3–9					
	Dogwood, roundleaf	Shrub	3–9			X	X	X
	Dogwood, silky	Shrub	6–10		X	X	X	
	Elder, American	Shrub	3–10			X	X	X
	Honeysuckle (shrub type)	Shrub	6–12	X	X	X		
	Ninebark, common	Shrub	6–9	X	X		X	
	Spirea, narrowleaf	Shrub	3–4				X	
	Viburnum, American cranberrybush	Shrub	7–9	X	X	X	X	
	Viburnum, mapleleaf	Shrub	3–5			X	X	
	Viburnum, nannyberry	Shrub	9–12		X	X	X	
	Viburnum, wayfaringtree	Shrub	4–9	X		X	X	
	Willows (shrub types, including pussywillow).	Shrub	2–8	X	X	X	X	
	Winterberry, common	Shrub	6–9			X	X	

[1] See table 4, Landscape and windbreak planting guide, for the names of the soils in the tree and shrub groups.

wildlife. This relationship is applicable to upland and wetland soils.

Wildlife benefits from food and cover plantings in areas used primarily or secondarily for wildlife production. It also benefits from such soil and water conservation practices as stripcropping, fertilization, and planting of trees on soils used for pasture, woodland, and other purposes.

Most of the major soils in the county are suited to fairly intensive farming and have a high potential for wildlife, but because the soils are in other uses, there is little wildlife habitat.

The soils of Sheboygan County have been assigned to nine groups for wildlife interpretation according to a statewide system of grouping and identification. Soils in group 5 do not occur in Sheboygan County. Soils in groups 6, 7, and 8, which are somewhat poorly drained and poorly drained or are organic, are the most important for wildlife. They occur in the valuable wetlands.

About 72,000 acres of the county is designated as wet soils that have a permanent or seasonal high water table or are subject to flooding. According to a 1971 survey, only 27,100 acres remains as wetlands. Thus, less than 40 percent of the original wetlands remain (fig. 8). This decrease has had an effect upon the species of wildlife in the county.

In table 6 the soils in Sheboygan County are rated

TABLE 6.—*Soil interpretation for*

Wildlife group, description of soils, series, and map symbols	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants
Group 1: Well drained and moderately well drained soils; silty or loamy throughout; not subject to flooding. Cut and fill land, loamy: Cy. Fox: FsA, FsB, FsC2. Hebron: HeA, HeB, HfA, HfB. Hochheim: HmB2, HmC2, HmD2, HmE, HsC2, HsD2, HsE, HtB. St. Charles: ScA, ScB. Sisson: SrA, SrB, SrC2. Theresa: ThA, ThB, ThC2. Waymor: WbA, WbB, WbC2. Zurich: ZuA, ZuB.	Good if slope is 0 to 6 percent, fair if 6 to 12, poor if more than 12; hazard of water erosion.	Good if slope is 0 to 12 percent, fair if 12 to 20, poor if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.
Group 2: Well drained and moderately well drained soils; clayey subsoil. Silty and clayey land types. Cut and fill land, clayey: Cz. Kewaunee: KnA, KnB, KpB2, KpC2, KpD2, KsC3, KsD3. Rough broken land: Ry. Saylesville: ShA, ShB, SkC2.	Good if slope is 0 to 6 percent, fair if 6 to 12, unsuitable if more than 12.	Good if slope is 0 to 12 percent, fair if 12 to 20, unsuitable if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.
Group 3: Well drained and moderately well drained, droughty sandy soils. Boyer: BmB, BmC2. Oakville: OaB, OaC.	Fair: hazard of water erosion	Good	Good
Group 4: Droughty soils that are shallow over gravel and sand. Casco: CeA, CeB, CeC2, CrC, CrD2, CrE, CrF.	Fair if slope is 0 to 6 percent, poor if more than 6; hazard of water erosion.	Good if slope is 0 to 12 percent, fair if 12 to 20, poor if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.
Group 6: Somewhat poorly drained soils. Fabius: FaA. Kendall: KlA. Kibbie: KuA. Lamartine: LmA. Manawa: MbA. Martinton: MgA. Matherton: MkA. Mosel: MsA. Nenno: NnA, NnB. Wasepi: Wa. Yahara: YhA.	Good if drained, fair if undrained and wet.	Good if drained, fair if undrained and wet; few species suited.	Fair: wet; some species not suited.

for their suitability for the production of various elements of wildlife habitat. These elements are defined in the following paragraphs.

Grain and seed crops are corn, oats, sorghum, wheat, barley, rye, and soybeans that are used as food and cover by wildlife.

Grasses and legumes are such grasses as switchgrass, bromegrass, timothy, and fescue and such legumes as alfalfa, red clover, sweet clover, and vetch that are used by wildlife for food and cover.

Wild herbaceous upland plants are native or introduced grasses, legumes, and forbs that provide food and cover for upland wildlife and are mainly established naturally. Bluegrass, roundhead lespedeza, beggarsticks, aster, and goldenrod are important in this group.

Woody plants are shrubs, hardwood trees, and coniferous trees. Shrubs are low growing woody plants, including conifers less than 8 feet tall, that furnish fruit, seeds, browse, and cover for wildlife. Examples are viburnum, dogwood, and hazelnut. Hardwood trees, such as oak, maple, cherry, and nut trees, furnish mast, fruit, seeds, dens, cover, and browse for wildlife. Coniferous trees more than 8 feet tall, such as pine, fir, spruce, tamarack, and cedar furnish seeds, fruit, browse, and cover for wildlife.

Wetland plants are forbs, grasses, sedges, aquatic plants, and woody plants that grow well in wet areas.

wildlife habitat elements

Woody plants		Wetland plants for food and cover	Shallow and deep water developments
Hardwoods, trees, and shrubs	Coniferous trees		
Good if slope is 0 to 20 percent, fair if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.	Poor if slope is 0 to 2 percent, unsuitable if more than 2; few species suited.	Poor if slope is 0 to 2 percent, unsuitable if more than 2; moderate permeability.
Good if slope is 0 to 20 percent, fair if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.	Poor if slope is 0 to 2 percent, unsuitable if more than 2; few species suited.	Fair if slope is 0 to 2 percent, unsuitable if slope is more than 2 percent; most soils have moderately slow or slow permeability in substratum.
Good	Good	Poor if slope is 0 to 2 percent, unsuitable if more than 2; few species suited.	Unsuitable: shallow to very porous substratum.
Good if slope is 0 to 20 percent, fair if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.	Poor if slope is 0 to 2 percent, unsuitable if more than 2; few species suited.	Unsuitable: shallow to very porous substratum.
Fair: wet; some species not suited.	Fair: wet; some species not suited.	Good	Good if slope is 0 to 2 percent, fair if more than 2; wet; moderately rapid or rapid permeability in some soils.

TABLE 6.—*Soil interpretation for*

Wildlife group, description of soils, series, and map symbols	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants
Group 7: Poorly drained or very poorly drained soils and land types. Alluvial land, wet: An. Barry: Ba. Colwood: Cw. Elvers: Ev. Granby: Gb, Gg. Loamy land, seeped: Lo. Marsh: Mf. Montgomery: Mo. Navan: Na. Otter: Ot. Pella: Ph. Poygan: Py. Sebewa: Sm. Stony land, wet: Sw.	Good if drained, unsuitable if undrained and wet.	Fair if drained, poor if undrained and wet.	Unsuitable: very wet; few species suited.
Group 8: Mainly very poorly drained organic soils; sandy in places. Adrian: Ag, Ak. Boots: Bk. Edwards: Ed. Houghton: Hu. Muskego: Mz. Palms: Pa. Willette: We.	Fair if drained, unsuitable if undrained and wet.	Fair if drained, unsuitable if undrained and wet; few species suited.	Unsuitable: wet; few species suited.
Group 9: Well drained and moderately well drained soils and land types; subject to flooding. Alluvial land: Am. Bellevue: Be, Bf. Juneau: JuA.	Good	Good	Good
Group 10: Sandy and gravelly land types; droughty. Beaches, sandy: Bd. Cut and fill land, sandy and gravelly: Cx. Dune land: Dn. Gravel pit: Gp. Made land: Ma.	Poor: hazard of water erosion; shallow to rock; very low available water capacity.	Fair if slope is 0 to 12 percent, poor if more than 12; some species not suited; very low available water capacity.	Fair if slope is 0 to 20 percent, poor if more than 20; some species not suited; very low available water capacity.

They furnish fruit, seeds, browse, and cover for wildlife that live in wet areas and in or near open water. Examples are smartweed, canarygrass, sedges, arrowhead, alder, and willow.

Wetland plants grow well in types 1, 2, and 6 wetlands (*23*). Type 1 wetlands are seasonally flooded basins and nearly level areas that are covered with water or are saturated during seasonal wet periods but are usually dry during much of the growing season. Type 2 wetlands are fresh meadows that are usually not covered with water during the growing season but are saturated within a few inches of the soil surface. Type 6 wetlands are shrubby swamp areas in which the soil is usually saturated during the growing season.

Shallow water developments are less than 5 feet deep and include natural and artificial water areas formed near dug-out areas or low embankments. Common plants are cattails, bulrushes, sedges, and reeds. These developments are types 3 and 4 wetlands (*23*). Type 3 wetlands are shallow marshes in which the soil is saturated or covered with as much as 6 inches of water

wildlife habitat elements—Continued

Woody plants		Wetland plants for food and cover	Shallow and deep water developments
Hardwoods, trees, and shrubs	Coniferous trees		
Poor: very wet; few species suited.	Poor: very wet; few species suited.	Good	Good.
Poor: wet; some species suited	Fair: wet; some species not not suited.	Good	Good if slope is 0 to 2 percent, fair if more than 2; wet.
Fair: hazard of flooding	Fair: hazard of flooding; some species not suited.	Poor: few species suited	Poor if slope is 0 to 2 percent, unsuitable if more than 2; moderate permeability.
Poor: few species suited; very low available water capacity.	Poor: few species suited; very low available water capacity.	Unsuitable: very low available water capacity; insufficient soil moisture.	Unsuitable: shallow to fissured dolomite or gravel.

during the growing season. Type 4 wetlands are deep marshes that are covered with 6 inches to about 3 feet of water during the growing season.

Deep water developments are more than 5 feet deep and formed by dug-out areas or embankments. Common plants are coontail, water lilies, milfoil, and water weed. The deep water areas consist of ponds, lakes, and type 5 wetlands (*23*). Type 5 wetlands are open freshwater areas that include shallow ponds and reservoirs or wet areas where water is less than 10 feet deep.

Table 7 lists the important wildlife species in Sheboygan County and shows the importance of the various habitat elements for the stated kinds of wildlife.

The suitability of a particular soil for a given species of wildlife can be determined by the use of tables 6 and 7. For example, critical elements of the habitat for ring-necked pheasants are grasses and legumes, wild herbaceous upland plants, and herbaceous wetland plants. Only a combination of soil groups can be well suited to all these habitat elements. An environment

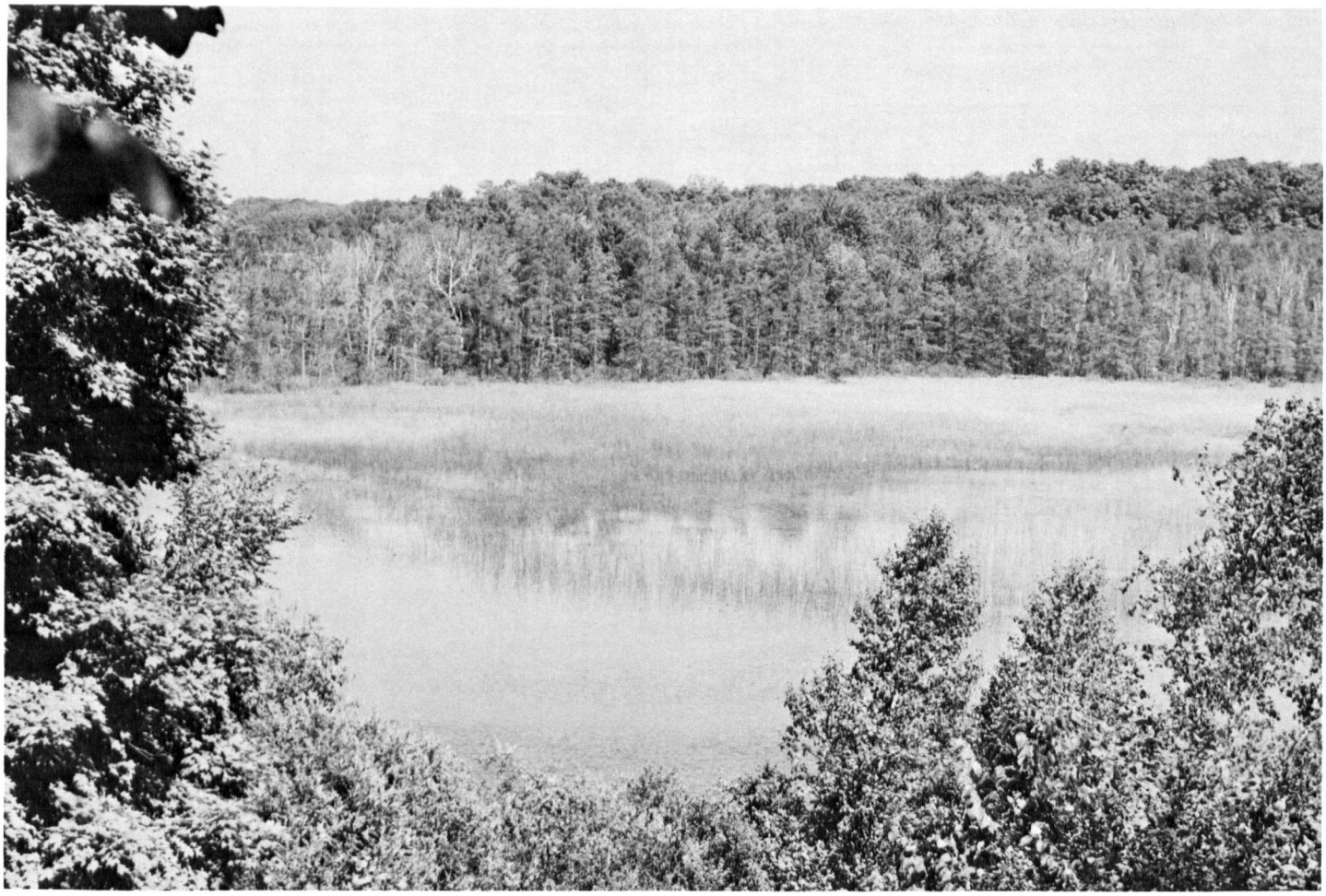

Figure 8.—Butler Lake in Mitchell Township is one of the few remaining wetlands in Sheboygan County. Houghton soils are along the shoreline.

having soils in group 1, well drained loamy soils, and soils in group 8, organic soils, is desirable.

Recreation

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 8 the soils of Sheboygan County have been placed in nine recreation groups, and the symbols of the soils assigned to each group are given. The soils are rated according to limitations that affect their use for camp areas, playgrounds, picnic areas, paths and trails, and golf course fairways.

In table 8 the soils are rated as having slight, moderate, and severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these is required.

Camp areas are used intensively for tents, small camp trailers, and the accompanying activities of outdoor living. Little preparation of the site is required other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, no flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, no flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic areas are attractive natural or landscaped tracts that are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads.

TABLE 7.—*Importance of selected elements of wildlife habitat*

[Numeral 1 indicates little or no value; 2, some value; 3, important; 4, very important. An asterisk indicates a key or critical element. Dashes indicate the element is not applicable to use by the stated kind of wildlife]

Selected wildlife species	Grain and seed crops		Grasses and legumes		Wild herbaceous upland plants	Woody plants			Wetland plants for food and cover	Water areas	
						Hardwood		Coniferous trees			
	Harvested	Unharvested	Harvested	Unharvested		Shrubs	Trees			Shallow	Deep
Migratory waterfowl:											
Ducks	3	3	1	3	3	----	1	----	*4	*4	4
Geese	4	*4	4	1	----	----	----	----	2	3	3
Upland game birds:											
Hungarian partridge	4	4	3	4	4	1	----	----	1	----	----
Pheasant	4	4	----	*4	*4	4	----	1	*4	3	----
Quail	4	4	2	4	4	*4	2	1	4	3	----
Woodcock	----	----	1	3	3	4	4	2	3	----	----
Small game:											
Rabbits, cottontail	3	4	3	*4	*4	*4	3	1	2	3	----
Raccoon	3	4	----	1	1	2	4	----	1	*4	4
Squirrels, fox and gray	3	4	----	1	1	2	*4	1	----	----	----
Large game:											
Deer	3	4	3	3	4	4	4	4	3	3	2
Furbearers:											
Beaver	----	----	----	----	----	4	*4	----	4	4	*4
Fox, red [1]	2	3	2	3	3	3	2	1	3	3	1
Mink [1]	----	----	----	----	----	2	1	1	3	*4	*4
Muskrat	1	1	----	----	----	1	----	----	4	*4	*4

[1] Carnivorous species not strictly dependent on elements listed.

The best soils are firm when wet but not dusty when dry; are free from flooding during the season of use; and do not have slopes or stoniness that greatly increase the cost of leveling sites or of building access roads.

Paths and trails are used for local and cross-country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded no more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Golf course fairways are areas beween greens or holes on the course. Soils for this use are rated in an undisturbed condition. Suitable soils must withstand intensive foot and vehicular traffic. The best soils have good drainage, a surface free of rocks and coarse fragments, no flooding during periods of heavy use, a high available water capacity, and moderate permeability. The soils should be relatively dry during the season of use and be capable of supporting a thick turf without special management.

Engineering [5]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of pre-

[5] By JOHN E. MILLIGAN, civil engineer, Soil Conservation Service, helped prepare this section.

TABLE 8.—*Degree and kind of*

Recreation groups, descriptions of soils, and map symbols	Camp areas	Playgrounds
Group 1: Mainly well drained soils; loamy surface layer; moderately or moderately rapidly permeable subsoil. Some soils in this group have a gravelly surface layer and are very rapidly permeable. Casco: CeA, CeB, CeC2, CrC, CrD2, CrE, CrF. Cut and fill land, loamy: Cy. Hebron: HeA, HeB, HfA, HfB. Sisson: SrA, SrB, SrC2.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; some areas are stony or gravelly.	Slight if slope is 0 to 2 percent, moderate if 2 to 6, severe if more than 6; erosive; some areas are stony or gravelly.
Group 2: Well drained and moderately well drained soils; silty or loamy surface layer; moderately and moderately slowly permeable subsoil. Fox: FsA, FsB, FsC2. Hochheim: HmB2, HmC2, HmD2, HmE, HsC2, HsD2, HsE, HtB. Kewaunee: KnA, KnB. St. Charles: ScA, ScB. Saylesville: ShA, ShB, SkC2. Theresa: ThA, ThB, ThC2. Waymor: WbA, WbB, WbC2. Zurich: ZuA, ZuB.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; surface is wet and soft after rains; compacts easily when wet.	Slight if slope is 0 to 2 percent, moderate if 2 to 6, severe if more than 6; erosive; compacts easily when wet; leveling can expose sand and gravel in some areas or bedrock in Hochheim-Knowles complex.
Group 3: Well drained and moderately well drained sandy and gravelly soils; droughty. Boyer: BmB, BmC2. Cut and fill land, sandy and gravelly: Cx. Oakville: OaB, OaC.	Moderate if slope is 0 to 12 percent, severe if more than 12; erosive; droughty; subject to soil blowing.	Severe: erosive; droughty; subject to soil blowing; difficult to maintain good vegetative cover.
Group 4: Somewhat poorly drained soils Fabius: FaA. Kendall: KlA. Kibbie: KuA. Lamartine: LmA. Manawa: MbA. Martinton: MgA. Mosel: MsA. Nenno: NnA, NnB. Wasepi: Wa. Yahara: YhA.	Moderate: sites remain wet for moderately long periods.	Moderate: soil saturated at a depth of less than 3 feet during wet periods; subject to occasional ponding; sod easily damaged.
Group 5: Mainly well drained and moderately well drained soils; silty or clayey surface layer; moderately slowly permeable. Cut and fill land, clayey: Cz. Kewaunee: KpB2, KpC2, KpD2, KsC3, KsD3.	Moderate if slope is 2 to 12 percent, severe if more than 12; erosive; surface muddy and slippery when wet; difficult to establish vegetative cover.	Moderate if slope is 2 to 6 percent, severe if more than 6; erosive; difficult to establish vegetative cover; muddy and slippery when wet.
Group 6: Land types, too variable to characterize. Beaches, sandy: Bd. Dune land: Dn. Gravel pit: Gp. Loamy land, seeped: Lo. Made land: Ma. Marsh: Mf. Rough broken land: Ry.	Severe: variable characteristics	Severe: variable characteristics
Group 7: Well drained and moderately well drained alluvial soils. Alluvial land: Am. Bellevue: Be, Bf. Juneau: JuA.	Severe: subject to occasional flooding	Moderate: subject to occasional flooding
Group 8: Poorly drained and very poorly, drained mineral soils. Alluvial land, wet: An. Barry: Ba. Colwood: Cw. Elvers: Ev. Granby: Gb, Gg.	Severe: sites remain wet for long periods; subject to flooding or ponding; low trafficability.	Severe: sites remain wet for long periods; subject to flooding or ponding; low trafficability.

limitation for recreational use

Picnic areas	Paths and trails	Golf course fairways
Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; some areas are stony or gravelly.	Slight if slope is 0 to 12 percent, moderate if 12 to 20, severe if more than 20.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; some areas are stony or gravelly.
Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; compacts easily when wet; some areas are stony or gravelly.	Slight if slope is 0 to 12 percent, moderate if 12 to 20, severe if more than 20; muddy and slippery when wet; some areas are stony or gravelly.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; some areas are stony or gravelly.
Moderate if slope is 0 to 12 percent, severe if more than 12; erosive; droughty; subject to soil blowing.	Moderate if slope is 0 to 12 percent, severe if more than 12; erosive; droughty; paths difficult to maintain.	Moderate if slope is 0 to 6 percent, severe if more than 6; erosive; droughty; difficult to maintain turf.
Moderate: soil saturated at a depth of less than 3 feet during wet periods; subject to occasional ponding.	Moderate: sites remain wet for moderately long periods.	Moderate: soils saturated at a depth of less than 3 feet for moderately long periods; subject to occasional ponding; turf easily damaged when wet.
Moderate if slope is 2 to 6 percent, severe if more than 6; erosive; muddy and slippery when wet; difficult to establish vegetative cover.	Moderate if slope is 2 to 12 percent, severe if more than 12; erosive; muddy and slippery when wet.	Moderate if slope is 2 to 6 percent, severe if more than 6; erosive; muddy and slippery when wet; difficult to establish good turf.
Severe: variable characteristics	Severe: variable characteristics	Severe: variable characteristics.
Moderate: subject to occasional flooding	Moderate: subject to occasional flooding	Moderate: subject to occasional flooding.
Severe: sites remain wet for long periods; subject to flooding or ponding.	Severe: sites remain wet for long periods; subject to flooding or ponding; low trafficability.	Severe: sites remain wet for long periods; subject to flooding or ponding; turf easily damaged.

TABLE 8.—*Degree and kind of*

Recreation groups, descriptions of soils, and map symbols	Camp areas	Playgrounds
Montgomery: Mo. Navan: Na. Otter: Ot. Pella: Ph. Poygan: Py. Sebewa: Sm. Stony land, wet: Sw.		
Group 9: Mainly very poorly drained organic soils; sandy areas in places. Adrian: Ag, Ak. Boots: Bk. Edwards: Ed. Houghton: Hu. Muskego: Mz. Palms: Pa. Willette: We.	Severe: sites are wet for long periods; subject to ponding; very low trafficability.	Severe: sites are wet for long periods; subject to ponding; very low trafficability.

dicting performance of structures on the same or similar kinds of soil in other locations.

6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is in tables 9, 10, and 11, which show, respectively, several estimated soil properties significant in engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 9 and 10, and it also can be used to make other useful maps.

This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 5 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning in soil science that may not be familiar to engineers. The Glossary defines many of these terms.

Engineering classification

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*2*) used by the SCS engineers, Department of Defense, and others, and the AASHTO system (*1*) adopted by the American Association of State Highway and Transportation Officials.

The Unified system is used to classify soils according to engineering uses for building material or for the support of structures other than highways. Soils are classified according to particle size distribution, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes and 11 dual classes. There are eight classes of coarse grained soils that are subdivided on the basis of gravel and sand content. These are identified as GW, GP, GM, GC, SW, SP, SM, and SC. Six classes of fine grained soils are subdivided on the basis of the plasticity index. Nonplastic classes are ML, MH, OL, and OH; plastic classes are CL and CH. There is one class of highly organic soils, Pt. Dual classifications used for a specific range of particle sizes are SP–SM, SW–SM, SU–SC, SW–SC, GP–GM, GW–GM, GP–GC, and GW–GC. For a specific range of liquid limits and plasticity indexes, the dual classifications of CL–ML, SC–SM, and GC–GM are used. For borderline cases, usually both possible classifications are listed.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system a soil is classified in one of seven basic groups ranging from A–1 through A–7 on the basis of grain size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils, which have high bearing strength and are the best soils for subgrade, or foundation. At the other extreme, in group A–7, are clay soils, which have low strength when wet and are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils,

limitation for recreational use—Continued

Picnic areas	Paths and trails	Golf course fairways
Severe: sites are wet for long periods; subject to ponding; very low trafficability.	Severe: sites are wet for long periods; subject to ponding; very low trafficability.	Severe: sites are wet for long periods; subject to ponding; very low trafficability.

with group index numbers in parentheses, is shown in table 11; the estimated classification, without group index numbers, is given in table 9 for all soils mapped in the survey area.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary. Stones, cobbles, and gravel are used as textural modifiers where present in the soil.

Estimated soil properties

Several estimated soil properties significant in engineering are given in table 9. These estimates are made by layers of representative soil profiles having significantly different soil properties. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the soil properties given in the table.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level of saturation in the soil in most years.

Hydrologic groups reflect the ability of soils to restrain runoff from a heavy storm after they have been thoroughly wetted. Where two hydrologic groups are shown, the first is for areas that are drained. *Group A* contains mainly well drained and excessively drained sandy or gravelly soils but in some cases includes drained organic soils. These soils have a high infiltration rate and a high rate of water transmission. *Group B* contains mainly moderately well drained, moderately fine textured to moderately coarse textured soils. These soils have a moderate infiltration rate and a moderate rate of water transmission. *Group C* contains moderately fine textured or fine textured soils that have layers that impede the downward movement of water. These soils have a slow infiltration rate and a slow rate of water transmission. *Group D* contains mainly clay soils that have high shrink-swell potential; soils that have a high permanent water table; soils that have a clay pan or clay layer at or near the surface; and shallow soils over a nearly impervious substratum. The soils have a very slow infiltration rate and a very slow rate of water transmission.

Soil texture is described in table 9 in the standard terms used by the Department of Agriculture. These terms are based on the percentage of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary.

Liquid limit and plasticity index are water contents obtained by specified operations. As the water content is increased in a dry, clayey soil from which the particles coarser than 0.5 millimeter have been removed, the material changes from a semisolid to a plastic. If the moisture content is further increased, the material changes from a plastic to a liquid. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic; and the liquid limit, from a plastic to a liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of water content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 9, but in table 11 the data are based on tests of soil samples.

Permeability is an estimate of the rate at which a

TABLE 9.—*Estimates of soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. Because the other series that appear in the first column of this table. Absence of data indicates that the soil is too variable

Soils series and map symbols	Depth to seasonal high water table	Hydrologic group	Depth from surface	USDA texture	Classification		Coarse fragments greater than 3 inches
					Unified	AASHTO	
	Ft		*In*				*Pct*
*Adrian: Ag, Ak	[2] 0–1	A/D	0–40	Muck	Pt		0
			40–60	Sand	SP	A–3	0
For Granby part of Ak, see Granby series; for Oakville part of Ak, see Oakville series.							
Alluvial land: Am	[2] 3–>5						
No valid estimates. Material too variable.							
Alluvial land, wet: An	[2] 0–1						
No valid estimates. Material too variable.							
Barry: Ba	[2] 0–1	D	0–10	Silt loam	ML, SM	A–4	0
			10–29	Silty clay loam and silt loam.	CL	A–6, A–7	0–3
			29–60	Gravelly sandy loam	SM	A–2, A–4	1–10
Beaches, sandy: Bd	([2])		0–60				0
No valid estimates for most items. Material too variable.							
Bellevue: Be	[2] 3–>5	C	0–10	Silt loam	ML	A–4	0
			10–23	Silty clay loam	CL	A–6	0
			23–33	Loam	CL, CL–ML	A–4, A–6	0
			33–60	Silt loam, loam, and fine sandy loam.	ML, SM	A–4	0
Bellevue variant: Bf	[2] 3–>5	B	0–18	Fine sandy loam	SM	A–4	0
			18–52	Loamy fine sand	SM	A–2	0
			52–60	Sand	SP–SM	A–2, A–3	0
Boots: Bk	[2] 0–1	A/D	0–14	Muck	Pt		
			14–40	Muck	Pt		
			40–60	Muck	Pt		
Boyer: BmB, BmC2	>5	A	0–8	Loamy sand	SM	A–2	0–5
			8–26	Sandy loam	SM	A–2, A–4	0–5
			26–60	Sand and gravel	SP–SM	A–1, A–3	0–10
*Casco: CeA, CeB, CeC2, CrC, CrD2, CrE, Crr.	>5	B	0–8	Loam	ML	A–4	0–10
			8–17	Sandy clay loam and clay loam.	SC or CL	A–6	0–10
For Rodman part of CrC, CrD2, CrE, and Crr, see Rodman series.			17–60	Gravel and sand	SP, SP–SM, GP or GP–GM	A–1 or A–3	5–10
Colwood: Cw	[2] 0–1	B/D	0–11	Silt loam	CL or CL–ML	A–4	0
			11–27	Silt loam	CL	A–6	0
			27–33	Loam	ML, CL–ML or CL	A–4	0
			33–60	Silt and very fine sand	ML	A–4	0
Cut and fill land, sandy and gravelly: Cx	>5		0–60				
Too variable to be rated for most items.							
Cut and fill land, loamy: Cy	>5		0–60				
Too variable to be rated for most items.							
Cut and fill land, clayey: Cz	1–>5		0–60				
Too variable to be rated for most items.							

See footnotes at end of table.

significant in engineering

soils in such mapping units can have different properties and limitations, it is necessary to follow carefully the instructions for referring to to be rated or that no estimate was made. The symbol > means greater than; the symbol < means less than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In/hr*	*In/in of soil*	*pH*			
					NP	2.0–6.0	0.35–0.45	6.1–7.8		High	Low to moderate.
100	90–95	60–75	1–4		NP	6.0–20.0	0.05–0.07	7.4–7.8	Low	High	Low.
95–100	95–100	65–90	36–65	<30	NP–5	0.6–2.0	0.22–0.24	6.1–7.8	Low	High	Low.
95–100	80–90	80–90	75–85	30–45	16–30	0.6–2.0	0.18–0.20	6.1–7.8	Moderate	High	Low.
85–95	70–90	60–70	25–45		NP	2.0–6.0	0.11–0.13	7.4–8.4	Low	High	Low.
100	95–100	10–30	0–1			>20.0					
100	100	85–100	55–85	<30	NP–4	0.6–2.0	0.22–0.24	6.6–7.3	Low	Low	Low.
100	100	85–100	80–90	25–40	13–20	0.6–2.0	0.18–0.20	6.6–7.3	Moderate	Low	Low.
100	100	60–95	50–70	20–30	5–15	0.6–2.0	0.17–0.19	6.6–7.3	Low	Low	Low.
100	100	85–100	40–80		NP	0.6–2.0	0.20–0.24	7.4–7.8	Low	Low	Low.
95–100	90–100	70–85	45–50	<19	NP–4	2.0–6.0	0.16–0.18	7.4–8.4	Low	Low	Low.
95–100	90–100	70–90	30–34		NP	2.0–6.0	0.10–0.13	7.4–8.4	Low	Low	Low.
95–100	90–100	60–70	5–15		NP	6.0–20.0	0.05–0.07	7.4–8.4	Low	Low	Low.
						2.0–6.0	0.35–0.45	6.1–7.8		Moderate	Low to moderate.
						2.0–6.0	0.35–0.45	6.1–7.8		Moderate	Low to moderate.
						2.0–6.0	0.35–0.45	6.1–7.8		Moderate	Low to moderate.
95–100	90–100	45–70	15–30		NP	6.0–20.0	0.10–0.12	6.1–7.8	Low	Low	Low.
95–100	80–100	55–85	25–40		NP	2.0–6.0	0.12–0.14	6.1–7.8	Low	Low	Low.
60–90	30–75	30–60	5–10		NP	>20.0	0.02–0.04	7.4–8.4	Low	Low	Low.
95–100	90–100	85–95	50–70	<30	NP–5	0.6–2.0	0.20–0.22	6.1–7.3	Low	Low	Low.
85–100	80–90	70–90	45–55	25–40	11–20	0.6–2.0	0.16–0.18	6.1–7.3	Moderate	Low	Low.
30–95	30–90	10–90	3–10		NP	>20.0	0.02–0.04	7.4–8.4	Low	Low	Low.
100	100	90–100	70–90	20–30	5–9	0.6–2.0	0.22–0.24	6.6–7.8	Low	Moderate	Low.
100	100	80–100	80–95	30–40	10–20	0.6–2.0	0.18–0.20	6.6–7.8	Moderate	High	Low.
100	100	80–100	50–70	<30	NP–10	0.6–2.0	0.17–0.19	6.6–7.8	Low	High	Low.
100	100	70–100	70–80		NP	0.6–2.0	0.18–0.20	7.4–8.4	Low	High	Low.
						6.0–20.0	0.02–0.04				
						0.6–6.0	0.10–0.12				
						0.2–0.6	0.10–0.12				

TABLE 9.—*Estimates of soil properties*

Soils series and map symbols	Depth to seasonal high water table	Hydrologic group	Depth from surface	USDA texture	Classification		Coarse fragments greater than 3 inches
					Unified	AASHTO	
	Ft		*In*				*Pct*
Dune land: Dn Too variable to be rated.	>5						
Edwards: Ed	[2] 0–1	B/D	0–38	Muck	Pt		
			38–60	Marl			
Elvers: Ev	[2] 0–1	D	0–22	Silt loam	ML	A–4	0
			22–60	Muck	Pt		
Fabius: FaA	[2] 1–3	B	0–12	Loam	ML	A–4	0–5
			12–16	Clay loam	CL	A–6	0–5
			16–19	Gravelly sandy loam	SM	A–2 or A–4	5–10
			19–43	Sand and gravel	SP	A–1	5–10
			43–60	Fine sand	SM	A–2	0
Fox: FsA, FsB, FsC2	>5	B	0–13	Silt loam	ML	A–4	0
			13–27	Clay loam	CL	A–6	0
			27–60	Sand and gravel	SP or SW	A–1	0–5
Granby: Gb	[2] 0–1	A/D	0–13	Loamy fine sand	SM	A–2 or A–4	0
			13–60	Sand	SM	A–2 or A–3	0
Granby variant: Gg	[2] 0–1	A/D	0–9	Silt loam	ML	A–4	0
			9–18	Gravelly sandy loam	SM	A–2	0–5
			18–60	Sand and gravel, gravelly loamy sand.	SP or SW	A–1	5–10
Gravel pit: Gp Too variable to be rated for most items.	>5						
Hebron: HeA, HeB	3–>5	C	0–12	Loam	ML	A–4	0
			12–23	Sandy loam	SM	A–2 or A–4	0
			23–60	Silty clay loam	CL	A–7	0
Hebron variant: HfA, HfB	3–>5	C	0–8	Sandy loam	SM	A–2 or A–4	0–5
			8–18	Loamy sand	SM	A–2	0–5
			18–26	Sandy clay loam	SC or CL	A–4 or A–6	0–5
			26–33	Loamy sand	SM	A–2	0–5
			33–38	Silty clay	CL	A–7	0
			38–60	Silt loam, silty clay loam, and silty clay.	CL	A–7	0
*Hochheim: HmB2, HmC2, HmD2, HmE, HsC2, HsD2, HsE, and HtB. For Casco part of HsC2, HsD2, and HsE, see Casco series; for Sisson part of HsC2, HsD2, and HsE, see Sisson series; for Knowles part of HtB, see Knowles series.	>5	B	0–10	Silt loam	CL or CL–ML	A–4	0
			10–22	Clay loam	CL	A–7	0–5
			22–60	Gravelly sandy loam	SM	A–2 or A–4	5–10
Houghton: Hu	[2] 0–1	A/D	0–60	Muck	Pt		
Juneau: JuA	[2] 3–>5	B	0–35	Silt loam	CL or CL–ML	A–4	0
			35–45	Silt loam	ML	A–4	0
			45–60	Silt loam	CL	A–6	0
Kendall: KlA	[2] 1–3	B	0–9	Silt loam	ML	A–4	0
			9–34	Silty clay loam	CL	A–7	0
			34–50	Loam and silt loam	ML	A–4	0
			50–60	Gravelly loam	ML	A–4	0–10
Kewaunee: KnA, KnB, KpB2, KpC2, KpD2, KsC3, KsD3.	3–>5	C	0–8	Silt loam	CL or CL–ML	A–4	0
			8–20	Silty clay	CL or CH	A–7	0
			20–60	Silty clay loam	CL	A–6	0

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In/hr*	*In/in of soil*	*pH*			
						2.0–6.0	0.35–0.45	6.1–7.8		High	Low to moderate.
						0.06–0.2	0.25–0.35	7.4–8.4		High	Low.
100	100	100	70–90	<30	NP–4	0.6–2.0	0.22–0.24	6.1–7.8	Low	High	Low.
						2.0–6.0	0.35–0.45	6.1–7.8		High	Low to moderate.
95–100	90–100	85–95	60–70	25–35	4–7	0.6–2.0	0.20–0.22	6.6–7.3	Low	Moderate	Low.
95–100	90–100	90–100	70–80	30–40	11–21	0.6–2.0	0.15–0.19	6.6–7.8	Moderate	Moderate	Low.
70–85	70–85	60–60	30–40	10–19	1–4	0.6–2.0	0.10–0.12	6.6–7.8	Low	Moderate	Low.
65–75	40–45	30–80	1–4		NP	2.0–6.0	0.02–0.04	7.9–8.4	Low	Low	Low.
95–100	90–100	65–80	20–35		NP	2.0–6.0	0.06–0.08	7.9–8.4	Low	Low	Low.
95–100	95–100	90–95	70–90	30–35	5–10	0.6–2.0	0.22–0.24	6.6–7.3	Low	Low	Low.
95–100	85–100	85–95	70–85	25–30	12–20	0.6–2.0	0.15–0.19	6.1–7.8	Moderate	Low	Low.
65–75	40–60	20–40	2–5		NP	>20.0	0.02–0.04	7.4–8.4	Low	Low	Low.
100	100	50–70	20–40		NP	6.0–20.0	0.10–0.12	6.1–7.3	Low	High	Low.
100	95–100	50–70	5–15		NP	6.0–20.0	0.06–0.08	6.1–7.3	Low	High	Low.
95–100	95–100	90–95	70–80	30–35	5–10	2.0–6.0	0.22–0.24	6.6–8.4	Low	Moderate	Low.
80–85	60–85	65–75	25–30		NP	2.0–6.0	0.10–0.12	7.4–8.4	Low	Moderate	Low.
60–65	40–45	20–50	0–4		NP	>20.0	0.03–0.05	7.9–8.4	Low	High	Low.
						>20.0	0.02–0.04				
95–100	90–100	85–100	60–70	20–30	1–5	0.6–2.0	0.20–0.22	6.6–7.8	Low	Low	Low.
95–100	90–100	60–70	30–40	10–15	1–2	0.6–2.0	0.12–0.14	6.6–8.4	Low	Low	Low.
100	90–100	90–100	85–95	40–45	20–25	0.2–0.6	0.18–0.20	7.4–8.4	Moderate	Moderate	Low.
95–100	90–100	60–70	30–40	10–19	1–4	2.0–6.0	0.13–0.15	6.1–7.3	Low	Low	Low.
95–100	90–100	50–75	15–30		NP	2.0–6.0	0.09–0.11	6.1–6.5	Low	Low	Moderate.
95–100	90–100	80–90	35–55	20–29	7–13	0.6–2.0	0.16–0.18	6.1–7.3	Moderate	Low	Low.
95–100	90–100	50–75	15–30		NP	2.0–6.0	0.09–0.11	6.1–7.3	Low	Low	Low.
100	100	95–100	90–95	40–49	23–29	0.2–0.6	0.11–0.13	6.6–7.8	Moderate	Moderate	Low.
100	100	95–100	85–95	40–45	20–25	0.2–0.6	0.10–0.20	7.9–8.4	Moderate	Moderate	Low.
95–100	95–100	85–100	70–90	20–30	5–10	0.6–2.0	0.22–0.24	6.1–7.3	Low	Low	Low.
95–100	90–100	90–100	70–85	40–45	20–25	0.6–2.0	0.15–0.19	6.1–7.8	Moderate	Low	Low.
70–85	60–85	60–70	25–45		NP	0.6–2.0	0.09–0.11	7.9–8.4	Low	Low	Low.
						2.0–6.0	0.35–0.45	6.1–7.8		High	Low to moderate.
100	100	95–100	70–90	20–30	5–10	0.6–2.0	0.22–0.24	6.1–7.8	Low	Moderate	Moderate.
100	100	90–100	70–90	35–40	5–10	0.6–2.0	0.20–0.22	6.1–7.8	Low	Moderate	Moderate.
100	100	90–100	70–90	35–40	15–30	0.6–2.0	0.20–0.22	6.1–7.8	Moderate	Moderate	Moderate.
100	100	90–100	70–90	35–40	5–8	0.6–2.0	0.22–0.24	6.6–7.3	Low	Moderate	Low.
100	95–100	95–100	85–95	40–45	20–25	0.6–2.0	0.18–0.20	6.6–7.8	Moderate	Moderate	Low.
95–100	90–100	85–95	60–75	30–35	2–5	0.6–2.0	0.17–0.19	6.6–7.8	Low	High	Low.
80–95	80–90	70–85	60–75		NP	0.6–2.0	0.17–0.19	7.4–8.4	Low	High	Low.
100	100	90–100	70–90	20–30	5–10	0.6–2.0	0.22–0.24	6.1–7.3	Low	Moderate	Low.
100	95–100	95–100	80–95	45–60	25–40	0.2–0.6	0.11–0.13	6.1–7.8	Moderate	High	Low.
95–100	95–100	90–100	70–95	30–40	15–25	0.2–0.6	0.18–0.20	7.4–8.4	Moderate	High	Low.

TABLE 9.—*Estimates of soil properties*

Soils series and map symbols	Depth to seasonal high water table	Hydrologic group	Depth from surface	USDA texture	Classification		Coarse fragments greater than 3 inches
					Unified	AASHTO	
	Ft		*In*				*Pct*
Kibbie: KuA	[2] 1–3	B	0–8	Silt loam	ML	A–4	0
			8–18	Clay loam	CL	A–6	0
			18–60	Silt, very fine sand, and silt loam.	ML	A–4	0
Knowles	>5	B	0–8	Silt loam	CL–ML or CL	A–4	0
Mapped only with Hochheim soils.			8–26	Silty clay loam and clay loam.	CL	A–6 or A–7	0
			26–60	Dolomite.			
Lamartine: LmA	1–3	B	0–14	Silt loam	CL or CL–ML	A–4	0
			14–28	Clay loam and silty clay loam.	CL	A–6	0–5
			28–60	Gravelly sandy loam	SM	A–2 or A–4	5–10
Loamy land, seeped: Lo	0–1						
Too variable to be rated.							
Made land: Ma.							
Too variable to be rated.							
Manawa: MbA	[2] 1–3	C	0–8	Silt loam	CL or CL–ML	A–4	0
			8–18	Clay	CL	A–7	0
			18–60	Silty clay loam	CL	A–6	0
Marsh: Mf	[2] 0–1						
Too variable to be rated for most items.							
Martinton: MgA	[2] 1–3	B	0–10	Silt loam	ML	A–4	0
			10–36	Silty clay	CH	A–7	0
			36–60	Silt loam and silty clay loam.	CL	A–6	0
Matherton: MkA	[2] 1–3	B	0–16	Silt loam	CL or CL–ML	A–4	0
			16–29	Clay loam and silty clay loam.	CL	A–6	0–5
			29–60	Sand and gravel	SP	A–1 or A–3	5–10
Montgomery: Mo	0–1	D	0–12	Silty clay loam	CL	A–7	0
			12–25	Silty clay	CH	A–7	0
			25–60	Silt, clay, and very fine sand.	CL	A–7	0
Mosel: MsA	1–3	C	0–9	Loam	ML	A–4	0
			9–26	Clay loam	CL–ML or CL	A–4	0
			26–60	Silty clay loam	CL	A–7	0
Muskego: Mz	[2] 0–1	D	0–40	Muck	Pt	----------	--------
			40–60	Coprogenous material	OH	----------	--------
Navan: Na	[2] 0–1	D	0–11	Loam	ML	A–4	0
			11–30	Sandy clay loam and loam.	CL, ML, SM or SC	A–6 or A–2	0
			30–36	Silty clay loam	CL	A–6 or A–7	0
			36–60	Silt and clay	CL	A–7	0
Nenno: NnA, NnB	[2] 1–3	B	0–8	Silt loam	CL or CL–ML	A–4	0
			8–20	Clay loam and loam	CL	A–6 or A–7	0
			20–60	Gravelly loam	ML	A–4	5–15
Oakville: OaB, OaC	3–>5	A	0–12	Loamy fine sand	SM	A–2	0
			12–60	Sand and fine sand	SM or SP–SM	A–2	0

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In/hr*	*In/in of soil*	*pH*			
100	100	90–100	70–90	20–40	5–8	0.6–2.0	0.22–0.24	6.6–7.8	Low	High	Low.
100	100	90–100	70–80	30–35	15–20	0.6–2.0	0.15–0.19	6.6–7.8	Low	High	Low.
100	100	70–100	70–80		NP	0.6–2.0	0.18–0.20	7.4–8.4	Low	High	Low.
100	100	90–100	85–95	20–30	5–10	0.6–2.0	0.22–0.24	6.1–7.3	Low	Low	Low.
95–100	95–100	90–100	85–95	35–45	15–25	0.6–2.0	0.18–0.20	6.1–7.8	Moderate	Moderate	Low.
100	100	90–100	70–90	20–30	5–10	0.6–2.0	0.22–0.24	6.1–7.8	Low	High	Low.
95–100	90–100	90–100	70–80	35–40	15–20	0.6–2.0	0.15–0.19	6.1–7.8	Low	High	Low.
85–95	70–90	60–70	25–45		NP	0.6–2.0	0.10–0.12	7.4–8.4	Low	High	Low.
100	100	90–100	70–90	20–30	5–10	0.6–2.0	0.22–0.24	6.1–7.3	Low	Low	Low.
100	95–100	90–100	80–90	45–50	25–35	0.06–0.2	0.09–0.11	6.6–7.8	Moderate	High	Low.
95–100	95–100	80–100	85–95	30–40	15–25	0.06–0.2	0.18–0.20	7.9–8.4	Moderate	High	Low.
100	100	90–100	70–90	35–40	5–8	0.6–2.0	0.22–0.24	6.6–7.8	Low	Moderate	Low.
100	100	95–100	90–95	60–65	35–40	0.2–0.6	0.11–0.13	6.6–7.8	Moderate	Moderate	Low.
100	100	90–100	70–90	30–35	12–15	0.2–0.6	0.18–0.22	7.4–8.4	Moderate	Moderate	Low.
100	95–100	90–100	70–90	20–25	5–8	2.0–6.0	0.22–0.24	6.6–7.8	Low	High	Low.
95–100	80–90	55–90	50–80	30–40	15–20	0.6–2.0	0.15–0.19	6.6–7.8	Low	High	Low.
60–80	30–75	30–60	0–4		NP	6.0–20.0	0.02–0.04	7.4–8.4	Low	High	Low.
100	100	95–100	85–95	41–45	20–25	0.2–0.6	0.21–0.23	6.6–7.3	High	High	Low.
100	100	95–100	90–95	50–55	30–35	0.06–0.2	0.11–0.13	6.6–7.8	High	High	Low.
100	100	90–100	85–95	41–50	20–30	0.06–0.2	0.18–0.20	7.4–8.4	Moderate	High	Low.
100	100	85–95	60–75	20–30	1–5	0.6–2.0	0.20–0.22	6.6–7.3	Low	High	Low.
95–100	80–100	80–95	70–80	20–30	5–10	0.6–2.0	0.15–0.19	6.6–7.8	Low	High	Low.
100	100	85–100	85–90	45–50	25–30	0.2–0.6	0.18–0.20	7.4–8.4	Moderate	High	Low.
						2.0–6.0	0.35–0.45	6.1–7.8		Moderate	Low to moderate.
						0.06–0.2	0.25–0.35	7.4–7.8		Moderate	Low.
100	100	85–95	60–75	30–35	5–10	0.6–2.0	0.20–0.22	6.6–7.3	Low	High	Low.
95–100	80–100	75–85	30–55	35–40	10–15	0.6–2.0	0.16–0.18	6.6–8.4	Low	High	Low.
100	100	95–100	85–95	35–50	20–30	0.06–0.2	0.18–0.20	6.6–8.4	Moderate	High	Low.
100	100	95–100	85–100	40–50	20–30	0.06–0.2	0.08–0.20	7.4–8.4	Moderate	High	Low.
100	100	90–100	70–90	20–30	5–10	0.6–2.0	0.22–0.24	6.6–7.3	Low	High	Low.
95–100	95–100	90–100	70–80	35–45	16–24	0.6–2.0	0.15–0.19	6.6–7.8	Moderate	High	Low.
85–90	60–85	60–85	60–75		NP	0.6–2.0	0.14–0.16	7.4–8.4	Low	High	Low.
100	100	55–75	20–35		NP	6.0–20.0	0.10–0.12	5.6–6.5	Low	Low	Moderate.
100	95–100	65–80	10–30		NP	>20.0	0.06–0.08	5.6–7.3	Low	Low	Moderate.

TABLE 9.—*Estimates of soil properties*

Soils series and map symbols	Depth to seasonal high water table	Hydrologic group	Depth from surface	USDA texture	Classification		Coarse fragments greater than 3 inches
					Unified	AASHTO	
	Ft		*In*				*Pct*
Otter: Ot	[2] 0–1	B/D	0–16	Silt loam	CL	A–6	0
			16–36	Silty clay loam and silt loam.	CL	A–6	0
			36–60	Silt loam	CL	A–6	0
Palms: Pa	[2] 0–1	A/D	0–36	Muck	Pt		
			36–60	Silt loam	CL or CL–ML	A–4 or A–6	0
Pella: Ph	[2] 0–1	B/D	0–16	Silt loam	ML	A–4	0
			16–35	Silty clay loam	CL	A–6	0
			35–60	Silt loam	ML	A–4	0
Poygan: Py	[2] 0–1	D	0–11	Silty clay loam	CL or CH	A–7	0
			11–24	Silty clay loam	CL or CH	A–7	0
			24–60	Silty clay	CL	A–6 or A–7	0
Rodman	>5	A	0–9	Gravelly sandy loam	SM	A–2 or A–4	0–10
			9–60	Gravel and sand	SP, SP–SM, SW, SW–SM, GP, GW, GP–GM, GW–GM	A–1	5–15
Mapped only with Casco soil.							
Rough broken land: Ry	>5						
Too variable to be rated for most items.							
St. Charles: ScA, ScB	3–>5	B	0–15	Silt loam	ML	A–4	0
			15–42	Silty clay loam and silt loam.	CL	A–6	0
			42–54	Loam	ML	A–4	0
			54–60	Silt loam and loam	CL or CL–ML	A–4	0–5
Saylesville: ShA, ShB, SkC2	3–>5	C	0–7	Silt loam	CL or CL–ML	A–4	0
			7–29	Silty clay loam and silty clay.	CH	A–7	0
			29–60	Silt loam and silty clay loam.	CL	A–6	0
Sebewa: Sm	[2] 0–1	B/D	0–10	Silt loam	ML	A–4	0
			10–20	Silty clay loam	CL	A–6	0
			20–33	Gravelly clay loam	CL	A–6	0–5
			33–60	Sand and gravel	SP–SM	A–1	10–20
Sisson: SrA, SrB, SrC2	>5	B	0–10	Very fine sandy loam	CL or CL–ML	A–4	0
			10–23	Clay loam	CL	A–6	0
			23–60	Silt and very fine sand	ML or CL–ML	A–4	0
Stony land, wet: Sw	0–1						
Too variable to be rated for most items.							
Theresa: ThA, ThB, ThC2	>5	B	0–11	Silt loam	CL or CL–ML	A–4	0
			11–30	Silty clay loam and clay loam.	CL	A–7	0
			30–35	Gravelly clay loam	CL	A–6 or A–7	0–5
			35–60	Gravelly sandy loam	SM	A–2 or A–4	5–10
Wasepi: Wa	[2] 1–3	B	0–14	Sandy loam	SM	A–2	0
			14–29	Sandy loam and loamy sand.	SM or SC	A–2	0–5
			29–60	Sand and fine sand	SP–SM	A–2 or A–3	0–5
Waymor: WbA, WbB, WbC2	>5	B	0–9	Silt loam	CL or CL–ML	A–4	0
			9–31	Silty clay loam and clay loam.	CL	A–6 or A–7	0–5
			31–60	Loam	CL or CL–ML	A–4	0–10

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In/hr*	*In/in of soil*	*pH*			
100	100	90–100	70–90	30–35	10–15	0.6–2.0	0.22–0.24	6.6–7.8	Low	High	Low.
100	100	95–100	85–95	30–35	10–20	0.6–2.0	0.18–0.20	6.6–7.8	Low	High	Low.
100	100	90–100	70–90	20–35	10–15	0.6–2.0	0.20–0.22	6.6–7.8	Low	High	Low.
						2.0–6.0	0.35–0.45	6.1–7.8		High	Low to moderate.
100	100	90–100	70–90	25–30	6–12	0.6–2.0	0.20–0.22	7.4–8.4	Low	High	Low.
100	100	90–100	70–90	30–35	5–8	0.6–2.0	0.22–0.24	6.1–7.8	Low	Moderate	Low.
100	100	95–100	85–95	35–40	18–23	0.6–2.0	0.18–0.20	6.1–7.8	Low	Moderate	Low.
100	100	85–95	70–90	30–35	5–8	0.6–2.0	0.20–0.22	7.4–8.4	Low	High	Low.
100	100	95–100	85–95	45–55	25–35	0.2–0.6	0.21–0.23	6.6–7.8	Moderate	High	Low.
100	100	95–100	85–95	45–60	30–45	0.06–0.2	0.18–0.20	6.6–7.8	Moderate	High	Low.
100	95–100	95–100	85–95	30–55	15–45	0.06–0.2	0.10–0.12	7.4–8.4	Moderate	High	Low.
70–85	65–85	60–80	25–45		NP	2.0–6.0	0.10–0.12	6.6–7.8	Low	Low	Low.
30–70	25–55	7–20	2–10		NP	>20.0	0.02–0.04	7.4–8.4	Low	Low	Low.
						0.2–0.6	0.08–0.12				
100	100	90–100	70–90	30–35	5–8	0.6–2.0	0.22–0.24	5.6–7.3	Low	Low	Low to moderate.
100	100	95–100	85–95	35–40	16–20	0.6–2.0	0.18–0.20	5.6–7.3	Moderate	Low	Low to moderate.
100	100	85–95	60–75	35–40	4–7	0.6–2.0	0.17–0.19	5.6–7.3	Low	Low	Low to moderate.
90–100	80–90	60–90	60–90	8–25	5–8	0.6–2.0	0.17–0.22	5.6–7.8	Low	Low	Low to moderate.
100	100	90–100	70–90	20–30	5–10	0.6–2.0	0.22–0.24	6.6–7.8	Low	Low	Low.
100	100	95–100	85–95	55–65	35–40	0.2–0.6	0.18–0.20	6.6–7.8	Moderate	High	Low.
100	100	90–100	70–95	30–35	12–15	0.2–0.6	0.18–0.22	7.4–8.4	Moderate	High	Low.
100	100	90–100	70–90	30–35	5–8	0.6–2.0	0.22–0.24	6.6–7.3	Low	Moderate	Low.
100	95–100	85–100	85–95	35–40	16–20	0.6–2.0	0.18–0.20	6.6–7.8	Moderate	Moderate	Low.
90–95	80–85	55–85	50–80	30–35	12–16	0.6–2.0	0.12–0.17	6.6–7.8	Low	Moderate	Low.
60–90	30–75	30–60	5–10		NP	6.0–20.0	0.02–0.04	7.4–8.4	Low	High	Low.
100	100	85–95	55–65	18–25	4–10	0.6–2.0	0.20–0.22	6.1–7.3	Low	Low	Low.
100	100	90–100	70–80	25–40	10–21	0.6–2.0	0.15–0.19	6.1–7.8	Low	Low	Low.
100	100	75–90	50–80	15–25	NP–7	0.6–2.0	0.07–0.22	7.4–8.4	Low	Low	Low.
100	100	90–100	70–90	20–30	5–10	0.6–2.0	0.22–0.24	6.6–7.3	Low	Low	Low.
100	95–100	95–100	55–90	35–50	20–30	0.6–2.0	0.18–0.20	6.6–7.8	Moderate	Moderate	Low.
90–95	80–85	55–85	50–80	35–50	15–30	0.6–2.0	0.15–0.19	6.6–7.8	Moderate	Moderate	Low.
70–85	60–85	60–75	25–45		NP	0.6–2.0	0.11–0.13	7.4–8.4	Low	Low	Low.
100	95–100	60–70	25–30		NP	2.0–6.0	0.13–0.15	5.6–7.3	Low	Moderate	Low to moderate.
95–100	90–95	55–70	20–35	15–35	2–16	2.0–6.0	0.12–0.14	5.6–7.8	Low	Moderate	Low to moderate.
95–100	90–95	50–70	5–15		NP	6.0–20.0	0.05–0.07	7.4–8.4	Low	Moderate	Low.
100	100	90–100	75–90	20–30	5–10	0.6–2.0	0.22–0.24	6.6–7.3	Low	Low	Low.
95–100	90–100	90–100	75–90	35–50	20–25	0.6–2.0	0.18–0.20	6.6–7.8	Moderate	Moderate	Low.
90–100	85–95	80–90	60–75	20–30	5–10	0.6–2.0	0.17–0.19	7.4–8.4	Low	Low	Low.

TABLE 9.—*Estimates of soil properties*

Soils series and map symbols	Depth to seasonal high water table	Hydrologic group	Depth from surface	USDA texture	Classification		Coarse fragments greater than 3 inches
					Unified	AASHTO	
	Ft		*In*				*Pct*
Willette: We	[2] 0–1	A/D	0–24	Muck	Pt		
			24–29	Coprogenous material	Pt		
			29–60	Silty clay	CL	A–7	0
Yahara: YhA	1–3	B	0–14	Very fine sandy loam	ML	A–4	0
			14–60	Stratified silt and very fine sand.	ML or SM	A–4	0
Zurich: ZuA, ZuB	3–>5	B	0–9	Silt loam	ML	A–4	0
			9–22	Silty clay loam	CL	A–7	0
			22–60	Silt and very fine sand	ML	A–4	0

[1] In many areas the pH of the surface layer is higher than the specified value as a result of liming.

saturated soil transmits water in a vertical direction under a unit head of pressure. It is estimated on the basis of those soil characteristics observed in the field, particularly structure, porosity, and texture. Lateral seepage or such transient soil features as plowpans and surface crusts are not considered.

Available water capacity is an estimate of the capacity of soils to hold water for use by most plants. It is the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most plants.

Reaction refers to the acidity or alkalinity of a soil, expressed in pH values for a stated soil-solution mixture. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks when dry or swells when wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating. Shrink-swell potential is not indicated for organic soils or certain soils which shrink markedly on drying but do not swell quickly when rewetted.

Risk of corrosion, as used in table 9, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion on uncoated steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. The rate of corrosion on concrete is influenced mainly by the content of sodium or magnesium sulfate but also by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. In most construction situations (backfilling a trench, driving piling, covering a conduit, etc.), the steel will come in contact with the soils of more than one horizon, thereby raising the potential for corrosion of uncoated steel. A corrosion rating of *low* indicates a low probability of soil-induced corrosion damage. A rating of *high* indicates a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Other soil properties significant to engineering are depth to bedrock and subsidence. Most soils in the survey area are deep enough that bedrock generally does not affect their use. Only Knowles soils are underlain by dolomite bedrock between a depth of 20 to 40 inches.

Subsidence pertains to the settlement of organic soils that are drained or of soils that contain semifluid mineral layers. Ratings for subsidence take into account rapid initial lowering of elevation resulting from drainage and lowering of the level of the ground water and later and slower loss of elevation that results from oxidation of organic materials. The maximum possible lowering of surface elevation is called *potential subsidence*. Only the organic soils that are drained are subject to subsidence. These include Adrian, Boots, Edwards, Houghton, Muskego, Palms, and Willette soils. Elvers soils are underlain by organic materials and are also subject to subsidence. Subsidence of these drained soils is approximately ½ to 1 inch per year. A more complete discussion of subsidence is given in the section "Crops and Pasture," where drainage is discussed.

Engineering interpretations

The estimated interpretations in table 10 are based on the engineering properties of soils shown in table 9, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Sheboygan County. In table 10, ratings are used to summarize limitation or

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In/hr*	*In/in of soil*	*pH*			
						2.0–6.0	0.35–0.45	6.1–7.8		High	Low to moderate.
						0.6–0.2	0.25–0.35	7.4–7.8	High	High	Low.
100	100	90–100	85–90	45–50	25–30	0.06–0.2	0.10–0.12	7.4–8.4	High	High	Low.
100	100	85–95	50–65	<30	NP–5	0.6–2.0	0.20–0.22	7.4–7.8	Low	High	Low.
100	100	85–95	40–80	<30	NP–5	0.6–2.0	0.18–0.20	7.4–8.4	Low	High	Low.
100	100	85–95	75–85	30–35	5–8	0.6–2.0	0.22–0.24	6.1–7.8	Low	Low	Low.
100	100	85–95	80–85	41–45	20–25	0.6–2.0	0.18–0.20	6.1–7.8	Low	Low	Low.
100	100	85–95	75–80		NP	0.6–2.0	0.18–0.20	7.4–8.4	Low	Moderate	Low.

[2] Soils are subject to flooding, ponding, or occasional overflow of short duration.
[3] NP means nonplastic.

suitability of the soils for all listed purposes except ponds and reservoirs, embankments, drainage for crops and pasture, terraces and diversions, and grassed waterways. For these particular uses, table 10 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are expressed as slight, moderate, and severe. *Slight* means that soil properties are generally favorable for the rated use, or limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required. For some uses, the rating of *severe* is divided into severe and very severe. *Very severe* means that one or more soil properties are so unfavorable for a particular use that overcoming the limitations is difficult and costly and commonly not practical for the rated use.

Soil suitability is expressed as good, fair, and poor, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of some of the columns in table 10.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 5 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope, the risk of soil erosion, lateral seepage, and downslope flow of effluent are soil properties that affect difficulty of layout and construction. Large rocks or boulders increase construction costs (*5*).

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. It is assumed that the embankment is compacted to medium density and the pond is protected from flooding. Properties that affect the pond floor and the embankment are considered. Those that affect the pond floor are permeability, organic matter, and slope. If the floor needs to be leveled, depth to bedrock is important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the content of stones, if any, that influences the ease of excavation and compaction of the embankment material.

Dwellings with basements, as rated in table 10, are no more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill refers to a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 10 apply only to a depth of about 6 feet. Limitation ratings of *slight* or *moderate*, therefore, may not be valid if trenches are to be deeper than that. For some soils, reliable predictions can be made to a depth of 10 or 15 feet, but every site should be investigated before it is selected.

TABLE 10.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. Because the other series that appear in

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
*Adrian: Ag, Ak. For Granby part of Ak, see Granby series; for Oakville part of Ak, see Oakville series.	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; rapid permeability in substratum.	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; low bearing strength; rapid permeability in substratum.	Very severe: high water table; subject to frequent flooding; low bearing strength.
Alluvial land: Am	Severe: subject to flooding; seasonal high water table in places.	Severe: subject to flooding; seasonal high water table in places.	Severe: subject to flooding; seasonal high water table in places.	Severe: subject to flooding; seasonal high water table in places.	Severe: subject to flooding; moderate frost action potential.
Alluvial land, wet: An	Severe: seasonal high water table; subject to flooding.	Severe: seasonal high water table; subject to flooding.	Severe: seasonal high water table; subject to flooding.	Severe: seasonal high water table; subject to flooding.	Severe: seasonal high water table; subject to flooding; high frost action potential.
Barry: Ba	Very severe: seasonal high water table; subject to flooding.	Severe: seasonal high water table; subject to flooding.	Severe: seasonal high water table; subject to flooding	Severe: seasonal high water table; subject to flooding.	Severe: seasonal high water table; subject to flooding.
Beaches, sandy: Bd	Severe: seasonal high water table.[1]	Severe: seasonal high water table; very rapid permeability.	Severe: seasonal high water table.	Severe: seasonal high water table; very rapid permeability.[1]	Moderate: seasonal high water table.
Bellevue: Be	Severe: subject to frequent flooding.	Moderate: seasonal high water table in places; moderate permeability.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.
Bellevue variant: Bf	Severe: subject to frequent flooding.	Severe: moderately rapid permeability.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding; moderately rapid permeability.	Severe: subject to frequent flooding.

See footnote at end of table.

interpretations

soils in such mapping units can have different properties and limitations, it is necessary to follow carefully the instructions for referring to the first column of this table]

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Poor: high water table; high compressibility; low bearing capacity.	Unsuited: high water table; poorly graded sand substratum.	Poor: oxidizes rapidly; high water table.	High water table; rapid permeability in substratum.	Organic material not suitable; poor stability in substratum; piping hazard.	High water table; moderately rapid and rapid permeability; poor stability in substratum.	Slopes of 0 to 2 percent; very poorly drained; organic material.
Poor: moderate frost action potential; low shear strength in most places.	Unsuited: fines.	Fair or poor: sandy to loamy; variable texture.	Soil material variable; subject to flooding.	Soil material variable; piping hazard; low to medium shear strength; medium to high permeability of compacted material.	Subject to flooding.	Slopes of 0 to 2 percent; well and moderately well drained; subject to frequent flooding.
Poor: seasonal high water table; high frost action potential.	Unsuited: fines.	Poor: seasonal high water table.	Soil material variable; seasonal high water table; subject to frequent flooding.	Soil material variable; low to medium shear strength; medium to high permeability of compacted material; piping hazard.	Seasonal high water table; subject to frequent flooding.	Slopes of 0 to 2 percent; poorly or very poorly drained; subject to frequent flooding.
Poor: seasonal high water table.	Poor: seasonal high water table.	Poor: seasonal high water table.	Seasonal high water table; moderate permeability.	Seasonal high water table; fair to good stability and compaction; medium shear strength; stones.	Seasonal high water table; moderate permeability; subject to flooding or ponding.	Slopes of 0 to 2 percent poorly drained; calcareous till at a depth of 24 to 40 inches; stones.
Fair: seasonal high water table.	Sand: good. Gravel: unsuited; fines.	Poor; sandy.	Very rapid permeability; seasonal high water table.	Medium shear strength; medium permeability of compacted soil; piping hazard.	Seasonal high water table; very rapid permeability.	Slopes of 2 to 6 percent; sandy; difficult to vegetate; subject to soil blowing.
Fair: medium to low shear strength.	Unsuited: fines.	Good.	Moderate permeability; seasonal high water table in some places.	Medium to low shear strength; piping hazard.	Not needed.	Slopes of 0 to 2 percent; subject to occasional flooding; well drained and moderately well drained.
Fair: medium shear strength.	Fair for sand: excess fines. Unsuited for gravel: fines.	Good.	Moderately rapid permeability.	Medium shear strength; piping hazard.	Not needed.	Slopes of 0 to 2 percent; subject to occasional flooding; well drained and moderately well drained.

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Boots: Bk	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; organic material.	Very severe: high water table; subject to frequent flooding; organic material.	Very severe: high water table; subject to frequent flooding; moderately rapid permeability.	Very severe: high water table; susceptible to frost action; organic material.
Boyer: BmB, BmC2	Slight if slope is 2 to 6 percent, moderate if 6 to 12.[1]	Severe: very rapid permeability in substratum.[1]	Slight if slope is 2 to 6 percent, moderate if 6 to 12.	Severe: very rapid permeability in substratum.[1]	Slight if slope is 2 to 6 percent, moderate if 6 to 12.
*Casco: CeA, CeB, CeC2, CrC, CrD2, CrE, CrF. For Rodman part of CrC, CrD2, CrE, and CrF, see Rodman series.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.[1]	Severe: very rapid permeability in substratum.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Severe: very rapid permeability in substratum.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.
Colwood: Cw	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding.	Severe: high water table; high frost action potential; subject to flooding.
Cut and fill land, sandy and gravelly: Cx.	Slight [1]	Severe: very rapid or rapid permeability in substratum.[1]	Slight	Severe: very rapid or rapid permeability in substratum.[1]	Slight
Cut and fill land, loamy: Cy	Slight	Moderate: moderate or moderately rapid permeability.	Slight	Slight	Slight
Cut and fill land, clayey: Cz	Moderate to severe: moderately slow permeability; seasonal high water table in places.	Slight if slope is 0 to 2 percent, moderate if 2 to 6; seasonal high water table in places.	Moderate to severe: clayey; medium frost action potential; seasonal high water table in places.	Moderate to severe: silty and clayey; difficult to work; seasonal high water table in places.	Severe: silty and clayey; difficult to work; seasonal high water table in places.
Dune land: Dn	Severe: very rapid permeability.[1]	Severe: very rapid permeability.[1]	Slight	Severe: very rapid permeability.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.
Edwards: Ed	Very severe: high water table; subject to flooding.	Very severe: high water table; subject to flooding.	Very severe: high water table; subject to flooding.	Very severe: high water table; subject to flooding.	Very severe: high water table; subject to flooding; high frost action potential.

See footnote at end of table.

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Poor: high water table; high compressibility; organic material.	Unsuited: organic material.	Poor: oxidizes rapidly; high water table.	Moderately rapid permeability; high water table.	Low shear strength; high compressibility; moderately rapid permeability; organic material.	Moderately rapid permeability; organic material; high water table; banks unstable.	Slopes of 0 to 2 percent; very poorly drained; organic material.
Good	Good for sand: poorly graded. Fair for gravel.	Poor: sandy texture.	Moderately rapid permeability in subsoil; very rapid permeability in substratum.	Medium to high shear strength; medium to low compressibility; fair to good compaction characteristics; piping hazard.	Not needed	Slopes of 2 to 12 percent; complex slopes; sandy; can be difficult to vegetate; subject to soil blowing; sand and gravel at a depth of 24 to 40 inches; stones.
Good	Fair for sand: high content of gravel. Good for gravel.	Poor: thin layer	Moderate permeability in subsoil; very rapid permeability in substratum.	High shear strength; low compressibility.	Not needed	Slopes of 0 to 45 percent; complex slopes; sand and gravel at a depth of 11 to 24 inches; stones.
Poor: high water table; high frost action potential.	Unsuited: fines	Poor: high water table.	Moderate permeability; high water table.	Medium shear strength; piping hazard.	High water table; moderate permeability; subject to flooding; banks unstable; tiles subject to clogging.	Slopes of 0 to 2 percent; poorly drained.
Good	Fair for sand: high content of gravel. Good for gravel.	Poor: too sandy	Rapid or very rapid permeability.	Good stability; pervious.	Not needed	Slopes of 0 to 6 percent; sandy; can be difficult to vegetate; stones.
Good	Poor: high content of fines.	Poor: topsoil usually has been removed.	Moderate or moderately rapid permeability.	Semipervious; medium shear strength and compressibility.	Not needed	Slopes of 0 to 6 percent.
Poor: low shear strength; high compressibility; moderate shrink-swell potential.	Unsuited: fines	Poor: topsoil usually has been removed.	Moderately slow permeability.	Moderate shrink-swell potential; medium to low shear strength.	Seasonal high water table in places.	Slopes of 0 to 6 percent; silty and clayey; difficult to work.
Fair: erosive; low stability unless confined.	Fair for sand: poorly graded. Unsuitable for gravel.	Poor: too sandy	Very rapid permeability.	Medium shear strength; low compressibility.	Not needed	Slopes of 6 to 60 percent; sandy; difficult to vegetate; subject to soil blowing.
Poor: organic material; high water table; high frost action potential.	Unsuited: organic material.	Poor: oxidizes rapidly; erosive.	Moderately rapid permeability in organic material; slow permeability in substratum; high water table.	Organic material unsuitable; low shear strength; high compressibility.	Slow permeability in substratum; high water table; subject to flooding.	Slopes of 0 to 2 percent; very poorly drained; organic material.

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Elvers: Ev	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding; high frost action potential.
Fabius: FaA	Severe: seasonal high water table.	Severe: seasonal high water table; moderately rapid permeability in substratum.	Severe: seasonal high water table.	Severe: seasonal high water table; moderately rapid permeability in substratum.	Moderate: seasonal high water table; moderate frost action potential.
Fox: FsA, FsB, FsC2	Slight if slope is 0 to 6 percent, moderate if 6 to 12.[1]	Severe: very rapid permeability in substratum.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12.	Severe: very rapid permeability in substratum; danger of ground water contamination.[1]	Moderate: moderate shrink-swell potential; moderate frost action potential.
Granby: Gb	Severe: high water table; subject to occasional flooding; rapid permeability.	Severe: high water table; subject to occasional flooding; rapid permeability.	Severe: high water table; subject to occasional flooding.	Severe: high water table; rapid permeability; subject to occasional flooding.	Severe: high water table; subject to occasional flooding.
Granby variant: Gg	Severe: high water table; subject to occasional flooding; very rapid permeability in substratum.	Severe: high water table; very rapid permeability in substratum; subject to occasional flooding.	Severe: high water table; subject to occasional flooding.	Severe: high water table; very rapid permeability in substratum.	Severe: high water table; subject to occasional flooding.
Gravel pit: Gp	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.[1]	Severe: very rapid permeability.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Severe: very rapid permeability.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.
Hebron: HeA, HeB	Severe: moderately slow permeability in substratum.	Slight if slope is 0 to 2 percent, moderate if 2 to 6; seasonal high water table in places.	Moderate: moderate shrink-swell potential; moderate frost action potential; seasonal high water table in places.	Moderate: difficult to work when wet; seasonal high water table in places.	Severe: low shear strength; seasonal high water table in places.

See footnote at end of table.

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Poor: high water table; low bearing capacity; organic material in lower part; high frost action potential.	Unsuited: fines.	Poor: high water table.	Moderately rapid permeability in organic material; high water table.	Organic material; unstable; low shear strength.	High water table; moderately rapid permeability in organic material; banks unstable.	Slopes of 0 to 2 percent; poorly drained; organic material in lower part.
Fair: seasonal high water table.	Fair for sand: high content of gravel. Good for gravel.	Fair: thin layer.	Moderate permeability in subsoil; moderately rapid permeability in substratum; seasonal high water table.	High shear strength; high permeability in compacted subsoil material.	Somewhat poorly drained; moderately rapid permeability; seasonal high water table.	Slopes of 0 to 3 percent; somewhat poorly drained; sand and gravel at a depth of 12 to 20 inches.
Fair for subsoil: moderate strength; moderate frost action potential. Good for substratum.	Fair for sand: high content of gravel. Fair for gravel: high content of sand.	Fair: thin layer.	Very rapid permeability in substratum.	Medium shear strength and compressibility in subsoil; high shear strength and low compressibility in substratum; high permeability in compacted substratum material.	Not needed.	Slopes of 0 to 12 percent; sand and gravel at a depth of 24 to 40 inches; stones.
Poor: high water table.	Good for sand: high water table. Unsuitable for gravel: fines.	Poor: too sandy; high water table.	Rapid permeability; high water table.	Medium shear strength; high permeability in compacted material; piping hazard.	High water table; rapid permeability; subject to occasional flooding.	Slopes of 0 to 2 percent; poorly drained or very poorly drained; sandy; subject to occasional flooding.
Poor: high water table.	Fair for sand and gravel: well graded to poorly graded sand and gravel; high water table.	Poor: high water table.	Very rapid permeability in substratum; high water table.	Medium shear strength; high permeability in compacted material; piping hazard.	High water table; moderately rapid permeability in subsoil; very rapid permeability in substratum.	Slopes of 0 to 2 percent; poorly drained; sandy; subject to occasional flooding.
Good if slope is 0 to 12 percent, fair if 12 to 20, poor if more than 20.	Good for sand and gravel.	Poor: gravelly.	Very rapid permeability.	Good stability; pervious; high permeability in compacted material.	Not needed.	Not applicable.
Poor: low shear strength.	Unsuited: fines.	Fair: thin layer.	Moderately slow permeability in substratum.	Medium shear strength and compressibility.	Not needed.	Slopes of 0 to 6 percent; moderately slow permeability in substratum.

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Hebron variant: HfA, HfB	Severe: moderately slow permeability in substratum.	Slight if slope is 0 to 2 percent, moderate if 2 to 6; seasonal high water table in places.	Moderate: moderate shrink-swell potential; moderate frost action potential; seasonal high water table in places.	Moderate: difficult to work when wet; seasonal high water table in places.	Moderate: moderate shrink-swell potential; seasonal high water table in places.
*Hochheim: HmB2, HmC2, HmD2, HmE, HsC2, HsD2, HsE, HtB. For Casco part of HsC2, HsD2, and HsE, see Casco series; for Sisson part of HsC2, HsD2, and HsE, see Sisson series; for Knowles part of HtB, see Knowles series.	Slight if slope is 1 to 6 percent, moderate if 6 to 12, severe if more than 12.	Moderate if slope is 1 to 6 percent, severe if more than 6; moderate permeability.	Slight if slope is 1 to 6 percent, moderate if 6 to 12, severe if more than 12.	Slight if slope is 1 to 12 percent, moderate if 12 to 20, severe if more than 20.	Moderate if slope is 1 to 12 percent, severe if more than 12; moderate frost action potential.
Houghton: Hu	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; moderately rapid permeability.	Very severe: high water table; subject to frequent flooding; high frost action potential.	Very severe: high water table; subject to frequent flooding; moderately rapid permeability.	Very severe: high water table; subject to frequent flooding; low strength; high frost action potential.
Juneau: JuA	Severe: subject to frequent flooding of short duration.	Moderate: subject to frequent flooding of short duration; seasonal high water table in places.	Severe: subject to frequent flooding of short duration; high frost action potential.	Severe: subject to frequent flooding of short duration; seasonal high water table in places.	Severe: subject to frequent flooding of short duration; high frost action potential.
Kendall: KlA	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding; high frost action potential.	Severe: seasonal high water table; subject to occasional flooding.	Severe: subject to occasional flooding; high frost action potential.
Kewaunee: KnA, KnB, KpB2, KpC2, KpD2, KsC3, KsD3.	Severe: moderately slow permeability.	Slight if slope is 0 to 2 percent, moderate if 2 to 6, severe if more than 6.	Moderate: clayey subsoil; moderate shrink-swell potential; seasonal high water table in places.	Severe: clayey subsoil; difficult to work; seasonal high water table in places.	Severe: clayey subsoil; difficult to work; low strength.
Kibbie: KuA	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: high frost action potential; subject to occasional flooding.

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Poor: low shear strength in substratum.	Unsuited: fines.	Fair: thin layer.	Moderately slow permeability in substratum.	Medium shear strength and compressibility.	Not needed.	Slopes of 0 to 6 percent; moderately slow permeability in substratum.
Good if slope is 1 to 12 percent, moderate if 12 to 20, severe if more than 20.	Unsuited: fines; can be underlain in places at a depth of 6 to more than 12 feet by stratified sand and gravel.	Fair: thin layer; gravelly or cobbly in places.	Moderate permeability; slopes generally prohibitive.	Medium shear strength; good compaction characteristics; piping hazard.	Not needed.	Slopes of 1 to 30 percent; complex slopes; calcareous till at a depth of 12 to 24 inches; stones.
Poor: high water table; organic material; high frost action potential.	Unsuited: organic material.	Poor: oxidizes rapidly; high water table.	High water table; moderately rapid permeability.	Low shear strength; high compressibility; hard to pack.	High water table; moderately rapid permeability; subject to frequent flooding.	Slopes of 0 to 2 percent; very poorly drained; organic material.
Poor: low shear strength; high frost action potential.	Unsuited: fines.	Good.	Moderate permeability; flooding for short periods.	Low shear strength; piping hazard.	Not needed.	Slopes of 0 to 3 percent; flooded for short periods; piping hazard.
Poor: medium to low shear strength; high frost action potential	Unsuited: fines.	Fair: thin layer.	Moderate permeability; seasonal high water table.	Medium to low shear strength; medium compressibility.	Seasonal high water table; moderate permeability.	Slopes of 0 to 3 percent; moderate permeability; somewhat poorly drained; subject to occasional flooding.
Poor: low shear strength.	Unsuited: fines; some small areas are underlain by sand and gravel at a depth of more than 5 feet.	Fair for silt loam on slopes of 0 to 12 percent; thin layer; poor on steeper slopes. Poor for silty clay loam and silty clay; too clayey.	Moderately slow permeability; clayey subsoil.	Low shear strength; medium compressibility; moderate shrink-swell potential.	Not needed.	Slopes of 0 to 20 percent; clayey subsoil; moderately slow permeability.
Poor: high frost action potential; low strength.	Unsuited: fines.	Fair: thin layer.	Moderate permeability; seasonal high water table.	Medium shear strength; piping hazard.	Seasonal high water table; moderate permeability; silt and fine sand substrata unstable, cause banks to slough.	Slopes of 0 to 3 percent; somewhat poorly drained; piping hazard.

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Knowles Mapped only with Hochheim soils.	Severe: fractured dolomite bedrock at a depth of 20 to 40 inches.[1]	Severe: fractured dolomite bedrock at a depth of 20 to 40 inches.[1]	Severe: dolomite bedrock near the surface.	Severe: fractured dolomite bedrock at a depth of 20 to 40 inches.[1]	Moderate: shallow to bedrock; low strength; moderate frost action potential.
Lamartine: LmA	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; high frost action potential; subject to occasional flooding.
Loamy land, seeped: Lo	Severe: high water table.	Severe: high water table.	Severe: high water table; high frost action potential.	Severe: high water table.	Severe: high water table; organic portions have low strength; high frost action potential.
Made land: Ma	Severe: nonsoil material.	Severe: nonsoil material.	Severe: nonsoil material.	Severe: nonsoil material.	Severe: nonsoil material.
Manawa: MbA	Severe: seasonally perched water table; subject to occasional flooding; slow permeability.	Severe: seasonally perched water table; subject to occasional flooding.	Severe: seasonally perched water table; subject to occasional flooding.	Severe: seasonally perched water table; subject to occasional flooding; clayey subsoil.	Severe: low shear strength; subject to occasional flooding.
Marsh: Mf	Very severe: flooded most of the year.	Very severe: flooded most of the year.	Very severe: flooded most of the year.	Very severe: flooded most of the year.	Very severe: flooded most of the year.
Martinton: MgA	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: subject to occasional flooding; clayey subsoil.	Severe: high frost action potential; low shear strength; subject to occasional flooding.
Matherton: MkA	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding; rapid permeability in substratum.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding; rapid permeability in substratum.	Severe: subject to occasional flooding; high frost action potential.
Montgomery: Mo	Severe: high water table; slow permeability; subject to flooding.	Severe: high water table.	Severe: high water table; subject to flooding; low shear strength; high shrink-swell potential.	Severe: high water table; subject to flooding; clayey subsoil.	Severe: very poorly drained; subject to flooding; low shear strength; high shrink-swell potential.

See footnote at end of table.

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Moderate: moderate frost action potential; moderate strength; moderate shrink-swell potential.	Unsuited: fines.	Fair: thin layer.	Fractured dolomite bedrock at a depth of 20 to 40 inches; moderate permeability.	Medium to low shear strength; piping hazard; dolomite bedrock at a depth of 20 to 40 inches.	Not needed.	Slopes of 1 to 6 percent; dolomite at a depth of 20 to 40 inches.
Poor: low shear strength; high frost action potential.	Unsuited: fines.	Good.	Moderate permeability; seasonal high water table.	Low shear strength; moderate shrink-swell potential; piping hazard.	Seasonal high water table; moderate permeability.	Slopes of 0 to 3 percent; somewhat poorly drained; piping hazard.
Poor: high water table; high frost action potential.	Unsuited: fines.	Poor: high water table; variable material.	Variable material; many springs.	Variable material; organic portions have low strength.	High water table; many springs.	Slopes of 2 to 20 percent; poorly drained; seepage areas.
Poor: nonsoil material.	Unsuited: nonsoil material or oily sand.	Poor: nonsoil material.	Nonsoil material.	Nonsoil material.	Not needed.	Nonsoil material.
Poor: low shear strength.	Unsuited: fines.	Fair: thin layer.	Slow permeability; seasonal high water table.	Low shear strength; medium compressibility; moderate shrink-swell potential.	Seasonal perched water table; slow permeability.	Slopes of 0 to 3 percent; somewhat poorly drained; clayey subsoil; slow permeability.
Very severe: flooded most of the year.	Unsuited: fines.	Poor: flooded most of the year.	Flooded most of the year.	Variable characteristics; flooded most of the year.	Not feasible; outlets generally not available; flooded most of the year.	Slopes of 0 to 2 percent; very poorly drained.
Poor: high frost action potential; low shear strength.	Unsuited: fines.	Fair: thin layer.	Moderately slow permeability; seasonal high water table.	Low shear strength; medium compressibility; moderate shrink-swell potential.	Moderately slow permeability; seasonal high water table; subject to occasional flooding.	Slopes of 0 to 3 percent; somewhat poorly drained; subject to occasional flooding.
Poor: high frost action potential.	Fair for sand; high content of gravel. Good for gravel.	Fair: thin layer.	Rapid permeability in substratum; seasonal high water table.	Medium shear strength and compressibility; medium to high permeability in compacted material.	Moderate permeability in subsoil; rapid permeability in substratum; seasonal high water table; subject to occasional flooding.	Slopes of 0 to 3 percent; somewhat poorly drained; subject to flooding.
Poor: very poorly drained; high shrink-swell potential; low shear strength.	Unsuited: fines.	Poor: very poorly drained; thin layer.	Slow permeability; seasonal high water table.	Low shear strength; high shrink-swell potential.	Slow permeability; seasonal high water table; subject to flooding.	Slopes of 0 to 2 percent; very poorly drained; subject to flooding; clayey subsoil.

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Mosel: MsA	Severe: seasonal high water table; moderately slow permeability in substratum.	Severe: seasonal high water table.	Severe: seasonal high water table; subject to rare flooding; high frost action potential.	Severe: seasonal high water table.	Severe: high frost action potential.
Muskego: Mz	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; high frost action potential.	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; high compressi bility; high frost action potential.
Navan: Na	Severe: high water table; subject to flooding; slow permeability in substratum.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding; high frost action potential; low shear strength.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding; high frost action potential.
Nenno: NnA, NnB	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: high frost action potential; subject to occasional flooding.
Oakville: OaB, OaC	Slight if slope is 0 to 6 percent, moderate if 6 to 12; very rapid permeability; seasonal high water table in places.[1]	Severe: very rapid permeability.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12; seasonal high water table in places.	Severe: very rapid permeability.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12.
Otter: Ot	Severe: high water table; subject to frequent flooding.	Severe: high water table; subject to frequent flooding.	Severe: high water table; subject to frequent flooding; high frost action potential.	Severe: high water table; subject to frequent flooding; high frost action potential.	Severe: high water table; high frost action potential; subject to frequent flooding.
Palms: Pa	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; organic material; moderately rapid permeability in organic layer.	Very severe: high water table; subject to frequent flooding; high frost action potential.	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; high frost action potential; low shear strength.

See footnote at end of table.

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Poor: low shear strength; high frost action potential.	Unsuited: fines.	Fair: thin layer.	Moderately slow permeability in substratum; seasonal high water table.	Medium to low shear strength; fair to good compaction characteristics; piping hazard.	Seasonal high water table; moderate permeability in subsoil; moderately slow permeability in substratum.	Slopes of 0 to 3 percent; somewhat poorly drained; moderately slow permeability in substratum.
Poor: high water table; organic material; high frost action potential.	Unsuited: organic material.	Poor: oxidizes rapidly; high water table.	Slow permeability in substratum; high water table.	Low shear strength; high compressibility hard to pack.	Moderately rapid permeability in organic material; slow permeability in substratum; high water table.	Slopes of 0 to 2 percent; very poorly drained; organic material.
Poor: low shear strength; high frost action potential; low shear strength.	Unsuited: fines.	Poor: high water table.	Slow permeability in substratum; high water table.	Low shear strength and compressibility; fair to good compaction characteristics; moderate shrink-swell potential.	Slow permeability in substratum; high water table.	Slopes of 0 to 2 percent; poorly drained; clayey substratum.
Poor: frost action potential.	Unsuited: fines.	Fair: thin layer; somewhat poorly drained.	Moderate permeability; seasonal high water table.	Medium to low shear strength and compressibility; moderate permeability of compacted material; piping hazard.	Moderate permeability; seasonal high water table; subject to occasional flooding.	Slopes of 0 to 6 percent; somewhat poorly drained.
Good	Fair for sand: poorly graded sand. Unsuitable for gravel: fines.	Poor: too sandy.	Very rapid permeability; slope.	Medium shear strength; medium to low permeability of compacted material.	Not needed	Slopes of 0 to 12 percent; sandy; difficult to vegetate; subject to soil blowing.
Poor: high water table; high frost action potential.	Unsuited: fines.	Poor: high water table.	Moderate permeability; high water table.	Low shear strength.	High water table; moderate permeability; subject to frequent flooding.	Slopes of 0 to 2 percent; poorly drained; subject to flooding.
Poor: high water table; high frost action potential.	Unsuited: organic material.	Poor: oxidizes rapidly; high water table.	Moderately rapid permeability in organic material; moderate permeability in substratum; high water table.	Low shear strength; high compressibility hard to pack.	Moderately rapid permeability in organic layer; moderate permeability in substratum; high water table; subject to frequent flooding.	Slopes of 0 to 2 percent; very poorly drained; organic material.

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Pella: Ph	Severe: high water table; subject to flooding.	Severe: high water table.	Severe: high water table; subject to flooding; high frost action potential.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding; high frost action potential; low shear strength.
Poygan: Py	Severe: high water table; subject to frequent flooding; slow permeability.	Severe: high water table; subject to frequent flooding.	Severe: high water table; subject to frequent flooding; high frost action potential.	Severe: high water table; subject to frequent flooding; clayey subsoil.	Severe: high water table; subject to frequent flooding; high frost action potential; low shear strength.
Rodman Mapped only with Casco soils.	Moderate if slope is 6 to 12 percent, severe if more than 12; very rapid permeability.[1]	Severe: very rapid permeability in substratum; slope.[1]	Moderate if slope is 6 to 12 percent, severe if more than 12.	Severe: very rapid permeability in substratum.[1]	Moderate if slope is 6 to 12 percent, severe if more than 12.
Rough broken land: Ry	Severe: steep and very steep; moderately slow permeability.	Severe: steep and very steep.	Severe: steep and very steep.	Severe: steep and very steep.	Severe: steep and very steep.
St. Charles: ScA, ScB	Slight: may have to be placed deeper than normal; seasonal high water table in places.	Moderate: moderate permeability; seasonal high water table in places.	Slight: seasonal high water table in places.	Slight: seasonal high water table in places.	Severe: subsoil has low bearing strength; high frost action potential.
Saylesville: ShA, ShB, SkC2	Severe: moderately slow permeability.	Slight if slope is 0 to 2 percent, moderate if 2 to 6, severe if more than 6.	Moderate: moderate shrink-swell potential; seasonal high water table in places.	Moderate: clayey subsoil; difficult to work; seasonal high water table.	Severe: low shear strength.
Sebewa: Sm	Severe: high water table; subject to frequent flooding.	Severe: high water table; rapid permeability in substratum; frequent flooding.	Severe: high water table; subject to frequent flooding.	Severe: high water table; subject to frequent flooding.	Severe: high water table; frequent flooding; high frost action potential.
Sisson: SrA, SrB, SrC2	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Moderate if slope is 0 to 6 percent, severe if more than 6.	Moderate if slope is 0 to 12 percent, severe if more than 12; low shear strength.	Slight if slope is 0 to 12 percent; moderate if 12 to 20, severe if more than 20.	Moderate: moderate frost action potential; low shear strength.
Stony land, wet: Sw	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.

See footnote at end of table.

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Poor: high water table; high frost action potential; low shear strength.	Unsuited: fines.	Poor: high water table.	Moderate permeability; high water table; subject to flooding.	Low shear strength.	High water table; moderate permeability.	Slopes of 0 to 2 percent; poorly drained; subject to flooding.
Poor: high water table; high frost action potential; low shear strength.	Unsuited: fines.	Poor: high water table.	Slow permeability; high water table; subject to flooding.	Low shear strength; medium to high compressibility; low permeability of compacted material.	High water table; slow permeability; subject to frequent flooding.	Slopes of 0 to 2 percent; poorly drained; subject to frequent flooding; clayey substratum.
Good if slope is 6 to 12 percent, fair if 12 to 20, severe if more than 20.	Fair for sand: high content of gravel. Good for gravel.	Poor: thin layer; small stones.	Very rapid permeability; slope.	Medium to high shear strength; high permeability of compacted material; piping hazard.	Not needed	Slopes of 6 to 45 percent; sand and gravel at a depth of 8 to 15 inches; stones; complex slopes.
Poor: low bearing strength; steep and very steep.	Unsuited: fines.	Poor: steep and very steep.	Moderately slow permeability; steep and very steep.	Low shear strength.	Not needed	Slopes of 20 to 45 percent; moderately slow permeability.
Poor: high frost action potential; low bearing strength in subsoil.	Unsuited: fines.	Fair: thin layer.	Moderate permeability.	Medium to low shear strength; medium to low permeability of compacted material.	Not needed	Slopes of 0 to 6 percent.
Poor: low shear strength.	Unsuited: fines.	Fair for silt loam: thin layer. Fair for silty clay loam to clayey; thin layer.	Moderately slow permeability.	Low shear strength; low permeability of compacted material.	Not needed	Slopes of 0 to 12 percent; clayey subsoil.
Poor: high water table; high frost action potential.	Poor: high water table.	Poor: high water table.	Rapid permeability in substratum; high water table.	Medium shear strength; high permeability of compacted material in substratum.	High water table; moderate permeability in subsoil; rapid permeability in substratum.	Slopes of 0 to 2 percent; poorly drained; sand and gravel at a depth of 20 to 40 inches.
Fair: moderate frost action potential.	Unsuited: fines.	Fair: thin layer.	Moderate permeability.	Low shear strength; medium to low permeability of compacted material; piping hazard; slope.	Not needed	Slopes of 0 to 30 percent.
Poor: high water table.	Unsuited: fines.	Poor: high water table.	High water table.	Loamy soil material with variable permeability; stony.	High water table; stony.	Slopes of 2 to 6 percent; poorly drained; stony.

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Theresa: ThA, ThB, ThC2	Slight if slope is 0 to 6 percent, moderate if 6 to 12; moderate permeability.	Moderate if slope is 0 to 6 percent, severe if more than 6; moderate permeability.	Slight if slope is 0 to 6 percent, moderate if 6 to 12.	Slight: moderate permeability.	Severe: low shear strength.
Wasepi: Wa	Severe: seasonal high water table.	Severe: seasonal high water table; rapid permeability in substratum.	Severe: seasonal high water table.	Severe: seasonal high water table; rapid permeability in substratum.	Severe: high frost action potential.
Waymor: WbA, WbB, WbC2	Moderate: lower end of moderate permeability range.	Moderate if slope is 0 to 6 percent, severe if 6 to 12; moderate permeability.	Slight if slope is 0 to 6 percent, moderate if 6 to 12.	Slight	Moderate: moderate frost action potential; medium to low shear strength in subsoil material; moderate shrink-swell potential.
Willette: We	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; organic material; moderately rapid permeability in organic layer.	Very severe: high water table; subject to frequent flooding; high compressibility; high frost action potential.	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; high frost action potential; low shear strength.
Yahara: YhA	Severe: seasonal high water table.	Severe: seasonal high water table; moderate permeability.	Severe: seasonal high water table; subject to flooding.	Severe: seasonal high water table.	Severe: high frost action potential.
Zurich: ZuA, ZuB	Moderate: moderate permeability; seasonal high water table in places.	Moderate: moderate permeability.	Moderate: medium to low shear strength; seasonal high water table in places.	Slight: seasonal high water table in places.	Severe: high frost action potential; medium to low shear strength.

[1] Hazard of ground water pollution in places because of permeability in the substratum.

Local roads and streets, as rated in table 10, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are the load supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material and the shrink-swell potential indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage; and the relative ease of excavating the material at borrow areas.

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Fair: low shear strength in subsoil; moderate frost action potential; moderate shrink-swell potential.	Unsuited: fines.	Fair: thin layer.	Moderate permeability.	Low shear strength; piping hazard.	Not needed.	Slopes of 0 to 12 percent; complex slopes; calcareous till at a depth of 24 to 40 inches.
Poor: high frost action potential.	Good for sand in substratum. Unsuitable for gravel: fines.	Fair: thin layer.	Rapid permeability in substratum; seasonal high water table.	Medium shear strength: medium to high permeability of compacted material; piping hazard.	Rapid permeability in substratum; seasonal high water table.	Slopes of 0 to 2 percent; somewhat poorly drained.
Fair: moderate shrink-swell potential; medium to low shear strength; moderate frost action potential.	Unsuited: fines.	Fair: thin layer.	Moderate permeability.	Medium to low shear strength; piping hazard.	Not needed.	Slopes of 0 to 12 percent.
Poor: high water table; high frost action potential.	Unsuited: organic material.	Poor: oxidizes rapidly; high water table.	Moderately rapid permeability in organic material; slow permeability in substratum; high water table.	Low shear strength; high compressibility; hard to pack.	Moderately rapid permeability in organic material; slow permeability in substratum; high water table; subject to frequent flooding.	Slopes of 0 to 2 percent; very poorly drained; organic material.
Poor: high frost action potential.	Unsuited: fines.	Good.	Moderate permeability; seasonal high water table.	Medium to low shear strength; piping hazard.	Seasonal high water table; moderate permeability.	Slopes of 0 to 3 percent; somewhat poorly drained.
Poor: high frost action potential; medium to low shear strength.	Unsuited: fines.	Fair: thin layer.	Moderate permeability.	Medium to low shear strength; piping hazard.	Not needed.	Slopes of 0 to 6 percent.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 10 provide information about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material, as in preparing a seedbed; the natural fertility of the material, or its reponse of plants when fertilizer is applied; and the absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Pond reservoirs hold water behind a dam or embankment. Soils suitable as pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Dikes, levees, and embankments require soil mate-

rial resistant to seepage and piping and with favorable stability, shrink-swell potential, shear strength, and compactibility. Stones and organic material in a soil are among factors that are unfavorable.

Drainage for crops and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; alkalinity; and availability of outlets for drainage.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Engineering test data

Table 11 contains engineering test data for some of the major soil series in Sheboygan County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limit and plastic limit. The

TABLE 11.—*Engineering*

[Tests were performed by Wisconsin Department of Transportation, Division of

Soil name and location	Parent material	Report number	Depth	Moisture density [1]	
				Maximum dry density	Optimum moisture
			In	*Lb/ft*	*Pct*
Boyer loamy sand:					
SE1/4SE1/4 sec. 11, T. 14 N., R. 22 E. (Modal profile)	Outwash sand and gravel.	571-WI-71-2-1	14-22	----------	----------
		571-WI-71-2-2	26-60	----------	----------
Colwood silt loam:					
SW1/4SW1/4 sec. 14, T. 13 N., R. 21 E. (Modal profile)	Lacustrine deposits	571-WI-71-6-1	11-27	----------	----------
		571-WI-71-6-2	40-60	----------	----------
Hochheim silt loam:					
SW1/4NW1/4 sec. 8, T. 15 N., R. 21 E. (Modal profile)	Glacial till (loamy)	569-WI-71-2-1	10-18	----------	----------
		569-WI-71-2-2	22-60	126.4	9.4
Kewaunee silt loam:					
NW1/4SE1/4 sec. 33, T. 15 N., R. 23 E. (subsoil contains slightly less clay than modal profile).	Glacial till (moderately fine textured).	569-WI-71-1-1	8-22	----------	----------
		569-WI-71-1-2	36-60	----------	----------
NW1/4NE1/4 sec. 13, T. 14 N., R. 21 E. (Modal profile)	Glacial till (moderately fine textured).	572-WI-71-2-1	13-24	----------	----------
		572-WI-71-2-2	34-60	----------	----------
Theresa silt loam:					
SE1/4SW1/4 sec. 26, T. 14 N., R. 20 E. (Modal profile)	Glacial till (loamy)	571-WI-71-1-1	20-30	----------	----------
		571-WI-71-1-2	34-60	134.7	8.2
NE1/4NE1/4 sec. 13, T. 16 N., R. 20 E. (Modal profile)	Glacial till (loamy)	572-WI-71-3-1	16-30	----------	----------
		572-WI-71-3-2	35-60	134.7	8.2
Waymor silt loam:					
SW1/4NW1/4 sec. 15 T. 13 N., R. 22 E. (Modal profile)	Glacial till (loamy)	571-WI-71-3-1	9-19	----------	----------
		571-WI-71-3-2	29-60	124.7	11.2
SW1/4NW1/4 sec. 8, T. 15 N., R. 23 E. (Modal profile)	Glacial till (loamy)	571-WI-71-4-1	9-21	----------	----------
		571-WI-71-4-2	31-60	123.5	11.4
Zurich silt loam:					
SE1/4SE1/4 sec. 31, T. 14 N., R. 21 E. (Modal profile)	Lacustrine deposits	569-WI-71-3-1	11-22	----------	----------
		569-WI-71-3-2	24-60	120.6	11.6

[1] Based on AASHTO Designation T 99-57, Method A (*1*).

[2] Mechanical analysis according to the AASHTO Designation T 88-57 (*1*). Results by this procedure may 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 the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters 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 calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes of soil.

mechanical analyses were made by combined sieve and hydrometer methods.

Compaction, or moisture-density, data are important in earthwork. If a soil material is compacted at a successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 9.

Shrinkage limit is the percentage of moisture at which shrinkage of the soil material stops.

Shrinkage ratio is the relation of change in volume of the soil material to the water content of the soil material when at the shrinkage limit. The change in volume of the soil material, and the water content is expressed as a percentage of the weight of the soil material when ovendry.

Linear shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the given value to the shrinkage limit.

test data

Highways. Absence of an entry indicates that no determination was made]

Mechanical analysis [2]										Liquid limit [3]	Plasticity index [4]	Classification	
Percentage less than 3 inches passing sieve—							Percentage smaller than—						
1 inch	¾ inch	⅜ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm			AASHTO [5]	Unified [6]
										Pct			
				100	97	25	21	16	15		[1] NP	A-2-4(0)	SM
	100	97	85	65	49	9	6	2	1		NP	A-1-6(0)	SP-SM
					100	95	90	27	21	33.4	13.2	A-6(9)	CL
					100	74	53	11	8		NP	A-4(8)	ML
				100	96	83	80	42	35	44.2	24.6	A-7-6(15)	CL
88	86	85	84	75	67	34	28	6	5		NP	A-2-4(0)	SM
				100	97	83	82	56	44	49.1	30.0	A-7-6(18)	CL
				100	97	85	82	46	31	30.0	15.2	A-6(10)	CL
				100	97	81	79	56	47	57.2	35.9	A-7-6(19)	CH
100	99	98	97	95	92	74	69	38	30	39.1	21.6	A-6(12)	CL
			100	98	87	55	53	36	32	39.3	20.7	A-6(8)	CL
94	90	82	77	73	63	30	24	8	5		NP	A-2-4(0)	SM
			100	98	90	67	62	35	30	46.6	28.1	A-7-6(15)	CL
99	93	82	76	69	61	40	31	9	7		NP	A-4(1)	SM
				100	98	75	73	51	42	42.5	24.1	A-7-6(14)	CL
	100	98	96	93	89	71	66	29	21	24.8	10.3	A-4(7)	CL
				100	99	88	86	59	47	46.2	25.0	A-7-6(15)	CL
100	99	97	96	93	89	69	64	29	20	24.4	9.9	A-4(7)	CL
				100	96	81	78	38	32	45.2	24.8	A-7-6(15)	CL
						77	56	11	7		NP	A-4(8)	ML

[3] Based on AASHTO Designation T 89–60 (*1*).
[4] Based on AASHTO Designation T 90–56 and AASHTO Designation T 91–54 (*1*).
[5] Based on AASHTO Designation M 145–49 (*1*).
[6] Based on ASTM Standard Designation D 2487–69 (*2*).
[7] NP means nonplastic.

Formation and Classification of Soils

This section describes the factors of soil formation that have affected the formation of soils in Sheboygan County. It also explains the system of soil classification currently used and assigns each soil series or land type to the classes of that system. The soil series and land types in the county and a profile representative of each series are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the composition of the parent material; the relief, or lay of the land; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; and the length of time the processes of soil formation have acted upon the parent material. As a result of these soil-forming processes, soil material is transformed in place, is removed through chemical action or by water and wind, or is added by chemical precipitation or by transfer and deposition of soil components from one part of the soil profile to another.

The results of these soil-forming processes can be readily seen in soil profiles. For example, the parent material of Theresa soils is loess and calcareous gravelly sandy loam glacial till. The silt was probably deposited over the till after the glacial period. The position on the landscape and the relief contributed to the factors that make these soils well drained. The temperate climate and rainfall that was adequate for the growth of plants were conducive to dissolving minerals and moving them in solution downward through the soil profile. In time, as a result of moisture and organic acids, the soil-forming processes became active. Plants and animals contributed to the accumulation of organic matter and organic acids, which were partly mixed with the soil. These processes were accelerated as more and higher organisms grew in the soil and produced a greater amount of organic residue.

Free lime in the soil material gradually dissolved and was moved downward by percolating water into the lower part of the soil. As water continued to move downward through the soil, suspended particles of clay were also translocated. As a result, the lower part of the silty layer and the upper part of the glacial till in Theresa soils contain more clay than the other parts of the soil. While the clay was being moved downward, organic matter, in various stages of decomposition, was accumulating on and near the surface. Decomposed organic matter gave the surface layer a darker color than that of the parent material.

While these changes were occurring in the silty upper part of the soil, the loamy lower part, which was mainly ground dolomite, was also being changed through chemical weathering. The upper part of this layer was gradually changed to a mixture of gravel and brown clay loam. Impurities of iron in the dolomitic till became oxidized in the presence of soil air and thus gave the clay loam its brown color.

As a result of these soil-forming processes, Theresa soils now have a surface layer of dark grayish brown silt loam. The subsoil is yellowish brown silty clay loam in the upper part and brown clay loam in the lower part. The underlying material is unweathered calcareous glacial till that has changed little since it was deposited by the glacier. Processes that were active in the formation of Theresa soils were the *accumulation* of organic matter in the surface layer, the *removal* of clay from the upper part of the profile, the *addition* of clay to the lower part of the profile, and the *transformation* of some of the material in place.

In varying degrees, all of these processes are occurring in all soils of the county. The kind of parent material and the relief, or topography, have, to a large extent, determined the processes that have been dominant in the formation of all soils and have thus caused differences among the soils. Factors that have contributed to the formation of soils in the area are described in more detail in the following paragraphs.

Parent material

Most of the soils of Sheboygan County formed wholly or in part from material laid down by glaciers of the Wisconsin Age. Each time the glacial ice advanced, it changed surface features that had formed during earlier glacial periods. As a result, little is known of the earlier glacial stages in the county.

The glacial material left in this area was mainly derived from the underlying bedrock. Part of this material, however, originated north of the survey area. It was moved to the survey area by glaciers and glacial melt water and was mired with the material derived from the local bedrock. The resulting soil material ranges from a few inches to several hundred feet in thickness.

After the glacial ice melted, deposits of till, outwash, and lacustrine material remained. Of these deposits, glacial till is the most common in the survey area. It is of poorly sorted crushed rock and soil material and ranges in texture from sandy loam and gravelly sandy loam to silty clay loam containing few pebbles. In the western half of the county, the glacial till ranges from gravelly sandy loam to loam. Bordering the Kettle Moraine, it is loam and is the parent material of Hochheim and Theresa soils. In places cobblestones are near or on the surface. In cultivated areas these stones have been placed into rows as field boundaries.

Kewaunee and Waymor soils formed in the silty clay loam and loam glacial till in the eastern half of the county.

As the glaciers melted, the flowing melt water carried away the finer particles and sorted the coarser particles. Boyer, Casco, and Fox soils are underlain by this glacial outwash material.

The glacial melt water caused the level of Lake Michigan to rise, and the wave action deposited a somewhat thin layer of sand over the silty clay loam till and the fine lake sediments that border the lake. Hebron, Mosel, and Oakville soils formed mostly in this material.

During the postglacial period clay, silt, and very fine sand were sorted by slowly moving or ponded water in many shallow lakes. This lacustrine material was deposited in somewhat thin layers. Colwood, Kibbie,

Montgomery, and Saylesville soils formed in these sediments. These shallow lakes favored the growth of aquatic plants. The organic Adrian, Boots, Houghton, Muskego, Palms, and Willette soils formed in the partly decomposed remains of these plants.

Relief and drainage

The drainage of soils is determined, to a great extent, by relief and the position of the soils on the landscape. For example, Kewaunee, Manawa, and Poygan soils formed in a thin silty mantle and calcareous silty clay loam or silty clay glacial till. Kewaunee soils generally are higher on the landscape (fig. 9). They typically are gently sloping and sloping and are well drained. Manawa soils are mostly on foot slopes or in narrow drainageways and depressions. They are nearly level and gently sloping, and they receive runoff from adjacent higher areas. Runoff on Manawa soils is slow, and the soils are somewhat poorly drained. The subsoil has gray and yellowish mottles, which indicate that the soils are poorly aerated and are excessively moist for long periods. Poygan soils are in depressions or other low areas where runoff is ponded and the soil is saturated most of the time. They are poorly drained. They have a gray and olive gray subsoil, indicating that reduction of iron compounds has taken place.

Climate and plants and animals

Differences in climate within the survey area are too small to have caused any major differences in the soils. Lake Michigan, however, has a modifying influence on the climate in areas adjacent to the lake. It is the cause of a lag in seasonal temperature changes, which is more pronounced in spring, summer, and fall. Temperatures in spring and early in summer are as much as 10 to 15 degrees cooler than those a few miles inland. In fall, because of the warm lake water, night temperatures are higher than those a short distance inland.

The modifying effect of Lake Michigan on the climate of the area has permitted natural stands of hemlock and other conifers that are typical in areas north of the county to grow along the lake. This climatic effect is also evident in soil characteristics along a narrow band adjacent to the lake. The soils have horizons that typically form in soils in areas north of the county.

Man has influenced the soils to a marked extent by disturbing and altering the natural soil-forming processes. He has removed trees, planted crops, and added organic matter. He has added lime to neutralize soil acidity and has applied fertilizers. He has grown alfalfa, which transfers calcium from the glacial till to

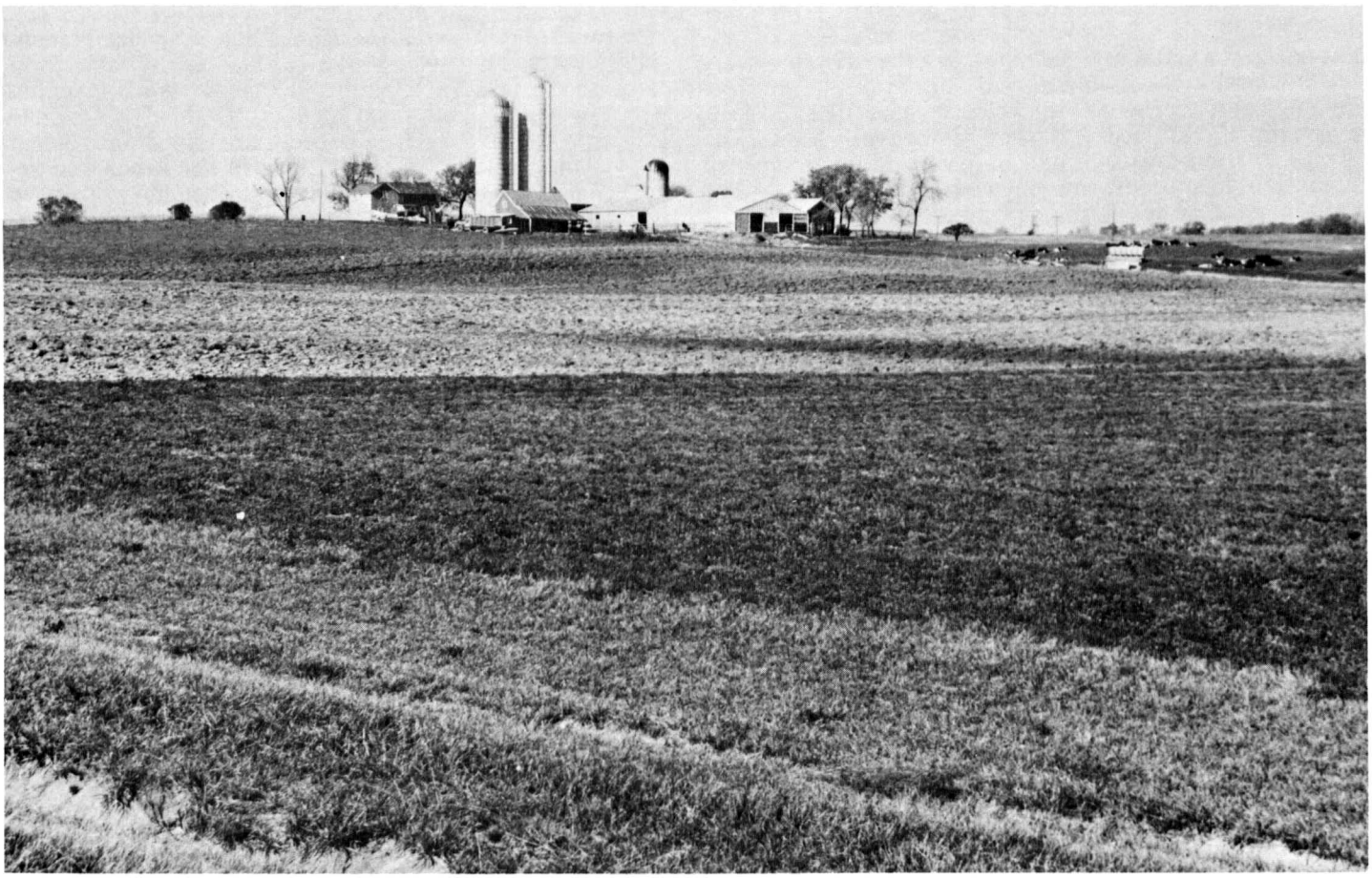

Figure 9.—Landscape of Kewaunee and Manawa soils. The somewhat poorly drained Manawa soils are in low areas in the foreground, and the better drained Kewaunee soils are on higher elevations near the farm buildings.

the soil surface. He has planted grasses, such as Kentucky bluegrass and bromegrass, which through their fine, fibrous root systems have added organic matter to the upper part of the soil.

The addition of lime has not only neutralized soil acidity but also has created a more favorable environment for beneficial soil bacteria. The increased bacterial action, in turn, has hastened the decomposition of organic matter, which darkens many cultivated soils. Results of man's activities can be readily observed by comparing an undisturbed soil in a woodlot with an adjacent cultivated soil.

Time

Time is required for the active agents of soil formation to change parent material into soil. Some soils form rapidly, while others form slowly. The length of time required for a particular kind of soil to form depends upon the interaction of the other factors.

Most of the material in which the soils of Sheboygan County formed probably was deposited during or shortly after the Wisconsin Stage of glaciation, about 11,000 years ago.

As soils begin to form, their characteristics are almost identical to those of their parent material. These soils are said to be immature. A soil is said to be mature when it has well defined horizons and is nearly in equilibrium with its environment. Through a long period of time, soils go through successive stages of immaturity, maturity, and old age.

Dune land is an example of an immature soil in Sheboygan County. The soil material is infertile sand that is constantly shifted by wind or wave action. The effects of time are minimal, and very little or no soil formation has occurred. Where the plant cover has stabilized the dunes for some time, the accumulation of organic matter in the upper few inches indicates the first stages of soil formation.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*25, 27*).

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. The same property or subdivisions of this property may be used in several different categories. In table 12, the soil series of Sheboygan County are placed in four categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. Three exceptions are the Entisols, Histosols, and Vertisols which occur in many different climates. Each order is identified by a word of three or four syllables ending in *sol* (Moll-i-sol).

SUBORDER. Each order is divided into suborders that are based on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders are more narrowly defined than are the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of a shallow water table; soil climate; accumulation of clay, iron, or organic carbon in the upper part of the solum; cracking of soils caused by a decrease in soil moisture; and fine stratification. Each suborder is identified by a word of two syllables. The last syllable indicates the order. An example is *Aquoll* (*Aqu*, meaning water or wet, and *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of soil horizons and features. The horizons used to make separations are those in which clay, carbonates, and other constituents have accumulated or have been removed and those having pans that interfere with growth of roots, movement of water, or both. Among the features used are soil acidity, soil climate, soil composition, and soil color. Each great group is identified by a word of three or four syllables; a prefix is added to the name of the suborder. An example is Haplaquoll (*Hapl* meaning simple horizons, *aqu* for wetness or water, and *oll*, from Mollisols).

SUBGROUP. Each great group is divided into subgroups, one representing the central (typic) segment of the group, and others called intergrades, which have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also have soil properties unlike those of any other great group, suborder, or order. Each subgroup is identified by the name of the great group preceded by one or more adjectives. An example is Typic Haplaquolls (a typical Haplaquoll).

FAMILY. Soil families are established within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, soil depth, and consistence. A family name is the subgroup name preceded by a series of adjectives, class names for texture and mineralogy, for example, that are used as family differentiae (see table

TABLE 12.—*Classification of soils*

Soils	Family	Subgroup or great group	Order
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic	Terric Medisaprists	Histosols.
Alluvial land	Loamy, mixed, nonacid, mesic	Typic Udifluvents	Entisols.
Alluvial land, wet	Loamy, mixed, nonacid, mesic	Fluvaquents	Entisols.
Barry	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Bellevue	Fine-loamy, mixed, mesic	Fluventic Hapludolls	Mollisols.
Bellevue variant	Sandy, mixed, mesic	Fluventic Hapludolls	Mollisols.
Boots	Euic, mesic	Typic Medihemists	Histosols.
Boyer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Casco	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Colwood	Fine-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Cut and fill land, clayey	Clayey, mixed, nonacid, mesic	Typic Udorthents	Entisols.
Cut and fill land, loamy	Loamy, mixed, nonacid, mesic	Typic Udorthents	Entisols.
Cut and fill land, sandy and gravelly.	Sandy-skeletal, mixed, nonacid, mesic	Typic Udorthents	Entisols.
Dune land	Mixed, mesic	Typic Udipsamments	Entisols.
Edwards	Marly, euic, mesic	Limnic Medisaprists	Histosols.
Elvers	Coarse-silty, mixed, nonacid, mesic	Thapto-Histic Fluvaquents	Entisols.
Fabius	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Aquic Argiudolls	Mollisols.
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Granby	Sandy, mixed, mesic	Typic Haplaquolls	Mollisols.
Granby variant	Sandy-skeletal, mixed, mesic	Typic Haplaquolls	Mollisols.
Hebron [1]	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Hebron variant	Coarse-loamy over clayey, mixed, mesic	Typic Hapludalfs	Alfisols.
Hochheim [2]	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Houghton	Euic, mesic	Typic Medisaprists	Histosols.
Juneau	Coarse-silty, mixed, nonacid, mesic	Typic Udifluvents	Entisols.
Kendall [3]	Fine-silty, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Kewaunee [4]	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
Kibbie [5]	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Knowles	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Lamartine [6]	Fine-silty, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Loamy land, seeped	Loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Manawa [7]	Fine, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Martinton [8]	Fine, illitic, mesic	Aquic Argiudolls	Mollisols.
Matherton [9]	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Montgomery	Fine, mixed, mesic	Typic Haplaquolls	Mollisols.
Mosel	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Muskego	Coprogenous, euic, mesic	Limnic Medisaprists	Histosols.
Navan	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Nenno	Fine-loamy, mixed, mesic	Aquic Argiudolls	Mollisols.
Oakville	Mixed, mesic	Typic Udipsamments	Entisols.
Otter	Fine-silty, mixed, mesic	Cumulic Haplaquolls	Mollisols.
Palms	Loamy, mixed, euic, mesic	Terric Medisaprists	Histosols.
Pella	Fine-silty, mixed, mesic	Typic Haplaquolls	Mollisols
Poygan	Fine, mixed, mesic	Typic Haplaquolls	Mollisols.
Rodman [10]	Sandy-skeletal, mixed, mesic	Typic Hapludolls	Mollisols.
Rough broken land	Fine, mixed, nonacid, mesic	Typic Udorthents	Entisols.
St. Charles	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Saylesville	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Argiaquolls	Mollisols.
Sisson	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Stony land, wet	Loamy-skeletal, mixed, mesic	Haplaquolls	Mollisols.
Theresa	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Wasepi	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Waymor	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Willette	Clayey, illitic, euic, mesic	Terric Medisaprists	Histosols.
Yahara [11]	Coarse-loamy, mixed, mesic	Aquic Hapludolls	Mollisols.
Zurich	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.

[1] Taxadjunct to the series. These soils are redder throughout the subsoil than is defined as the range for the series.
[2] Taxadjunct to the series. These soils have a lighter colored surface layer than is defined as the range for the series.
[3] Taxadjunct to the series. These soils are less gray and more alkaline than is defined as the range for the series.
[4] Taxadjunct to the series. These soils have less clay in the substratum within a depth of 40 inches than is defined as the range for the series.
[5] Taxadjunct to the series. These soils are shallower over free carbonates than is defined as the range for the series.
[6] Taxadjunct to the series. These soils have a higher calcium carbonate equivalent in the substratum within a depth of 40 inches than is defined as the range for the series.
[7] Taxadjunct to the series. These soils have less clay in the substratum within a depth of 40 inches than is defined as the range for the series.
[8] Taxadjunct to the series. These soils have a thinner mollic epipedon and a thinner subsoil and are shallower over free carbonates than is defined as the range for the series.
[9] Taxadjunct to the series. These soils are less gray than is defined as the range for the series.
[10] Taxadjunct to the series. These soils have a slightly darker colored subsoil than is defined as the range for the series.
[11] Taxadjunct to the series. These soils have a thinner solum and are shallower over free carbonates than is defined as the range for the series.

12). An example is the fine-loamy, mixed, mesic family of Typic Haplaquolls.

Environmental Factors Affecting Soil Use

This section provides information about the chief natural and cultural features that affect the use and management of the soils of Sheboygan County. It explains briefly those features that affect the existing and potential use of soils for farming and other purposes.

Relief and Drainage

The surface relief of Sheboygan County ranges from nearly level to very steep and irregular. The landscape is generally a gently sloping plain crossed from northeast to southwest by a range of hills known as the Kettle Moraine. Between the Kettle Moraine and Lake Michigan the soils are nearly level and gently sloping. They are generally nearly level near the lake but are gently sloping to the west.

Within the Kettle Moraine the surface is very irregular and has many kames, eskers, and potholes (fig. 10). The highest points are more than 200 feet above the surrounding landscape. West of the Kettle Moraine the soils are mostly gently sloping. Elevation ranges from about 600 feet in the eastern part of the county to more than 1,200 feet at the highest point in the Kettle Moraine. The shore of Lake Michigan is very steep in the northern half of the county.

Sheboygan County is divided by three major drainage basins. The southwestern part of the county is drained to the south by the northern branch of the Milwaukee River. The northeastern part is drained by the Sheboygan River and its major tributaries, the Mullet and Onion Rivers.

Geology and Underlying Material

The landscape of Sheboygan County was formed by glaciers that covered most of Wisconsin about 11,000 years ago. These ice masses formed in the Hudson Bay Area of Canada and pushed their way southward over North America. The glaciers advanced and retreated as the climate changed.

The physiography and distribution of soils is mainly

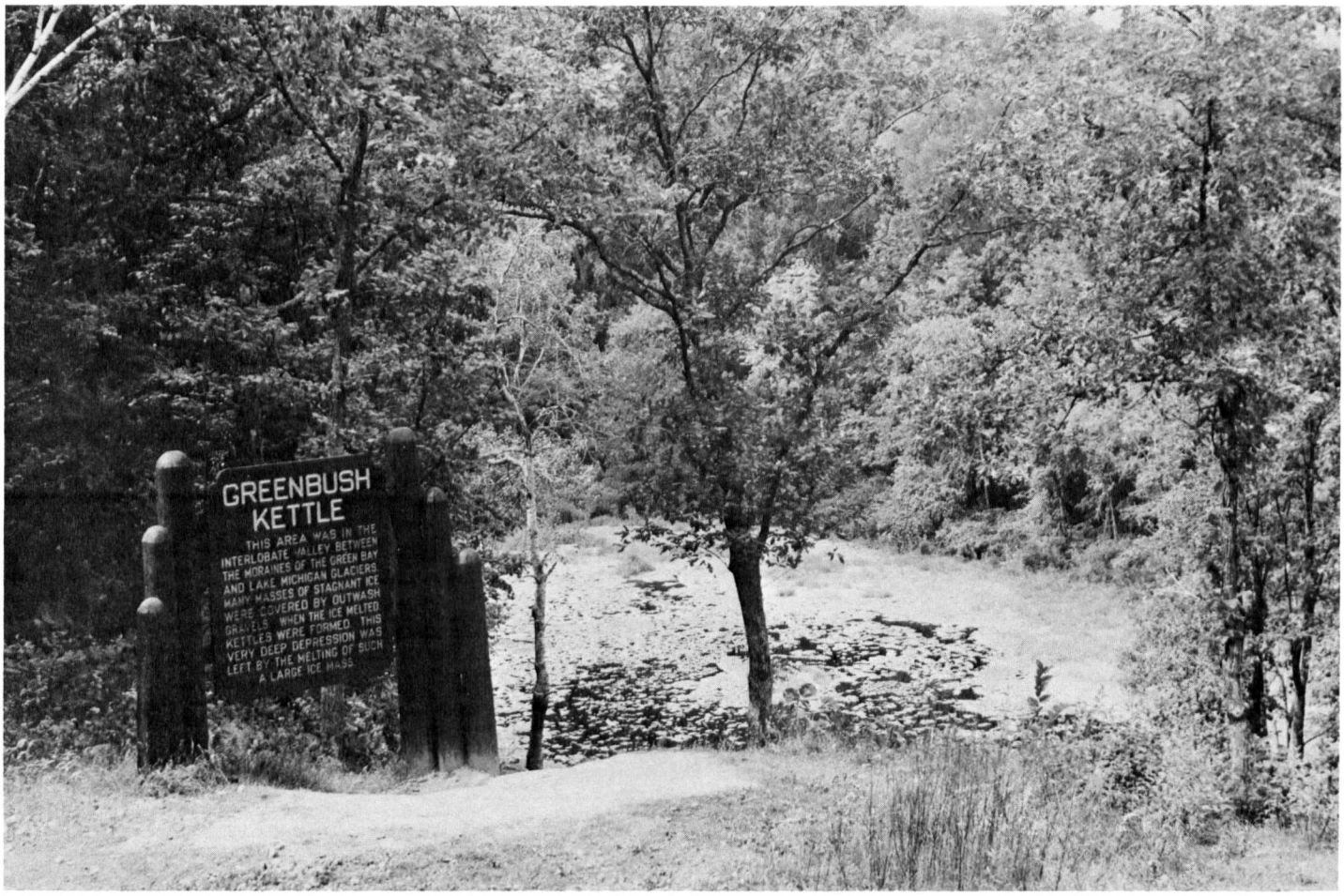

Figure 10.—A pothole typical of the Kettle Moraine in the foreground and wooded hills in the background. Soils of the Casco-Rodman complex are common in this moraine.

the result of glacial action, which buried the underlying Niagara dolomite bedrock with unconsolidated deposits ranging from a few feet to several hundred feet in thickness. The outstanding physical feature of the landscape is the Kettle Moraine, which crosses the western part of the county in a northeast-southwest direction from the north-central part of Rhine Township to the Crooked Lake Area in the northwestern part of Scott Township. The Kettle Moraine ranges from ½ mile to 4 miles in width. It is made up mainly of glacial drift deposited by large masses of glacial ice known as the Lake Michigan and Green Bay Lobes. Most areas of the steep and very steep Casco and Rodman soils are in this area. This area is a source of sand and gravel and has many gravel pits.

As the glaciers retreated, they left a mass of loamy material or glacial till in the western half of the county. Hochheim, Theresa, and other soils formed in this material. Drumlins are the most common landscape feature in this area.

Water from the melting glaciers transported, sorted, and deposited some of the glacial till as stratified gravel and sand on outwash plains. Casco, Fox, and other soils formed in this material (fig. 11). These areas are sources of sand and gravel.

In some glacial lake basins silt, fine sand, and clay accumulated to form lacustrine soils. In other places residue from water-tolerant plants accumulated to form organic soils.

The reddish brown loamy and clayey soils in the eastern half of the county are a result of a later glacial stage. Sediments in Lake Michigan were reworked by the readvance of the Lake Michigan Lobe and deposited mainly as gently sloping ground moraines. This area is commonly known as the "red clay" area. Kewaunee, Manawa, and other soils formed in these deposits. In many places the soils have a severe limitation for onsite sewage disposal systems because they have moderately low permeability.

Climate [6]

The climate of Sheboygan County is classified as continental. It is typical of a continental location in the middle latitudes but is somewhat modified by the proximity to Lake Michigan. Winters are long, cold, and snowy, and summers are warm and occasionally humid. Spring and fall are at times short and are mixtures of both summer and winter. The character of the seasons varies widely from year to year. All seasons are marked by storms that accompany changes from one air mass to another, particularly from late in fall through the middle of spring, when changes often occur every 2 to 4 days.

[6] By HANS C. ROSENDAL, State climatologist, National Weather Service, U.S. Department of Commerce.

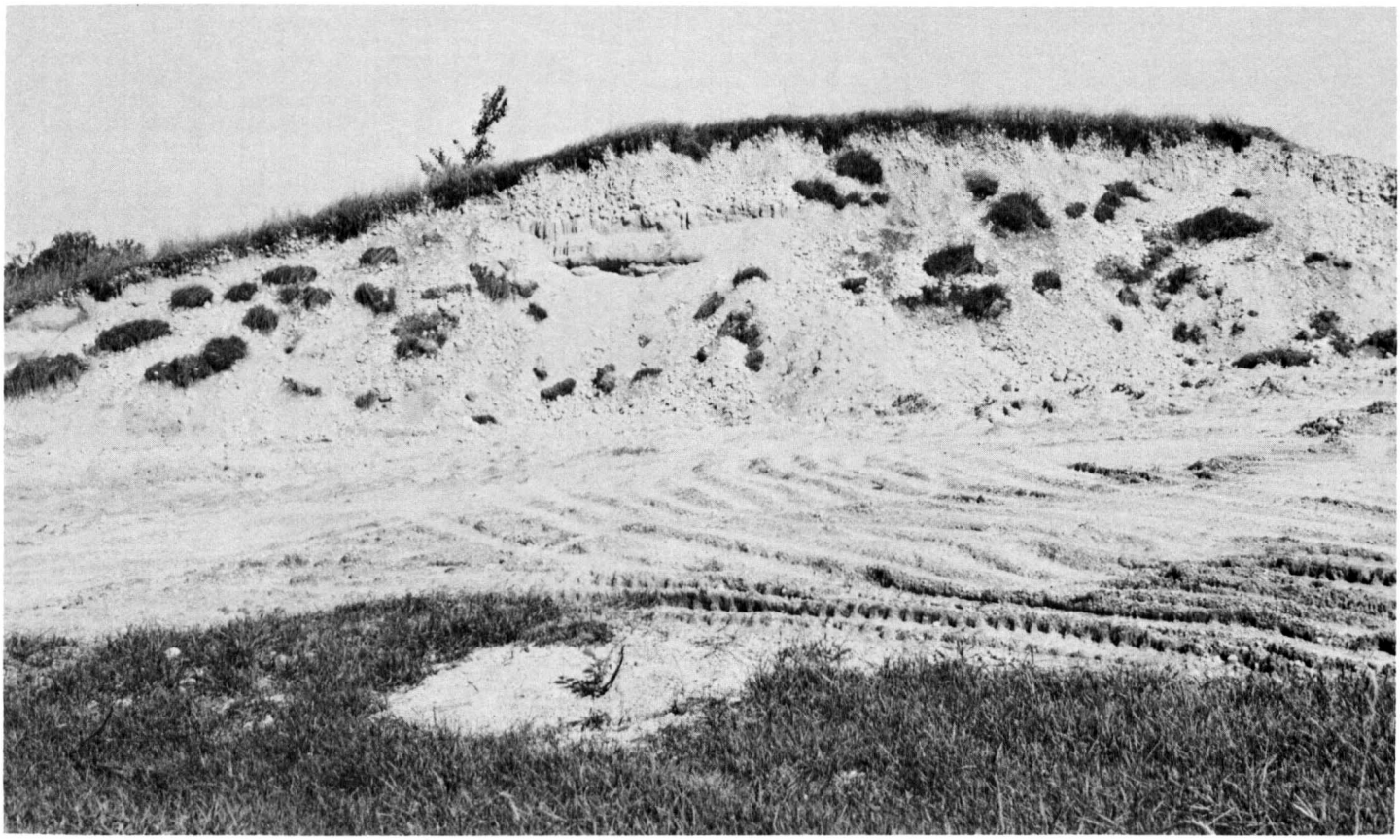

Figure 11.—Exposure of stratified gravel and sand. Casco, Fox, and Rodman soils are underlain by gravel and sand.

Data in tables 13 and 14 are fairly representative of the climate of the county. The weather station from which most of these data were obtained is in Plymouth, which is near the center of Sheboygan County about 15 miles from Lake Michigan. Temperatures during spring and summer average slightly higher away from the lake in the western part of the county, whereas during autumn and winter they are slightly warmer near the lake. Also, higher elevations tend to experience a decrease in the daily and annual temperature ranges, whereas increases in these ranges occur at lower elevations and over large expanses of marshlands because of a lowering of minimum temperatures through cold-air pooling.

Table 13 gives temperature and precipitation data. The temperature range from season to season, as well as from year to year, is quite large. During the last 40 years, days with temperatures of 90°F or higher have ranged from 0 in 1962, 1951, and 1950 to 26 in 1955. Days with 0° or lower have ranged from 3 in 1953 to 38 in 1963. Both the hottest and coldest periods occurred in 1936. From July 7 to July 14, 8 consecutive days had temperatures greater than 100°, while the period January 20 to February 12 had 24 consecutive days below 0°.

Precipitation is generally ample for the growth of all crops common to the latitude. In about 50 percent of the years, precipitation falls in the 5-month period from May through September. Since 1910 there has never been a month without a measurable amount of precipitation. Intensities of about 1.25 inches in 1 hour, 1.85 inches in 6 hours, and 2.60 inches in 24 hours can be expected to occur about once in 2 years. The greatest amount of precipitation to fall in 24 hours was 4.96 inches on August 4, 1924. Normally, for the 3 summer months, the first parts of June and August

TABLE 13.—*Temperature and precipitation data*

[All data from Plymouth, Wis. Elevation 845 feet]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Average maximum	Average minimum	Average monthly precipitation	One year in 10 will have—		Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover
						Less than—	More than—		
	°F	°F	°F	°F	*Inches*	*Inches*	*Inches*	*Number*	*Inches*
January	28	12	45	−10	1.5	0.5	2.8	20	5.7
February	30	13	47	−8	1.4	.4	2.6	19	5.6
March	39	23	60	4	1.9	.8	3.3	11	3.7
April	54	34	75	22	2.7	1.1	4.2	2	.7
May	66	44	85	32	3.0	1.2	4.8	(1)	0
June	76	54	91	42	3.5	1.6	5.6	0	0
July	82	60	92	49	2.9	1.2	5.2	0	0
August	81	59	92	48	2.7	1.4	5.0	0	0
September	72	51	89	37	3.0	1.0	6.5	0	0
October	60	41	79	26	2.1	.6	4.0	(1)	0
November	44	28	64	10	2.1	.7	4.0	3	2.0
December	32	17	50	−4	1.5	.5	3.2	12	3.3
Year	55	36	[2] 94	[3] −15	28.3	21.0	37.5	67	4.6

[1] Less than 0.5 day. [2] Average annual maximum. [3] Average annual minimum.

TABLE 14.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Plymouth, Wis. Elevation 845 feet]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	April 12	April 18	April 27	May 11	May 24
2 years in 10 later than	March 30	April 5	April 14	April 29	May 12
5 years in 10 later than	March 27	April 2	April 11	April 25	May 9
Fall:					
1 year in 10 earlier than	November 3	October 26	October 16	October 5	September 26
2 years in 10 earlier than	November 17	November 8	October 30	October 18	October 8
5 years in 10 earlier than	November 20	November 11	November 2	October 21	October 11

are the wettest periods. The likelihood of 1 inch or more of rain falling during the periods May 31 to June 6 and August 2 to August 8 is once in 3 years. The period August 23 to August 29 is the driest, and the likelihood of a trace or less of rain is once in 5 years. Annual snowfall has ranged from 19 inches in 1958 to 99 inches in 1959.

Thunderstorms have occurred on an average of 35 days per year, and individual years range from 20 to 45 days. Hail has fallen on an average of 2 days per year and in extreme years on 0 and 5 days.

Wind, sunshine, and humidity records are not available at Plymouth, but sunshine and humidity records at Green Bay and wind records at Appleton can be used. Prevailing winds are from the northwest in winter and from the southwest in summer. Annually, the wind blows from the northwest about one-fifth of the time and from the southwest about one-fifth of the time. March and November are the windiest months, and winds average more than 12 miles per hour. The highest windspeeds are generally from a westerly direction and can be expected to exceed 50 miles per hour every year.

The least amount of possible sunshine occurs in November and December, which have monthly averages of about 40 percent, and in January, which has an average of about 45 percent. Maximum possible sunshine occurs during the period May through September, when monthly averages are about 60 percent. The rest of the year averages a little more than 50 percent of possible sunshine.

Relative humidity ranges from a winter nighttime average maximum of about 80 percent to a daytime average minimum of about 70 percent; summers range from a nighttime average maximum of about 80 percent to a daytime minimum average of about 60 percent.

Table 14 shows the likelihood of critical temperatures occurring. The average date of the last freezing temperature in spring is May 9, and that of the first in fall is October 11. The growing season, defined as the number of days between the last freezing temperature in spring and first in fall, averages 155 days. Data on freezing temperatures are calculated for Plymouth. Minimum temperatures vary considerably across Sheboygan County on calm, clear nights, depending on such physical characteristics as the topography and kinds of soil of the area and the proximity to open water.

Transportation and Schools

Railroads provide daily freight service in Sheboygan County (*24*). The county is also served by one U.S. highway and seven state highways. Truck highways are almost entirely hard surfaced and are in excellent condition.

There are about 11 interstate trucking firms carrying motor freight and several local carriers and truck rental services (*24*). Trucking services in Sheboygan County are more than adequate.

An airport is located approximately 5 miles west of the city of Sheboygan. Air ambulance service and airfreight service are also provided.

The Sheboygan city port has one municipal wharf and two privately owned wharfs. The major products shipped are fuel oil, crude oil, pig iron, coal, and newsprint.

Sheboygan County is served by ten public high schools and two colleges.

Industry

About 42 percent of the jobs in Sheboygan County are in manufacturing. The major industries manufacture plumbing fixtures, engines, machinery, textiles, utensils, shoe leathers, cheese, and plastics (*29*). Most of this manufacturing is done in Sheboygan, Kohler, and Plymouth.

Food processing plants are in Sheboygan, Cedar Grove, and Random Lake. The livestock markets are primarily in Oostburg and Plymouth. Businesses that service and sell farm machinery and other farm supplies are throughout the county.

Trends in Soil Use

As is the case generally throughout the United States, the number of farms in Sheboygan County is decreasing and the size of the farms is increasing. In 1964 there were 2,306 farms with an average size of 115.5 acres (*29*). In 1969 there were 1,869 farms with an average size of 127.7 acres. An increasing acreage is in nonfarm uses. In 1964, 82.2 percent of the area was in farms, compared to 73.8 percent in farms in 1969 (*29*). This change in land use is especially noticeable in the urban-rural fringe areas where each year more land is being used for homesites, industrial sites, and recreation areas.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibily 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.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

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.

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.

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.

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 classs 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 excessivly 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.

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.

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.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

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.

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.

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.

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 combina- 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.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lower or the elevation of the land is raised.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

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.

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 debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

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.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

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

Relief. The elevations or inequalities of a land surface, considered collectively.

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 groundwater runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

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.

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 (0.005 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.

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."

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.

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.

GUIDE TO MAPPING UNITS

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Wildlife group	Recreation group	Tree and shrub group
			Symbol	Page	Symbol	Number	Number	Number
Ag	Adrian muck	7	IVw-7	53	3w3	8	9	4
Ak	Adrian-Granby-Oakville complex	7	IVw-7	53	3w3	8	9	4
Am	Alluvial land	7	IIw-13	50	3o2	9	7	1
An	Alluvial land, wet	7	Vw-14	54	4w2	7	8	3
Ba	Barry silt loam	8	IIw-1	49	4w2	7	8	3
Bd	Beaches, sandy	8	VIIIs-10	55	6s1	10	6	---
Be	Bellevue silt loam	8	IIw-11	50	3o1	9	7	1
Bf	Bellevue fine sandy loam, sandy subsoil variant	9	IIIw-12	52	3o1	9	7	1
Bk	Boots muck	10	IIIw-9	52	3w3	8	9	4
BmB	Boyer loamy sand, 2 to 6 percent slopes	11	IIIs-4	52	3o1	3	3	2
BmC2	Boyer loamy sand, 6 to 12 percent slopes, eroded	11	IIIe-7	52	3o1	3	3	2
CeA	Casco loam, 0 to 2 percent slopes	12	IIIs-8	53	3d1	4	1	2
CeB	Casco loam, 2 to 6 percent slopes	12	IIIe-3	51	3d1	4	1	2
CeC2	Casco loam, 6 to 12 percent slopes, eroded	12	IVe-3	53	3d1	4	1	2
CrC	Casco-Rodman complex, 6 to 12 percent slopes	12	IVe-3	53	3d1	4	1	2
CrD2	Casco-Rodman complex, 12 to 20 percent slopes, eroded	13	VIe-3	54	3d2	4	1	2
CrE	Casco-Rodman complex, 20 to 30 percent slopes	13	VIIe-3	55	3d2	4	1	2
CrF	Casco-Rodman complex, 30 to 45 percent slopes	14	VIIe-3	55	3d3	4	1	2
Cw	Colwood silt loam	14	IIw-1	49	1w1	7	8	3
Cx	Cut and fill land, sandy and gravelly	14	VIIIs-10	55	6s1	10	3	---
Cy	Cut and fill land, loamy	15	IIIe-1	51	6s1	1	1	---
Cz	Cut and fill land, clayey	15	IIIe-6	51	6s1	2	5	---
Dn	Dune land	15	VIIIs-10	55	6s1	10	6	---
Ed	Edwards muck	15	IVw-7	53	3w3	8	9	4
Ev	Elvers silt loam	16	IIw-13	50	4w2	7	8	3
FaA	Fabius loam, 0 to 3 percent slopes	17	IIw-5	50	3o2	6	4	3
FsA	Fox silt loam, 0 to 2 percent slopes	17	IIs-1	51	2o1	1	2	1
FsB	Fox silt loam, 2 to 6 percent slopes	17	IIe-2	49	2o1	1	2	1
FsC2	Fox silt loam, 6 to 12 percent slopes, eroded	18	IIIe-2	51	2o1	1	2	1
Gb	Granby loamy fine sand	18	IVw-5	53	3w1	7	8	3
Gg	Granby silt loam, gravelly variant	19	IIw-5	50	3w1	7	8	3
Gp	Gravel pit	19	VIIIs-10	55	6s1	10	6	---
HeA	Hebron loam, 0 to 2 percent slopes	19	IIs-7	51	2o1	1	1	1
HeB	Hebron loam, 2 to 6 percent slopes	20	IIe-6	49	2o1	1	1	1
HfA	Hebron sandy loam, sandy subsoil variant, 0 to 2 percent slopes	20	IIs-7	51	2o1	1	1	1
HfB	Hebron sandy loam, sandy subsoil variant, 2 to 6 percent slopes	20	IIe-7	49	2o1	1	1	1
HmB2	Hochheim silt loam, 2 to 6 percent slopes, eroded	21	IIe-1	48	2o1	1	2	1
HmC2	Hochheim silt loam, 6 to 12 percent slopes, eroded	21	IIIe-1	51	2o1	1	2	1
HmD2	Hochheim silt loam, 12 to 20 percent slopes, eroded	21	IVe-1	53	2r1	1	2	1
HmE	Hochheim silt loam, 20 to 30 percent slopes	22	VIe-1	54	2r1	1	2	1
HsC2	Hochheim-Casco-Sisson complex, 6 to 12 percent slopes, eroded	22	IIIe-1	51	2o1	1	2	1

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Wildlife group	Recreation group	Tree and shrub group
			Symbol	Page	Symbol	Number	Number	Number
HsD2	Hochheim-Casco-Sisson complex, 12 to 20 percent slopes, eroded	22	IVe-1	53	2r1	1	2	1
HsE	Hochheim-Casco-Sisson complex, 20 to 30 percent slopes	22	VIe-1	54	2r1	1	2	1
HtB	Hochheim-Knowles silt loams, 1 to 6 percent slopes	23	IIe-1	48	2o1	1	2	1
Hu	Houghton muck	23	IIIw-9	52	3w3	8	9	4
JuA	Juneau silt loam, 0 to 3 percent slopes	24	I-2	48	2o1	9	7	1
KlA	Kendall silt loam, 0 to 3 percent slopes	24	IIw-2	49	2o2	6	4	3
KnA	Kewaunee silt loam, 0 to 2 percent slopes	25	IIs-7	51	2c1	2	2	1
KnB	Kewaunee silt loam, 2 to 6 percent slopes	25	IIe-6	49	2c1	2	2	1
KpB2	Kewaunee silty clay loam, 2 to 6 percent slopes, eroded	25	IIe-6	49	2c1	2	5	1
KpC2	Kewaunee silty clay loam, 6 to 12 percent slopes, eroded	26	IIIe-6	51	2c1	2	5	1
KpD2	Kewaunee silty clay loam, 12 to 20 percent slopes, eroded	26	IVe-6	53	2c3	2	5	1
KsC3	Kewaunee silty clay, 6 to 12 percent slopes, severely eroded	26	IVe-6	53	3c1	2	5	1
KsD3	Kewaunee silty clay, 12 to 20 percent slopes, severely eroded	26	VIe-6	55	3c2	2	5	1
KuA	Kibbie silt loam, 0 to 3 percent slopes	27	IIw-2	49	1o2	6	4	3
LmA	Lamartine silt loam, 0 to 3 percent slopes	28	IIw-2	49	2o2	6	4	3
Lo	Loamy land, seeped	28	Vw-16	54	4w2	7	6	3
Ma	Made land	28	VIIIs-10	55	6s1	10	6	---
MbA	Manawa silt loam, 0 to 3 percent slopes	29	IIw-2	49	2c2	6	4	3
Mf	Marsh	29	VIIIw-15	55	6w1	7	6	---
MgA	Martinton silt loam, 0 to 3 percent slopes	30	IIw-2	49	4o1	6	4	3
MkA	Matherton silt loam, 0 to 3 percent slopes	30	IIw-5	50	3o2	6	4	3
Mo	Montgomery silty clay loam	31	IIw-1	49	4w2	7	8	3
MsA	Mosel loam, 0 to 3 percent slopes	32	IIw-2	49	2o2	6	4	3
Mz	Muskego muck	32	IVw-7	53	3w3	8	9	4
Na	Navan loam	33	IIw-1	49	4w2	7	8	3
NnA	Nenno silt loam, 0 to 2 percent slopes	33	IIw-2	49	2o2	6	4	3
NnB	Nenno silt loam, 2 to 6 percent slopes	33	IIw-2	49	2o2	6	4	3
OaB	Oakville loamy fine sand, 0 to 6 percent slopes	34	IVs-3	54	3s1	3	3	2
OaC	Oakville loamy fine sand, 6 to 12 percent slopes	34	VIs-3	55	3s1	3	3	2
Ot	Otter silt loam	35	IIw-1	49	2w1	7	8	3
Pa	Palms muck	35	IIw-8	50	3w3	8	9	4
Ph	Pella silt loam	36	IIw-1	49	3w2	7	8	3
Py	Poygan silty clay loam	36	IIw-1	49	2w1	7	8	3
Ry	Rough broken land	37	VIIe-6	55	6s1	2	6	---
ScA	St. Charles silt loam, 0 to 2 percent slopes	38	I-3	48	1o1	1	2	1
ScB	St. Charles silt loam, 2 to 6 percent slopes	38	IIe-1	48	1o1	1	2	1

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Wildlife group	Recreation group	Tree and shrub group
			Symbol	Page	Symbol	Number	Number	Number
ShA	Saylesville silt loam, 0 to 2 percent slopes	39	IIs-7	51	2c1	2	2	1
ShB	Saylesville silt loam, 2 to 6 percent slopes	39	IIe-6	49	2c1	2	2	1
SkC2	Saylesville silty clay loam, 6 to 12 percent slopes, eroded	39	IIIe-6	51	2c1	2	2	1
Sm	Sebewa silt loam	40	IIw-5	50	4w2	7	8	3
SrA	Sisson very fine sandy loam, 0 to 2 percent slopes	40	I-4	48	1o1	1	1	1
SrB	Sisson very fine sandy loam, 2 to 6 percent slopes	40	IIe-1	48	1o1	1	1	1
SrC2	Sisson very fine sandy loam, 6 to 12 percent slopes, eroded	40	IIIe-1	51	1o1	1	1	1
Sw	Stony land, wet	41	Vw-16	54	4w2	7	8	---
ThA	Theresa silt loam, 0 to 2 percent slopes	41	I-4	48	1o1	1	2	1
ThB	Theresa silt loam, 2 to 6 percent slopes	41	IIe-1	48	1o1	1	2	1
ThC2	Theresa silt loam, 6 to 12 percent slopes, eroded	41	IIIe-1	51	1o1	1	2	1
Wa	Wasepi sandy loam	42	IVw-5	53	3o2	6	4	3
WbA	Waymor silt loam, 0 to 2 percent slopes	43	I-4	48	1o1	1	2	1
WbB	Waymor silt loam, 2 to 6 percent slopes	43	IIe-1	48	1o1	1	2	1
WbC2	Waymor silt loam, 4 to 12 percent slopes, eroded	43	IIIe-1	51	1o1	1	2	1
We	Willette muck	44	IIIw-8	52	3w3	8	9	4
YhA	Yahara very fine sandy loam, 0 to 3 percent slopes	44	IIw-4	49	1o2	6	4	3
ZuA	Zurich silt loam, 0 to 2 percent slopes	45	I-3	48	1o1	1	2	1
ZuB	Zurich silt loam, 2 to 6 percent slopes	45	IIe-1	48	1o1	1	2	1

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