United States Department of Agriculture

Soil Conservation Service

In cooperation with the United States Department of Agriculture, Forest Service, and the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin

Soil Survey of Oneida County, Wisconsin

How To Use This Soil Survey

General Soil Map

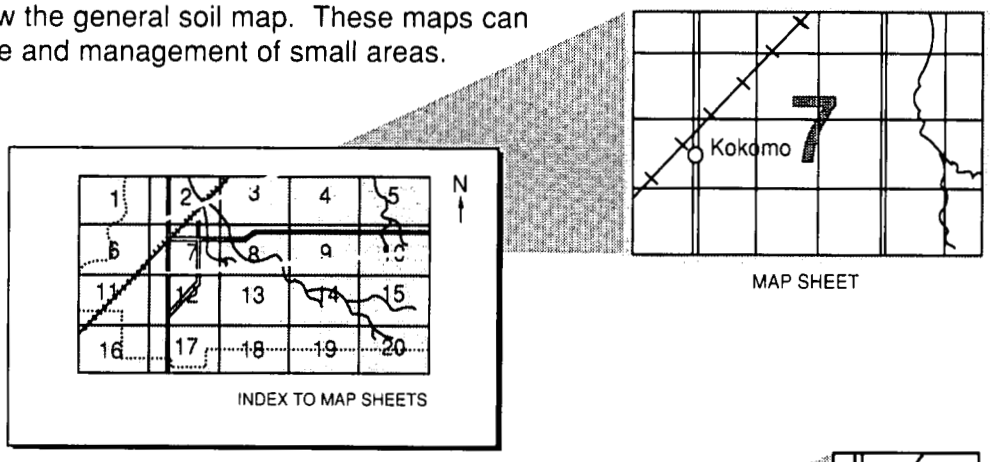
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

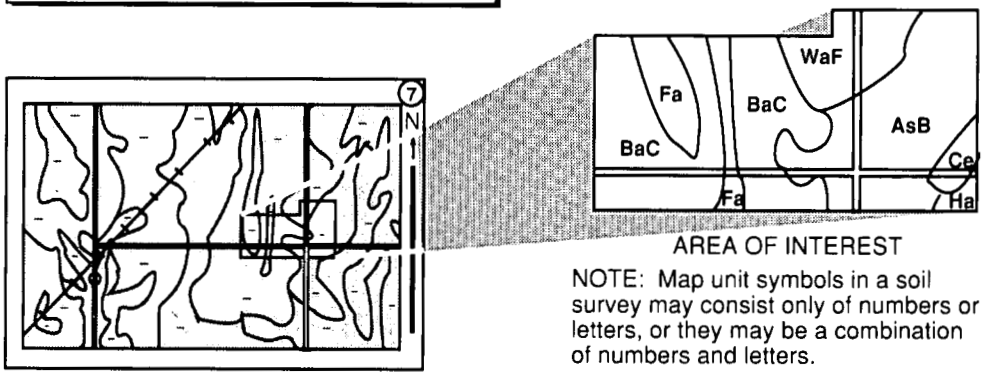
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET

AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1987. Soil names and descriptions were approved in 1988. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. This survey was made cooperatively by the Soil Conservation Service, the Forest Service, and the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin. The survey is part of the technical assistance furnished to the Oneida County Land Conservation Committee, which helped to finance the fieldwork for the survey.

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

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: An area of Little Carr Lake, one of the numerous lakes that make Oneida County a popular vacation area.

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Issued February 1993

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Foreword

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

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

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

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

Earl Cosby
State Conservationist
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Soil Survey of Oneida County, Wisconsin

By Joseph M. Boelter, Soil Conservation Service

Fieldwork by Joseph M. Boelter, Kim C. Goerg, David J. Hvizdak, Steven K. Kluess, Mark J. Kopecky, Kenneth W. Lubich, Steve W. Payne, and Harvey V. Strelow, Soil Conservation Service; Larry L. Day, Duane L. Greuel, and Yves E. Riopel, North-Central Wisconsin Regional Planning Commission; and Lance R. Lindwall and Edward W. Neumann, Forest Service

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

ONEIDA COUNTY is in the north-central part of Wisconsin (fig. 1). It has a total area of 791,347 acres. Of this acreage, 723,251 acres is land and 68,096 acres is areas of water more than 40 acres in size. The population of the county was 31,216 in 1980. Rhinelander, the county seat, had a population of 7,873.

Most of the county is forest land. Only about 5.5 percent is farmland. Recreation, tourism, agriculture, manufacturing, and retail trade are important industries in the county. Lumber and other wood-related industries also are major enterprises.

The soils in the county are dominantly sandy or loamy. The principal crops are potatoes, cranberries, small grain, and grasses and legumes. The most common tree species are aspen and birch *(10)*.

This survey updates the soil surveys of Oneida County published in 1916 *(16)* and 1959 *(4)*. It provides additional information and larger, more detailed maps. The soil names may differ from those in the earlier surveys because of a better knowledge of the soils and changes in soil concepts.

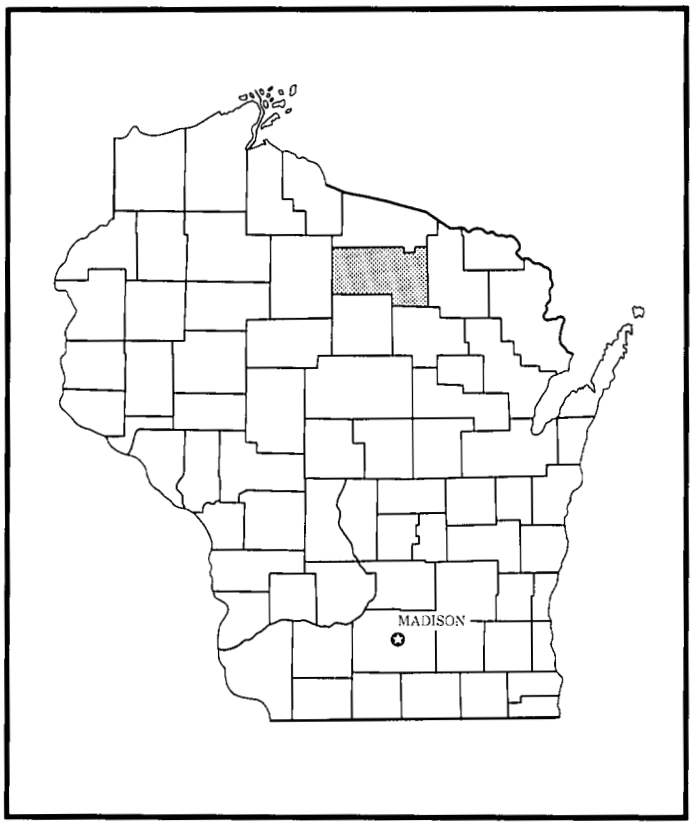

Figure 1.—Location of Oneida County in Wisconsin.

General Nature of the County

This section gives general information about the county. It describes history and development; climate;

physiography, relief, and drainage; water supply; and transportation facilities and industry.

History and Development

Little is known about the early history of what is now Oneida County. In the early 1600's, the first French explorers encountered Santee Sioux Indians in Michigan's Upper Peninsula and in the northwestern part of Wisconsin, including Oneida County. The Sioux Indians and others, including the Chippewa Tribe, established travel routes throughout the region. Eventually, the Chippewa became the rulers of northern Wisconsin.

Oneida County, which was originally part of Lincoln County, was established in 1885. The name Oneida is derived from an Indian tribe that migrated from New York to the Green Bay area around 1820. Originally, the county included most of the present Vilas County and part of Iron County. The present boundaries were established in 1905.

The first logging activities in the county occurred in 1857 near the present location of Rhinelander. The lumber industry reached its peak in the 1890's, when eight large sawmills were operating day and night in Rhinelander.

The county initially was settled in the area where the Wisconsin River joins the Pelican River. This area was originally referred to as Pelican Rapids. In 1878, Pelican Rapids was linked to the Lake Shore and Western Railway, which extended from Milwaukee to Ontonogon. Pelican Rapids then changed its name to Rhinelander, in honor of the president of the railroad company.

From 1900 to 1920, the acreage of farmland in the county significantly increased. In 1920, the county had 724 farms *(5)*. The number of farms reached a peak of 789 in 1940. Since that year, the number has decreased as large commercial farms have taken over many small family farms. In 1972, the county had a total of 180 farms, which averaged 240 acres in size *(17)*. In 1982, it had 117 farms, which averaged 351 acres in size *(15)*.

The Oneida County Rural Zoning Ordinance, adopted on May 16, 1933, prohibited settlement in remote areas. It was the first such ordinance in the United States. Its purpose was to reduce the cost of transporting children to school and of constructing and maintaining new roads.

The areas surrounding the numerous lakes in the county have been developed in recent years. Many summer homes and cottages as well as year-round homes have been built near the lakes. Also, many campgrounds and picnicking facilities have been developed on public lands.

Climate

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

In Oneida County, winters are very cold and summers are fairly warm. A short freeze-free period in summer limits crops mainly to forage, small grain, and suitable vegetables. Precipitation is fairly well distributed throughout the year, reaching a peak in summer. Snow covers the ground much of the time from late in fall to early in spring.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Rhinelander in the period 1951 to 1981. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 14 degrees F and the average daily minimum temperature is 4 degrees. The lowest temperature on record, which occurred at Rhinelander on February 9, 1951, is -40 degrees. In summer, the average temperature is 66 degrees and the average daily maximum temperature is 77 degrees. The highest recorded temperature, which occurred at Rhinelander on July 14, 1977, is 98 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 30.66 inches. Of this, about 22 inches, or more than 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 4.64 inches at Rhinelander on June 13, 1981. Thunderstorms occur on about 34 days each year.

The average seasonal snowfall is 53 inches. The greatest snow depth at any one time during the period of record was 47 inches. On the average, 71 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the

average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 12 miles per hour, in spring.

Physiography, Relief, and Drainage

Oneida County is in the Northern Highlands physiographic region of Wisconsin, a gently arched dome underlain by crystalline rock. Elevation ranges from about 1,460 feet above sea level near McCord, in the southwestern part of the county, to about 1,735 feet at Squirrel Hill, in the northwestern part.

The crystalline rock is overlain by thick glacial deposits. Most of the county is a pitted outwash plain. Other areas consist of glacial till or glacial drift. The largest area of glacial till is an extensive ground moraine in the southwestern and southeastern parts of the county. A remnant of an end moraine is southeast of Rhinelander. The southeastern part of the county has a number of parallel, streamlined ridges that appear to be an extension of a drumlin field located in the adjacent Langlade and Forest Counties *(4)*. The county has some eskers, commonly in areas parallel to drainageways.

The glacial deposits in the southern, eastern, and western parts of the county are covered by silty deposits. The soils in these areas are among the best suited in the county for agricultural crops and hardwood forests.

The drainage pattern in the county is irregular and poorly defined, as is typical in a glaciated region. It is characterized by numerous lakes, bogs, and marshes. Most of the county is drained by the Wisconsin River and its tributaries. The Wolf River and its tributaries drain a small acreage in the southeastern part of the county. Watersheds in the extreme northwest corner of the county drain through Squaw Creek and into the Flambeau-Chippewa River system, which empties into the upper Mississippi River.

Few areas in the world have as many lakes as the northern part of the county. Most of the lakes were formed from ice blocks that were buried in outwash deposits as the glaciers melted and receded. Lakes formed in depressions on the moraines. The lakes in the county are relatively shallow.

Water Supply

The many lakes, streams, and rivers in the county supply abundant surface water. The supply of ground water is adequate for present and anticipated domestic, agricultural, municipal, and industrial needs. The availability of the ground water varies locally, however, and onsite investigation is needed when water developments are planned.

The main aquifer in the county is glacial drift, particularly glacial outwash and ice-contact sand and gravel. Generally, the fractured crystalline bedrock does not supply much water, although locally it provides a small amount for domestic uses. The bedrock or the thin deposits of glacial drift overlying the bedrock in the southeastern part of the county, near Monico, generally yield only a few gallons of water per minute *(8)*. The aquifers in areas of the moraines, which are mainly in the southeastern and southwestern parts of the county, generally yield 5 to 50 gallons of water per minute. Most of the water is in thin lenses of sand and gravel within or below the glacial till.

The potential yields from wells vary greatly in the moderately well sorted sand and gravel in the hilly areas of end moraine and ice-contact deposits. The yields range from less than 50 gallons per minute in areas on hilltops where the depth to water is a limiting factor to several hundred gallons per minute in areas that consist of thick deposits of saturated sand and gravel outwash.

The yields from wells in areas of glacial outwash range from a few gallons to 2,000 gallons per minute. A well at Rhinelander yields more than 1,000 gallons per minute.

The ground water in the county generally is of good quality. The total mineral content is less than 150 milligrams per liter. The main components in the water are calcium, magnesium, and bicarbonate ions. In some areas, particularly within moraines, the ground water is hard. A large concentration of iron is in the ground water throughout the county, but it is not considered to be a health hazard.

Most of the lakes in the county are small. The largest natural lake is Lake Tomahawk, which is 3,627 acres in size. Willow Reservoir, which is 5,135 acres in size, is the largest body of water in the county. The deepest lake is Clear Lake, which is as much as 100 feet deep.

Generally, the quality of the surface water in the county is good. Most of the lakes and streams are clear, but those that receive deposits of organic material from wetland vegetation are brownish. The streams that drain wetlands and the lakes they empty into commonly are discolored. The smaller lakes commonly are more discolored, and the larger ones are clearer *(8)*.

The county has three types of lakes—spring lakes, seepage lakes, and drainage lakes. Spring lakes seldom have an inlet, but they have an outlet with substantial flow. These lakes are fed by ground water rather than by surface drainage. Seepage lakes generally do not have an inlet or an outlet, but some

have an intermittent outlet. The water level of these lakes is maintained by the water table or by a well sealed lake bottom. Drainage lakes have an outlet and at least one inlet. Their main water source is drainage from streams.

The spring lakes in the county have the highest mineral content because they receive the greatest amount of ground water. The drainage lakes have a lower mineral content than the spring lakes, and the seepage lakes have a very low mineral content. Drainage lakes have the greatest range in reaction. Water in the spring lakes has reaction similar to that of the ground water. The seepage lakes commonly are acid, and some of the drainage lakes are alkaline. About 80 percent of the lakes in the county are acid, or have a pH of less than 7.0. The rest are neutral or alkaline, or have a pH of 7.0 or higher *(3)*.

Pollution of the surface water generally is minimal because the county is relatively undeveloped and there is little municipal or industrial waste. The quality of the part of the Wisconsin River below the city of Rhinelander, however, has been reduced. The building of cottages, homes, and resorts along some of the lakes is a growing concern. The effluent from sewage disposal facilities can pollute the water and result in growth of weeds and algae. This problem is especially severe in seepage lakes, where there is little water exchange.

Transportation Facilities and Industry

Oneida County is served by three federal highways and four state highways. Also, a major railroad provides freight service to the county. An airport that offers passenger service is directly west of Rhinelander, near U.S. Highway 8.

The manufacturing and retail trade industries employ most of the people in the county. The paper industry is the largest employer *(10)*.

The lumber industry, which previously produced only sawtimber, now processes large amounts of pulp for paper. Small amounts of sawtimber and poles still are produced.

The vast number of lakes and the surrounding forested areas provide year-round opportunities for recreation and tourism. Such activities as fishing, hunting, boating, waterskiing, swimming, camping, hiking, snowmobiling, and cross-country skiing and the natural beauty of the county attract many vacationers.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

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

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

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

The general soil map of Oneida County joins with the general soil maps of Forest, Langlade, Lincoln, and Vilas Counties. Some of the association names in Oneida County do not agree with those in the adjoining counties because the extent of the major soils is different or because similar associations have different names in the adjoining counties. The soils in these similar associations have similar land use potentials. The differences in the association names do not significantly affect the use of these maps for general planning.

Soil Descriptions

1. Magnor-Greenwood-Cable Association

Nearly level and gently sloping, somewhat poorly drained to very poorly drained, silty, peaty, and mucky soils on moraines

The soils in this association are on low ridges and foot slopes and in depressions, basins, and drainageways. Slope ranges from 0 to 6 percent.

This association makes up about 3 percent of the county. It is about 50 percent Magnor soils, 32 percent Greenwood and similar soils, 14 percent Cable soils, and 4 percent soils of minor extent.

Magnor soils are on low ridges and foot slopes on moraines. They are somewhat poorly drained. Slope ranges from 1 to 6 percent. Permeability is moderate in the silty mantle and very slow in the substratum. The available water capacity is moderate. Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is grayish brown, mottled silt loam about 4 inches thick. The next layer is grayish brown and dark brown, mottled silt loam about 9 inches thick. The subsoil is about 18 inches thick. It is dark brown and grayish brown and is mottled. It is silt loam in the upper part and sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled, firm sandy loam.

Greenwood soils are in depressions and basins on moraines. They are very poorly drained. Slope is 0 to 1 percent. Permeability is moderate or moderately rapid. The available water capacity is very high. Typically, the surface layer is brown peat about 9 inches thick. Below this to a depth of about 60 inches is dark brown mucky peat.

Cable soils are in depressions and drainageways on moraines. They are poorly drained and very poorly drained. Slope ranges from 0 to 3 percent. Permeability is moderate or moderately slow in the subsoil and is moderately slow in the substratum. The available water capacity is high. Typically, the surface layer is black muck about 3 inches thick. The subsurface layer is black loam about 2 inches thick. The next layer is dark gray loam about 5 inches thick. The subsoil is about 24 inches thick. It is dark grayish brown and grayish brown, mottled loam in the upper part and brown, mottled sandy loam in the lower part. The substratum to a depth of about 60 inches is dark brown, mottled sandy loam.

Some of the soils of minor extent in this association are the well drained and moderately well drained Goodman and Keweenaw soils on ridges and knolls. Goodman soils formed in silty material and in the underlying gravelly loamy sand or gravelly sandy loam

glacial till. Keweenaw soils formed in loamy and sandy deposits and in the underlying gravelly loamy sand glacial drift.

Most areas of the Magnor and Cable soils are used as woodland. Some small areas are used as cropland or pasture. The Greenwood soils support wetland vegetation, including sphagnum moss, leatherleaf, laurel, bog rosemary, and stunted black spruce and tamarack.

The Greenwood soils are not suited to woodland because they do not support trees of merchantable size and quality. The Magnor and Cable soils are suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The equipment limitation is caused by wetness, by low soil strength, and in some areas by stones. Seedling mortality is caused by wetness, and the windthrow hazard is caused by the seasonal high water table, which limits the rooting depth.

The Magnor and Cable soils are not suited to cultivated crops, mainly because of stoniness and the seasonal high water table. Also, erosion is a hazard in the more sloping areas of the Magnor soils. The Greenwood soils are suited to cranberries. They generally are unsuited to cultivated crops, however, because of ponding, low natural fertility, extreme acidity, the seasonal high water table, and the frost hazard.

Because of the seasonal high water table and ponding, the Magnor soils are poorly suited to dwellings and the Cable and Greenwood soils are generally unsuited. The seasonal high water table and the very slow permeability are severe limitations if the Magnor soils are used for septic tank absorption fields. The Cable and Greenwood soils generally are unsuited to septic tank absorption fields, mainly because of ponding.

2. Goodman-Monico-Cable Association

Nearly level to moderately steep, well drained to very poorly drained, silty, loamy, and mucky soils on drumlins and moraines

The soils in this association are on ridges, knolls, and foot slopes and in depressions and drainageways. Slope ranges from 0 to 25 percent.

This association makes up about 5 percent of the county. It is about 26 percent Goodman soils, 25 percent Monico soils, 17 percent Cable soils, and 32 percent soils of minor extent.

Goodman soils are on ridges, knolls, and side slopes on drumlins and moraines. They are well drained and moderately well drained. Slope ranges from 1 to 25 percent. Permeability is moderate. The available water capacity also is moderate. Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is brown silt loam about 3 inches thick. The upper 12 inches of the subsoil is dark reddish brown and dark brown silt loam. The next 8 inches is brown, mottled silt loam, and the lower 15 inches is dark brown, mottled gravelly sandy loam and brown, mottled gravelly loamy sand. The substratum to a depth of about 60 inches is dark brown gravelly loamy sand that has a few pockets of sandy loam.

Monico soils are on low ridges and foot slopes and in depressions on drumlins and moraines. They are somewhat poorly drained. Slope ranges from 1 to 6 percent. Permeability is moderate. The available water capacity is also moderate. Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is black loam about 1 inch thick. The subsurface layer is brown loam about 2 inches thick. The subsoil is mottled. It is dark reddish brown and dark brown silt loam in the upper 11 inches, brown silt loam in the next 9 inches, and dark brown sandy loam in the lower 6 inches. The substratum to a depth of about 60 inches is dark brown, mottled sandy loam.

Cable soils are in depressions and drainageways on moraines. They are poorly drained and very poorly drained. Slope ranges from 0 to 3 percent. Permeability is moderate or moderately slow in the subsoil and is moderately slow in the substratum. The available water capacity is high. Typically, the surface layer is black muck about 3 inches thick. The subsurface layer is black loam about 2 inches thick. The next layer is dark gray loam about 5 inches thick. The subsoil is about 24 inches thick. It is dark grayish brown and grayish brown, mottled loam in the upper part and brown, mottled sandy loam in the lower part. The substratum to a depth of about 60 inches is dark brown, mottled sandy loam.

Some of the soils of minor extent in this association are the Carbondale, Dawson, Greenwood, Loxley, Lupton, Markey, and Padus soils. The very poorly drained, organic Carbondale, Dawson, Greenwood, Loxley, Lupton, and Markey soils are in depressions and basins. The well drained and moderately well drained Padus soils formed in loamy deposits and in the underlying outwash of stratified sand and gravel. They are on flats, knolls, and side slopes.

Most areas of this association are used as woodland. Some small areas are used as cropland or pasture.

The major soils are suited to trees. The main concern in managing woodland is the equipment limitation, which is caused by low soil strength during wet periods and in some areas by stones. Windthrow is a hazard because of the seasonal high water table, which limits the rooting depth. The slope is a management concern

in areas of the Goodman soils. The seedling mortality caused by wetness also is a concern on the Cable soils.

The major soils are not suited to cultivated crops, mainly because of the stoniness of the Goodman soils and the stoniness and seasonal high water table in the Monico and Cable soils. If the Goodman and Monico soils are cultivated, water erosion is a hazard in the more sloping areas.

The nearly level and gently sloping areas of the Goodman soils are only moderately suited to dwellings without basements and are poorly suited to dwellings with basements because of the seasonal high water table. Because of the seasonal high water table and ponding, the Monico soils are poorly suited to dwellings and septic tank absorption fields, the Cable soils are generally unsuited to dwellings and septic tank absorption fields, and the less sloping areas of the Goodman soils are poorly suited to septic tank absorption fields.

3. Greenwood-Dawson-Carbondale Association

Nearly level, very poorly drained, peaty and mucky soils on outwash plains and moraines

The soils in this association are in depressions and basins. Slope is 0 to 1 percent.

This association makes up about 3 percent of the county. It is about 40 percent Greenwood and similar soils, 32 percent Dawson soils, 19 percent Carbondale and similar soils, and 9 percent soils of minor extent.

Permeability is moderate or moderately rapid in the Greenwood soils. The available water capacity is very high. Typically, the surface layer is brown peat about 9 inches thick. Below this to a depth of about 60 inches is dark brown mucky peat.

Permeability is moderately slow to moderately rapid in the organic layers of the Dawson soils and is rapid in the sandy substratum. The available water capacity is very high. Typically, the surface layer is dark reddish brown peat about 4 inches thick. The next 31 inches is dark reddish brown and black muck. The substratum to a depth of about 60 inches is brown sand.

Permeability is moderately slow to moderately rapid in the Carbondale soils. The available water capacity is very high. Typically, the upper 35 inches is black muck. Below this to a depth of about 60 inches is very dark grayish brown mucky peat.

Some of the soils of minor extent in this association are the Au Gres, Kinross, and Worcester soils on flats and in depressions. The somewhat poorly drained Au Gres soils and the poorly drained Kinross soils formed in sandy glacial outwash. The somewhat poorly drained Worcester soils formed in loamy deposits underlain by outwash of stratified sand and gravel.

Most areas of this association support wetland vegetation of sphagnum moss, leatherleaf, laurel, bog rosemary, marsh grasses, sedges, reeds, alder brush, and cattail. Some areas support trees. Some small areas of the Greenwood and Dawson soils are used for cranberries.

The Greenwood and Dawson soils are not suited to woodland because they do not support trees of merchantable size and quality. The Carbondale soils are suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The equipment limitation is caused by wetness and low soil strength. Seedling mortality is caused by wetness, and the windthrow hazard is caused by the seasonal high water table, which limits the rooting depth.

The major soils are generally unsuited to cultivated crops. If drained and managed intensively, however, the Carbondale soils are suited to certain crops. The main management concerns are ponding, low natural fertility, the hazard of frost, and the seasonal high water table. Extreme acidity also is a problem in the Greenwood and Dawson soils.

The major soils are generally unsuited to dwellings and septic tank absorption fields, mainly because of ponding.

4. Padus-Goodman Association

Nearly level to steep, well drained and moderately well drained, loamy and silty soils on drumlins, moraines, and outwash plains and in areas of pitted outwash

The soils in this association are on flats, ridges, knolls, and side slopes. Slope ranges from 0 to 45 percent.

This association makes up about 7 percent of the county. It is about 42 percent Padus soils, 23 percent Goodman soils, and 35 percent soils of minor extent.

Padus soils are on flats, knolls, and side slopes on outwash plains and in areas of pitted outwash. They are well drained and moderately well drained. Slope ranges from 0 to 45 percent. Permeability is moderate or moderately rapid in the subsoil and rapid or very rapid in the substratum. The available water capacity is moderate. Typically, the surface layer is black sandy loam about 1 inch thick. The subsurface layer is brown sandy loam about 4 inches thick. The subsoil is about 30 inches thick. The upper part is dark reddish brown, dark brown, and brown sandy loam, and the lower part is dark brown gravelly loamy sand. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel.

Goodman soils are on ridges, knolls, and side slopes

on drumlins and moraines. They are well drained and moderately well drained. Slope ranges from 1 to 25 percent. Permeability is moderate. The available water capacity also is moderate. Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is brown silt loam about 3 inches thick. The upper 12 inches of the subsoil is dark reddish brown and dark brown silt loam, the next 8 inches is brown, mottled silt loam, and the lower 15 inches is dark brown, mottled gravelly sandy loam and brown, mottled gravelly loamy sand. The substratum to a depth of about 60 inches is dark brown gravelly loamy sand that has a few pockets of sandy loam.

Some of the soils of minor extent in this association are the Alcona, Cable, Carbondale, Dawson, Greenwood, Keweenaw, Loxley, Lupton, Markey, Monico, Pence, Plover, and Worcester soils. The moderately well drained Alcona soils and the somewhat poorly drained Plover soils formed in loamy and sandy deposits underlain by stratified loamy, silty, and sandy lacustrine deposits. Alcona soils are on flats, knolls, and short, uneven side slopes. Plover soils are on flats and in depressions. The poorly drained and very poorly drained Cable soils formed in loamy deposits and in the underlying sandy loam glacial till. They are in depressions and drainageways. The very poorly drained, organic Carbondale, Dawson, Greenwood, Loxley, Lupton, and Markey soils are in depressions and basins. The well drained and moderately well drained Keweenaw soils formed in loamy and sandy deposits and in the underlying gravelly loamy sand glacial drift. They are on knolls and ridges. The somewhat poorly drained Monico soils formed in silty material and in the underlying sandy loam or loamy sand glacial till. They are on low ridges and foot slopes and in depressions. The well drained Pence soils formed in loamy deposits and in the underlying outwash of gravelly sand or gravelly coarse sand. They are on flats, knolls, and side slopes. The somewhat poorly drained Worcester soils formed in loamy deposits underlain by stratified sand and gravel. They are on flats and in depressions.

Most areas of this association are used as woodland. Some small areas are used as cropland or pasture.

The major soils are suited to trees. The main concern in managing woodland is the equipment limitation, which is caused by low soil strength during wet periods, by the slope, and by stones in some areas of the Goodman soils. The hazard of water erosion also is a concern in the steeper areas of the Padus soils. Windthrow is a hazard in areas where the Goodman soils are moderately well drained. It is caused by the seasonal high water table, which limits the rooting depth.

The less sloping areas of the Padus soils are suited to cultivated crops, but the Goodman soils are not suited because of stoniness. Water erosion is a hazard if the more sloping areas are cultivated. Droughtiness and soil blowing also are concerns in areas of the Padus soils.

The nearly level and gently sloping Goodman soils are only moderately suited to dwellings without basements and are poorly suited to dwellings with basements because of the seasonal high water table. The Padus soils that are moderately well drained are suited to dwellings without basements, but they are only moderately suited to dwellings with basements because of the seasonal high water table. The Padus soils that are well drained are suited to dwellings. The nearly level and gently sloping areas of the Goodman soils and the moderately well drained areas of the Padus soils are poorly suited to septic tank absorption fields because of the seasonal high water table. The effluent can pollute ground water in areas of the Padus soils.

5. Au Gres-Croswell-Kinross Association

Nearly level and gently sloping, moderately well drained to poorly drained, sandy and mucky soils on outwash plains

The soils in this association are on flats and in depressions. Slope ranges from 0 to 3 percent.

This association makes up about 7 percent of the county. It is about 26 percent Au Gres soils, 25 percent Croswell soils, 15 percent Kinross soils, and 34 percent soils of minor extent.

Au Gres soils are somewhat poorly drained. Slope ranges from 0 to 2 percent. Permeability is rapid. The available water capacity is low. Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is black loamy sand about 3 inches thick. The subsurface layer is brown sand about 4 inches thick. The subsoil is about 18 inches thick. It is mottled. It is dark reddish brown loamy sand in the upper part and dark reddish brown and strong brown sand in the lower part. The substratum to a depth of about 60 inches is brown, mottled sand.

Croswell soils are moderately well drained. Slope ranges from 0 to 3 percent. Permeability is rapid. The available water capacity is low. Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is brown sand about 4 inches thick. The subsoil is about 34 inches thick. It is dark reddish brown loamy sand in the upper part, dark brown sand in the next part, and strong brown, mottled sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, light yellowish

brown, and pale brown, mottled sand.

Kinross soils are poorly drained. Slope ranges from 0 to 2 percent. Permeability is rapid. The available water capacity is low. Typically, the surface layer is black muck about 5 inches thick. The subsurface layer is brown, mottled sand about 5 inches thick. The subsoil is about 19 inches thick. It is mottled. It is dark reddish brown and dark brown loamy sand in the upper part and brown sand in the lower part. The substratum to a depth of about 60 inches is brown, mottled sand.

Some of the soils of minor extent in this association are the Carbondale, Dawson, Greenwood, Loxley, Lupton, Markey, Sayner, and Vilas soils. The very poorly drained, organic Carbondale, Dawson, Greenwood, Loxley, Lupton, and Markey soils are in depressions and basins. The excessively drained Sayner and Vilas soils are on flats, knolls, and short, uneven side slopes. Sayner soils formed in sandy deposits and in the underlying outwash of stratified sand and gravel. Vilas soils formed in sandy glacial outwash.

Most areas of this association are used as woodland. Some small areas are used as cropland or pasture.

The major soils are suited to trees. The main concern in managing woodland is the equipment limitation, which is caused by wetness in the Au Gres and Kinross soils and by the sandy upper part of the Croswell soils. Seedling mortality, which is caused by droughtiness in the Croswell soils and wetness in the Au Gres and Kinross soils, is a management concern. Windthrow is a hazard on the Au Gres and Kinross soils. It is caused by the seasonal high water table, which limits the rooting depth.

The Au Gres and Croswell soils are suited to cultivated crops, but the Kinross soils are generally not suited. The main management concern in areas of the Au Gres and Kinross soils is the seasonal high water table. Ponding and the frost hazard also are concerns in areas of the Kinross soils. Low natural fertility, seasonal droughtiness, and the hazard of soil blowing are concerns in areas of the Croswell soils.

Because of the seasonal high water table and ponding, the Au Gres soils are poorly suited to dwellings and the Kinross soils are generally unsuited. The Croswell soils are only moderately suited to dwellings without basements and are poorly suited to dwellings with basements because of the seasonal high water table. Because of the seasonal high water table, the Au Gres and Kinross soils are generally unsuited to septic tank absorption fields and the Croswell soils are poorly suited. Ponding is a hazard on the Kinross soils. The effluent can pollute ground water in areas of all three soils.

6. Sayner-Vilas Association

Nearly level to steep, excessively drained, sandy soils on outwash plains and in areas of pitted outwash

The soils in this association are on flats, knolls, and side slopes. Slope ranges from 0 to 45 percent.

This association makes up about 24 percent of the county. It is about 39 percent Sayner and similar soils, 26 percent Vilas and similar soils, and 35 percent soils of minor extent.

Permeability is moderately rapid in the subsoil of the Sayner soils and rapid or very rapid in the substratum. Slope ranges from 0 to 45 percent. The available water capacity is low. Typically, the surface layer is black loamy sand about 2 inches thick. The subsurface layer is brown loamy sand about 2 inches thick. The subsoil is about 18 inches thick. It is dark reddish brown loamy sand in the upper part, reddish brown sand in the next part, and strong brown gravelly sand in the lower part. The substratum to a depth of about 60 inches is strong brown, light yellowish brown, and brownish yellow, stratified sand and gravel.

Permeability is rapid in the Vilas soils. Slope ranges from 0 to 25 percent. The available water capacity is low. Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is black loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 2 inches thick. The subsoil is about 27 inches thick. It is dark reddish brown and dark brown loamy sand in the upper part and strong brown sand in the lower part. The substratum to a depth of about 60 inches is brown sand.

Some of the soils of minor extent in this association are the Au Gres, Carbondale, Croswell, Dawson, Greenwood, Keweenaw, Kinross, Loxley, Lupton, Markey, Padus, and Pence soils. The somewhat poorly drained Au Gres soils, the moderately well drained Croswell soils, and the poorly drained Kinross soils formed in sandy glacial outwash. They are on flats and in depressions. The very poorly drained, organic Carbondale, Dawson, Greenwood, Loxley, Lupton, and Markey soils are in depressions and basins. The well drained and moderately well drained Keweenaw soils formed in loamy and sandy deposits and in the underlying gravelly loamy sand glacial drift. They are on knolls and ridges. The well drained and moderately well drained Padus soils and the well drained Pence soils formed in loamy deposits and in the underlying outwash of stratified sand and gravel, gravelly sand, or gravelly coarse sand. They are on flats, knolls, and side slopes.

Most areas of this association are used as woodland. Some small areas are used as cropland or pasture.

The major soils are suited to trees. The main

concerns in managing woodland are the equipment limitation, which is caused by the slope, and the hazard of water erosion on the steeper slopes. Seedling mortality, which is caused by droughtiness in the Sayner soils, also is a concern.

The less sloping areas of the major soils are suited to cultivated crops. The main management concerns are droughtiness, low natural fertility, and soil blowing. Water erosion is a hazard if the more sloping areas are cultivated.

The nearly level and gently sloping areas of the major soils are suited to dwellings. The effluent in septic tank absorption fields can pollute ground water because of the rapid or very rapid permeability in the substratum.

7. Padus-Pence Association

Nearly level to steep, well drained and moderately well drained, loamy soils on outwash plains and in areas of pitted outwash

The soils in this association are on flats, knolls, and side slopes. Slope ranges from 0 to 45 percent.

This association makes up about 25 percent of the county. It is about 47 percent Padus soils, 18 percent Pence and similar soils, and 35 percent soils of minor extent.

Padus soils are well drained and moderately well drained. Slope ranges from 0 to 45 percent. Permeability is moderate or moderately rapid in the subsoil and rapid or very rapid in the substratum. The available water capacity is moderate. Typically, the surface layer is black sandy loam about 1 inch thick. The subsurface layer is brown sandy loam about 4 inches thick. The subsoil is about 30 inches thick. The upper part is dark reddish brown, dark brown, and brown sandy loam, and the lower part is dark brown gravelly loamy sand. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel.

Pence soils are well drained. Slope ranges from 1 to 45 percent. Permeability is moderately rapid in the subsoil and rapid or very rapid in the substratum. The available water capacity is low. Typically, the surface layer is dark reddish brown sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 5 inches thick. The subsoil is about 13 inches thick. The upper part is dark reddish brown sandy loam, the next part is reddish brown gravelly sandy loam, and the lower part is yellowish red gravelly coarse sand. The substratum to a depth of about 60 inches is yellowish red and reddish yellow gravelly coarse sand.

Some of the soils of minor extent in this association are the Carbondale, Dawson, Greenwood, Loxley, Lupton, Markey, Minocqua, and Worcester soils. The very poorly drained, organic Carbondale, Dawson, Greenwood, Loxley, Lupton, and Markey soils are in depressions and basins. The very poorly drained Minocqua soils formed in silty and loamy deposits and in the underlying outwash of gravelly coarse sand. They are in depressions and drainageways. The somewhat poorly drained Worcester soils formed in loamy deposits underlain by outwash of stratified sand and gravel. They are on flats and in depressions.

Most areas of this association are used as woodland. Some small areas are used as cropland or pasture.

The major soils are suited to trees. The main concern in managing wooded areas of the Padus soils is the equipment limitation, which is caused by low soil strength during wet periods. The hazard of water erosion also is a concern in the more sloping areas. The equipment limitation and the hazard of water erosion are management concerns in the more sloping areas of the Pence soils.

The less sloping areas of the major soils are suited to cultivated crops. The main management concerns are droughtiness and soil blowing. Water erosion is a hazard if the more sloping areas are cultivated.

The nearly level and gently sloping, well drained Pence and Padus soils are suited to dwellings. The nearly level and gently sloping, moderately well drained Padus soils are suited to dwellings without basements, but they are only moderately suited to dwellings with basements because of the seasonal high water table. The pollution of ground water is a hazard if the major soils are used for septic tank absorption fields. In areas of the nearly level and gently sloping, moderately well drained Padus soils, the seasonal high water table also is a management concern.

8. Keweenaw-Vilas Association

Nearly level to steep, moderately well drained, well drained, and excessively drained, loamy and sandy soils on drumlins, water-worked moraines, and outwash plains and in areas of pitted outwash

The soils in this association are on flats, ridges, knolls, and side slopes. Slope ranges from 0 to 30 percent.

This association makes up about 24 percent of the county. It is about 34 percent Keweenaw and similar soils, 31 percent Vilas and similar soils, and 35 percent soils of minor extent.

Keweenaw soils are moderately well drained and well drained. Slope ranges from 1 to 30 percent. Permeability is moderate or moderately rapid in the subsoil and is moderately rapid in the substratum. The available water capacity is low. Typically, a mat of partially decomposed forest litter about 1 inch thick is at

the surface. The surface layer is black sandy loam about 1 inch thick. The subsurface layer is dark brown loamy sand about 1 inch thick. The upper 21 inches of the subsoil is dark brown sandy loam and brown gravelly loamy sand, the next 12 inches is brown gravelly loamy sand and dark brown gravelly sandy loam, and the lower 20 inches is dark brown, firm gravelly sandy loam and brown, firm gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly loamy sand.

Vilas soils are excessively drained. Slope ranges from 0 to 25 percent. Permeability is rapid. The available water capacity is low. Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is black loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 2 inches thick. The subsoil is about 27 inches thick. It is dark reddish brown and dark brown loamy sand in the upper part and strong brown sand in the lower part. The substratum to a depth of about 60 inches is brown sand.

Some of the soils of minor extent in this association are the Cable, Carbondale, Dawson, Greenwood, Loxley, Lupton, Markey, Monico, and Pequaming soils. The poorly drained and very poorly drained Cable soils formed in loamy deposits and in the underlying sandy loam glacial till. The very poorly drained, organic Carbondale, Dawson, Greenwood, Loxley, Lupton, and Markey soils are in depressions and basins. The somewhat poorly drained Monico and Pequaming soils are on low ridges and foot slopes and in depressions. Monico soils formed in silty material and in the underlying sandy loam or loamy sand glacial till. Pequaming soils formed primarily in sandy deposits underlain by sandy and loamy glacial drift.

Most areas of this association are used as woodland. Some small areas are used as cropland or pasture.

The major soils are suited to trees. The main concern in managing woodland is the equipment limitation, which is caused by the slope and by stones in some areas of the Keweenaw soils. Water erosion is a hazard in the more sloping areas of the Vilas soils.

The less sloping areas of the Vilas soils are suited to cultivated crops. The hazard of soil blowing, low natural fertility, and droughtiness are management concerns. The hazard of water erosion also is a concern in the more sloping areas. The Keweenaw soils are not suited to cultivated crops because of stoniness.

The nearly level and gently sloping areas of the Vilas soils are suited to dwellings, but the nearly level and gently sloping areas of the Keweenaw soils are only moderately suited because of large stones. Wetness also is a limitation on sites for dwellings with basements. The nearly level and gently sloping areas of the Keweenaw soils are poorly suited to septic tank absorption fields because of the seasonal high water table. In areas of the Vilas soils, the effluent can pollute ground water.

9. Goodman-Keweenaw Association

Nearly level to steep, moderately well drained and well drained, silty and loamy soils on drumlins and water-worked moraines

The soils in this association are on ridges, knolls, and side slopes. Slope ranges from 1 to 30 percent.

This association makes up about 2 percent of the county. It is about 39 percent Goodman soils, 32 percent Keweenaw and similar soils, and 29 percent soils of minor extent.

Goodman soils are well drained and moderately well drained. Slope ranges from 1 to 25 percent. Permeability is moderate. The available water capacity also is moderate. Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is brown silt loam about 3 inches thick. The upper 12 inches of the subsoil is dark reddish brown and dark brown silt loam, the next 8 inches is brown, mottled silt loam, and the lower 15 inches is dark brown, mottled gravelly sandy loam and brown, mottled gravelly loamy sand. The substratum to a depth of about 60 inches is dark brown gravelly loamy sand that has a few pockets of sandy loam.

Keweenaw soils are moderately well drained and well drained. Slope ranges from 1 to 30 percent. Permeability is moderate or moderately rapid in the subsoil and is moderately rapid in the substratum. The available water capacity is low. Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is black sandy loam about 1 inch thick. The subsurface layer is dark brown loamy sand about 1 inch thick. The upper 21 inches of the subsoil is dark brown sandy loam and brown gravelly loamy sand, the next 12 inches is brown gravelly loamy sand and dark brown gravelly sandy loam, and the lower 20 inches is dark brown, firm gravelly sandy loam and brown, firm gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly loamy sand.

Some of the soils of minor extent in this association are the Carbondale, Dawson, Greenwood, Loxley, Lupton, Markey, Monico, Padus, and Plover soils. The very poorly drained, organic Carbondale, Dawson, Greenwood, Loxley, Lupton, and Markey soils are in depressions and basins. The somewhat poorly drained Monico soils formed in silty material and in the underlying sandy loam or loamy sand glacial till. They are on low ridges and foot slopes and in depressions.

The well drained and moderately well drained Padus soils formed in loamy deposits and in the underlying outwash of stratified sand and gravel. They are on flats, knolls, and side slopes. The somewhat poorly drained Plover soils formed in loamy and sandy deposits underlain by stratified loamy, silty, and sandy lacustrine deposits. They are on flats and in depressions.

Most areas of this association are wooded. The main concern in managing woodland is the equipment limitation, which is caused by the steeper slopes and in some areas by stones. During wet periods low strength in the Goodman soils also restricts the use of equipment. Windthrow is a hazard in areas of the moderately well drained Goodman soils. It is caused by the seasonal high water table, which limits the rooting depth.

The major soils are not suited to cultivated crops, mainly because of stoniness. Water erosion is a hazard if the more sloping areas are cultivated. If the Keweenaw soils are cultivated, soil blowing and droughtiness also are management concerns.

The nearly level and gently sloping areas of the Goodman soils are only moderately suited to dwellings without basements and are poorly suited to dwellings with basements because of the seasonal high water table. The nearly level and gently sloping areas of the Keweenaw soils are only moderately suited to dwellings without basements because of large stones and to dwellings with basements because of the seasonal high water table and the large stones. Both soils are poorly suited to septic tank absorption fields because of the seasonal high water table.

Detailed Soil Map Units

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

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

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

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

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

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

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Padus-Pence sandy loams, 6 to 15 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Greenwood, Loxley, and Dawson peats, 0 to 1 percent slopes, is an undifferentiated group in this survey area.

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

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

Several soils that were mapped in Oneida County join with similar soils in adjacent counties. The similar soils in the adjacent counties were not mapped or correlated in Oneida County because of their small extent.

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

Soil Descriptions

AcB—Alcona fine sandy loam, 0 to 6 percent slopes. This nearly level and gently sloping, moderately well drained soil is on flats, knolls, and short, uneven side slopes on glacial lake plains, outwash plains, and moraines. Individual areas are irregularly shaped and generally range from 5 to 70 acres in size.

Typically, a mat of partially decomposed forest litter

about 2 inches thick is at the surface. The surface layer is grayish brown fine sandy loam about 3 inches thick. The upper 11 inches of the subsoil is dark brown fine sandy loam, the next 3 inches is brown loamy fine sand, and the lower 9 inches is dark brown fine sandy loam and brown loamy fine sand. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown, mottled, stratified very fine sandy loam and silt loam. In some places the upper layers are loamy sand, sandy loam, very fine sandy loam, or silt loam. In other places the substratum is loamy sand, sand, or sand and gravel. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of Plover, Rousseau, Vilas, and Worcester soils. These soils make up less than 10 percent of the unit. The somewhat poorly drained Plover and Worcester soils are on the lower flats and in depressions. The well drained Rousseau soils and the excessively drained Vilas soils are in positions on the landscape similar to those of the Alcona soil. They have less silt and clay than the Alcona soil. Also included are areas where the Alcona soil is well drained and a few areas where it is stony.

Permeability is moderate or moderately rapid in the upper part of the Alcona soil and is moderate in the lower part of the subsoil and in the substratum. The available water capacity is moderate, and natural fertility is medium. The depth to a perched seasonal high water table is 2.5 to 6.0 feet.

Most areas are used as woodland. Some small areas are used as cropland or pasture. This soil is suited to trees. The main concern in managing woodland is the equipment limitation. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soil is dry or has a thick cover of snow. On unsurfaced roads ruts form easily during wet periods. On sites for all-weather roads, a gravel base is needed. If stabilized, landings can better withstand the repeated use of heavy equipment.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Water erosion is the main management concern in cultivated areas where the slope is more than about 2 percent. A conservation cropping sequence, contour farming, grassed waterways, cover crops, and a system of conservation tillage, such as chisel plowing, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and good soil tilth.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table. This limitation can be overcome by constructing a mound of suitable filtering material.

This soil is suited to dwellings without basements. Because of the seasonal high water table, however, it is only moderately suited to dwellings with basements. Constructing basements above the level of wetness or installing a subsurface drainage system that has a gravity outlet or another dependable outlet can overcome this limitation.

This soil is only moderately suited to local roads and streets because of the potential for frost action. This limitation can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing adequate roadside ditches, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is IIe. The woodland ordination symbol is 3L. The primary habitat type is ATM, and the secondary habitat type is PMV.

AcC—Alcona fine sandy loam, 6 to 15 percent slopes. This sloping, moderately well drained soil is on knolls and side slopes on outwash plains, moraines, and glacial lake plains. Many slopes are complex. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 60 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is grayish brown fine sandy loam about 3 inches thick. The upper 6 inches of the subsoil is dark brown and strong brown fine sandy loam, the next 7 inches is brown loamy fine sand, and the lower 19 inches is dark brown fine sandy loam and dark yellowish brown loamy fine sand. The substratum to a depth of about 60 inches is dark yellowish brown, brown, and yellowish brown, mottled, stratified very fine sandy loam and silt loam. In some places the upper layers are loamy sand, sandy loam, very fine sandy loam, or silt loam. In other places

the substratum is loamy sand, sand, or sand and gravel. In some areas the slope is less than 6 percent or more than 15 percent.

Included with this soil in mapping are small areas of the well drained Rousseau and excessively drained Sayner and Vilas soils. These soils make up less than 15 percent of the unit. They are in positions on the landscape similar to those of the Alcona soil. They have less silt and clay than the Alcona soil. Also included are some areas where the Alcona soil is well drained, a few areas where the Alcona soil is stony, and small areas of wet soils in depressions.

Permeability is moderate or moderately rapid in the upper part of the Alcona soil and is moderate in the lower part of the subsoil and in the substratum. The available water capacity is moderate, and natural fertility is medium. The depth to a perched seasonal high water table is 2.5 to 6.0 feet.

Most areas are used as woodland. Some small areas are used as cropland or pasture. This soil is suited to trees. The main concern in managing woodland is the equipment limitation. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soil is dry or has a thick cover of snow. On unsurfaced roads ruts form easily during wet periods. On sites for all-weather roads, a gravel base is needed. The slope limits the selection of landing sites. Landings can be established in areas of the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Water erosion is the main management concern in cultivated areas. A conservation cropping sequence, contour farming, grassed waterways, cover crops, and a system of conservation tillage, such as chisel plowing, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and good soil tilth.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table. This limitation can be overcome by constructing a mound of suitable filtering material.

This soil is only moderately suited to dwellings without basements because of the slope and to dwellings with basements because of the slope and the seasonal high water table. The slope can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land. Constructing basements above the level of wetness or installing a subsurface drainage system that has a gravity outlet or another dependable outlet helps to overcome the wetness.

This soil is only moderately suited to local roads and streets because of the slope and the potential for frost action. Frost action can be controlled by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by installing a good subsurface drainage system. The slope can be shaped by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadways.

The land capability classification is IIIe. The woodland ordination symbol is 3L. The primary habitat type is ATM, and the secondary habitat type is PMV.

Au—Au Gres loamy sand, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on flats and in depressions on outwash plains. Individual areas are long and narrow or are irregularly shaped, and they generally range from 5 to 250 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is black loamy sand about 3 inches thick. The subsurface layer is brown sand about 4 inches thick. The subsoil is about 18 inches thick. It is dark reddish brown, mottled loamy sand in the upper part and dark reddish brown and strong brown, mottled sand in the lower part. The substratum to a depth of about 60 inches is brown, mottled sand. In a few areas the upper layers are sandy loam. In places the surface layer and the upper part of the subsoil are sand. In some areas the substratum is stratified sandy, loamy, and silty material, and in other areas it is gravelly sand. In some places the soil is fine sand or very fine sand throughout. In other places the slope is more than 2 percent.

Included with this soil in mapping are small areas of the moderately well drained Croswell and poorly drained Kinross soils. These soils make up less than 10 percent of the unit. Croswell soils are higher on the landscape than the Au Gres soil. Kinross soils are on the lower flats and in depressions.

Permeability is rapid in the Au Gres soil. The available water capacity and natural fertility are low.

The depth to a seasonal high water table is 0.5 foot to 1.5 feet.

Most areas are used as woodland. Some small areas are used as cropland or pasture. This soil is suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The use of equipment is restricted in spring and in other wet periods because of the seasonal high water table. Ruts form easily if wheeled vehicles are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Access by machinery is limited to dry periods in summer or to periods in winter when the soil is frozen or has a thick cover of snow. The seedling mortality caused by wetness can be minimized by planting vigorous nursery stock on the crest of cradle knolls or on prepared ridges. A shallow rooting depth, which is caused by the seasonal high water table, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means may be needed to control plant competition. Subsequent control of invading species also may be needed.

If drained, this soil is suited to corn, small grain, and specialty crops and to grasses and legumes for hay and pasture. In undrained areas the seasonal high water table limits yields and the kinds of crops that can be grown. If the soil is drained and cultivated, soil blowing is a hazard during dry periods. Cover crops, field windbreaks, and a system of conservation tillage, such as chisel plowing, minimize soil loss, conserve soil moisture, and help to maintain the content of organic matter.

This soil is suited to pasture. Maintaining forage stands is difficult, however, because of the low natural fertility, the seasonal high water table during wet periods, and droughtiness during dry periods. A cover of pasture plants is effective in controlling soil blowing. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the seasonal high water table and a poor filtering capacity, which results from the rapid permeability. Overcoming these limitations is difficult. A better suited site should be considered. In some areas the effluent can be pumped to an absorption field established on better suited soils on the higher parts of the landscape.

Because of the seasonal high water table, this soil is poorly suited to dwellings and local roads and streets. Constructing dwellings without basements on fill material, which raises the level of the site, and constructing basements above the level of wetness help to overcome this limitation. The wetness also can be overcome by installing a subsurface drainage system that has a gravity outlet or another dependable outlet. The risk of damage to local roads and streets can be reduced by providing coarse textured fill material, such as sand or gravel, which raises the roadbed above the level of wetness, and providing adequate roadside ditches and culverts, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is IVw. The woodland ordination symbol is 6W. The habitat type is TMC.

CaA—Cable muck, 0 to 3 percent slopes, stony. This nearly level and gently sloping, poorly drained and very poorly drained soil is in depressions and drainageways on moraines. It is subject to ponding. Stones are in the surface layer in most areas. Individual areas are long and narrow or are irregularly shaped, and they generally range from 5 to 600 acres in size.

Typically, the surface layer is black muck about 3 inches thick. The subsurface layer is black loam about 2 inches thick. The next layer is dark gray loam about 5 inches thick. The subsoil is about 24 inches thick. It is mottled. It is dark grayish brown and grayish brown loam in the upper part and brown sandy loam in the lower part. The substratum to a depth of about 60 inches is dark brown, mottled sandy loam. In some areas the upper layers are sand, loamy sand, sandy loam, or silt loam. In some places the substratum is loamy sand or gravelly, very gravelly, cobbly, or very cobbly sandy loam or loamy sand, and in other places it is stratified sandy, loamy, and silty material. In the south-central part of the county, the substratum is grayer.

Included with this soil in mapping are small areas of Magnor, Markey, Minocqua, and Monico soils. These soils make up less than 10 percent of the unit. The somewhat poorly drained Magnor and Monico soils are higher on the landscape than the Cable soil. The very poorly drained Markey soils are in depressions and basins. They are organic to a depth of more than 16 inches and are underlain by sandy deposits. The poorly drained and very poorly drained Minocqua soils are in positions on the landscape similar to those of the Cable soil. They are underlain by gravelly coarse sand. Also included are some areas where the Cable soil is not stony or is very stony or bouldery.

Permeability is moderate or moderately slow in the

subsoil of the Cable soil and is moderately slow in the substratum. The available water capacity is high, and natural fertility is medium. The seasonal high water table is within a depth of 1 foot.

Most areas are used as woodland. Some small areas are used as cropland or pasture. This soil is suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The soil is usually wet from fall to spring. Ruts form easily when wheeled skidders are used during the wet periods. Deep ruts restrict lateral drainage and expose tree roots. Access by machinery is limited to dry periods in summer or to periods in winter when the soil is frozen or has a thick cover of snow. A gravel base is needed on sites for all-weather roads. Culverts are needed to maintain the natural drainage system. Because wetness and low soil strength are severe limitations on landing sites, the better suited adjacent soils should be selected. Trees generally are not planted on this soil because of the wetness. Reforestation is limited to natural regeneration or hand planting. The seedling mortality caused by wetness can be minimized by planting vigorous nursery stock on the crest of cradle knolls or on prepared ridges. In areas where stones limit the use of equipment, yarding of the logs by cable may be necessary. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Subsequent control of invading species also may be needed.

This soil generally is not suited to cultivated crops. The seasonal high water table, the stoniness, the frost hazard, and the ponding are management concerns.

Mainly because of the ponding, this soil generally is unsuitable as a site for septic tank absorption fields and dwellings. Overcoming this limitation is difficult. A better suited site should be selected.

This soil is poorly suited to local roads and streets because of the ponding and the potential for frost action. Surface water can be removed by suitable outlets in culverts and ditches. Additions of fill material can raise the roads above the level of ponding. Installing culverts helps to prevent road damage by equalizing the water level on both sides of the road. Frost action can be controlled by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing a good surface and subsurface drainage system.

The land capability classification is VIw. The woodland ordination symbol is 2X. No habitat type is assigned.

Cb—Carbondale, Lupton, and Markey mucks, 0 to 1 percent slopes. These nearly level, very poorly drained soils are in depressions and basins on outwash plains and moraines. They are subject to ponding. Microrelief of as much as 12 inches is common. Individual areas are long and narrow or are irregularly shaped, and they generally range from 5 to 400 acres in size. Some areas are 45 to 60 percent Carbondale soil, 0 to 15 percent Lupton soil, and 10 to 25 percent Markey soil. Some are 0 to 15 percent Carbondale soil, 35 to 55 percent Lupton soil, and 15 to 35 percent Markey soil. Others are 0 to 15 percent Carbondale soil, 0 to 15 percent Lupton soil, and 55 to 65 percent Markey soil. All three soils have similar behavior characteristics for the present or anticipated uses in the survey area; therefore, mapping them separately was not considered practical or necessary.

Typically, the Carbondale soil is black muck to a depth of about 35 inches. Below this to a depth of about 60 inches is very dark grayish brown mucky peat. In places the surface layer is mucky peat or peat.

Typically, the Lupton soil is black muck to a depth of about 60 inches. In places the surface layer is mucky peat or peat.

Typically, the Markey soil is black muck to a depth of about 26 inches. The upper part of the substratum is dark gray and brown loamy sand. The lower part to a depth of about 60 inches is brown sand. In places the surface layer is mucky peat or peat. In a few areas the substratum is gravelly sand, sandy loam, loam, or silt loam.

Included with these soils in mapping are small areas of Cable, Dawson, Fordum, Greenwood, Kinross, and Loxley soils. These included soils make up less than 15 percent of the unit. Cable soils formed mainly in loamy deposits in depressions and drainageways. Dawson, Greenwood, and Loxley soils are in positions on the landscape similar to those of the Carbondale, Lupton, and Markey soils. They are more acid than those soils. Fordum soils are on flood plains and in drainageways. They have a lower content of organic material than the Carbondale, Lupton, and Markey soils. The poorly drained Kinross soils are in the higher positions on the landscape. They formed mainly in sandy deposits. Also included are small areas of other mineral soils and small areas of water (fig. 2).

Permeability is moderately slow to moderately rapid in the Carbondale and Lupton soils. It is moderately slow to moderately rapid in the organic layers in the Markey soil and rapid in the sandy substratum. The available water capacity is very high in all three soils,

Figure 2.—A small area of water in an area of Carbondale, Lupton, and Markey mucks, 0 to 1 percent slopes.

and natural fertility is low. The seasonal high water table is within a depth of 1 foot.

Most areas support trees or wetland vegetation of marsh grasses, sedges, reeds, alder brush, and cattail. These soils are suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. Wetness and low soil strength are severe limitations. The use of equipment is generally limited to periods in winter when the soils are frozen or have a thick cover of snow. Reforestation is limited to natural regeneration. Trees generally are not planted on these soils because of the wetness, severe seedling mortality, and plant competition. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be

minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species also may be needed.

Because of the ponding, the low natural fertility, the frost hazard, and the seasonal high water table, these soils are generally unsuited to cultivated crops. If drained and managed intensively, however, they are suited to specialty crops, such as carrots and onions. Subsidence and soil blowing are management concerns in drained areas. Also, burning of the organic material is a concern when the soils are dry. Special drainage systems that control the water table minimize oxidation, subsidence, and soil blowing. Windbreaks also help to control soil blowing.

These soils are generally unsuited to septic tank absorption fields, dwellings, and local roads and streets, mainly because of the ponding, low soil strength, the potential for frost action, and subsidence. Overcoming these limitations is difficult. A better suited site should be selected.

The land capability classification is VIw. The woodland ordination symbol is 5W in areas of the Carbondale soil, 6W in areas of the Lupton soil, and 7W in areas of the Markey soil. No habitat type is assigned.

CrA—Croswell sand, 0 to 3 percent slopes. This nearly level and gently sloping, moderately well drained soil is on flats and in depressions on outwash plains. Individual areas are irregularly shaped and generally range from 10 to 100 acres in size.

Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is brown sand about 4 inches thick. The subsoil is about 34 inches thick. It is dark reddish brown loamy sand in the upper part, dark brown sand in the next part, and strong brown, mottled sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, light yellowish brown, and pale brown, mottled sand. In some places the surface layer is loamy sand. In other places the upper layers are loamy fine sand or sandy loam. In some areas the substratum is gravelly sand. In other areas the slope is more than 3 percent.

Included with this soil in mapping are small areas of Au Gres soils, the Croswell soils that have a loamy substratum, and Vilas soils. These soils make up less than 10 percent of the unit. The somewhat poorly drained Au Gres soils are on the lower flats and in depressions. The excessively drained Vilas soils are higher on the landscape than this Croswell soil. The Croswell soils that have a loamy substratum are in positions on the landscape similar to those of this Croswell soil. They have stratified silty, loamy, and sandy deposits at a depth of 40 to 60 inches.

Permeability is rapid in this Croswell soil. The available water capacity and natural fertility are low. The depth to a seasonal high water table is 2 to 4 feet.

Most areas are used as woodland. Some small areas are used as cropland or pasture. This soil is suited to trees. The main concern in managing woodland is the seedling mortality resulting from droughtiness. The equipment limitation also is a concern. Planting when the soil is moist and planting containerized seedlings or vigorous nursery stock can reduce the seedling mortality rate. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel.

After trees are cut, plant competition can prevent or delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Seasonal droughtiness, the low natural fertility, and soil blowing are management concerns in cultivated areas. Cover crops, field windbreaks, and a system of conservation tillage, such as chisel plowing, minimize soil loss, conserve soil moisture, and help to maintain the content of organic matter. Irrigation can overcome the droughtiness.

A cover of pasture plants or hay is effective in controlling soil blowing. Because of the low natural fertility and seasonal droughtiness, forage yields generally are somewhat limited. Rotation grazing, restricted use during dry periods, and proper stocking rates help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and a poor filtering capacity, which results from the rapid permeability. These limitations can be overcome by constructing a mound of suitable filtering material. In some areas the effluent can be pumped to an absorption field established on better suited soils on the higher parts of the landscape.

Because of the seasonal high water table, this soil is poorly suited to dwellings with basements and is only moderately suited to dwellings without basements. Constructing dwellings without basements on fill

material, which raises the level of the site, and constructing basements above the level of wetness help to overcome this limitation. The wetness also can be overcome by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

This soil is only moderately suited to local roads and streets because of the seasonal high water table. This limitation can be overcome by providing coarse textured fill material, such as sand or gravel, which raises the roadbed above the level of wetness, and by providing adequate roadside ditches and culverts, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is IVs. The woodland ordination symbol is 5S. The habitat type is AQV.

CsA—Croswell loamy sand, loamy substratum, 0 to 3 percent slopes. This nearly level and gently sloping, moderately well drained soil is on flats and in depressions on outwash plains. Individual areas are irregularly shaped and generally range from 5 to 70 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsoil is about 16 inches thick. It is dark brown loamy sand in the upper part and strong brown sand in the lower part. The upper part of the substratum is strong brown and brown, mottled sand. The lower part to a depth of about 60 inches is brown, mottled, stratified very fine sandy loam, fine sandy loam, silt loam, very fine sand, and fine sand. In some places the upper layers are sand or sandy loam. In other places the stratified silty, loamy, and sandy deposits are within a depth of 40 inches. In some areas the slope is more than 3 percent.

Included with this soil in mapping are small areas of Alcona and Vilas soils and the Croswell soils that do not have a loamy substratum. These soils make up less than 15 percent of the unit. The moderately well drained Alcona soils are on flats, knolls, and short, uneven side slopes. They contain more silt and clay in the surface layer and subsoil than this Croswell soil. The Croswell soils that do not have a loamy substratum are in positions on the landscape similar to those of this Croswell soil, and the excessively drained Vilas soils are on the higher flats, knolls, and short, uneven side slopes. Neither of these two soils has stratified silty, loamy, and sandy deposits at a depth of 40 to 60 inches.

Permeability is rapid in the sandy upper part of this Croswell soil and moderately slow in the underlying stratified silty, loamy, and sandy deposits. The available water capacity and natural fertility are low. The depth to a perched seasonal high water table is 2.5 to 5.0 feet.

Most areas are used as woodland. Some small areas are used as cropland or pasture. This soil is suited to trees. No major hazards or limitations affect planting or harvesting. The low available water capacity, however, limits the growth of trees, especially hardwoods, which grow better on soils that are not so droughty.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Seasonal droughtiness, the low natural fertility, and soil blowing are management concerns in cultivated areas. Cover crops, field windbreaks, and a system of conservation tillage, such as chisel plowing, minimize soil loss, conserve soil moisture, and help to maintain the content of organic matter. Irrigation can overcome the droughtiness.

A cover of pasture plants or hay is effective in controlling soil blowing. Because of the low natural fertility and seasonal droughtiness, forage yields generally are somewhat limited. Rotation grazing, restricted use during dry periods, and proper stocking rates help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table; a poor filtering capacity, which results from the rapid permeability in the upper sandy layers; and the moderately slow permeability in the stratified silty, loamy, and sandy deposits. These limitations can be overcome by constructing a mound of suitable filtering material. In some areas the effluent can be pumped to an absorption field established on better suited soils on the higher parts of the landscape.

This soil is suited to dwellings without basements and to local roads and streets. It is only moderately suited to dwellings with basements because of the seasonal high water table. This limitation can be overcome by constructing the basement above the level of wetness or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

The land capability classification is IVs. The woodland ordination symbol is 7A. The primary habitat type is AQV, and the secondary habitat type is PMV.

EmE—Emmert very gravelly sand, 20 to 45 percent slopes. This moderately steep and steep, excessively drained soil is on knolls and side slopes, in areas of pitted outwash, and on eskers and eskerlike ridges. Some slopes are complex. Stones and cobbles are in

the surface layer in some areas. Most areas are long and narrow or are irregularly shaped, and they generally range from 5 to 30 acres in size.

Typically, the surface layer is black very gravelly sand about 2 inches thick. The subsoil is reddish brown and yellowish red very gravelly sand about 20 inches thick. The substratum to a depth of about 60 inches is yellowish red very gravelly sand. In some places the upper layers are sand, loamy sand, sandy loam, or the gravelly analogs of those textures. In other places the substratum is gravelly loamy sand, cobbly loamy sand, or gravelly sand. In some areas the slope is less than 20 or more than 45 percent.

Included with this soil in mapping are small areas of the well drained and moderately well drained Padus and well drained Pence soils on knolls and side slopes. These soils have less gravel than the Emmert soil. They make up less than 10 percent of the unit.

Permeability is very rapid in the Emmert soil. The available water capacity is very low, and natural fertility is low.

The soil is used mainly as woodland. Some small areas are excavated for sand and gravel. This soil is poorly suited to trees. The trees grow slowly and tend to be deformed. The main concerns in managing woodland are the erosion hazard, the equipment limitation, and seedling mortality. Runoff concentrated on logging roads, skid trails, and landings and in the tracks of wheeled equipment results in erosion. Removing the water with water bars and out-sloping road surfaces, installing culverts and drop structures, and building logging roads and trails on the contour minimize the risk of erosion. Seeding exposed areas after the trees are logged helps to establish a protective plant cover. In areas where the slope limits the use of equipment, hand planting and yarding of the logs by cable may be needed. The slope also limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils. Planting when the soil is moist and selecting containerized seedlings or vigorous nursery stock reduce the seedling mortality rate.

This soil generally is not suited to cultivated crops. Droughtiness, the low natural fertility, the slope, soil blowing, and water erosion are management concerns.

Because of the slope, this soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets. Overcoming the slope is difficult. Better suited sites should be selected. The effluent from septic tank systems drains satisfactorily through the soil, but it can pollute ground water because of the very rapid permeability. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIs. The woodland ordination symbol is 6R. The primary habitat type is AQV, and the secondary habitat type is PMV.

Fh—Fordum mucky very fine sandy loam, 0 to 2 percent slopes. This nearly level, poorly drained and very poorly drained soil is on flood plains and in drainageways. It is subject to ponding and is frequently flooded. Many areas are dissected by old stream channels. Stones are in the surface layer in some areas. Individual areas are long and narrow and generally range from 5 to 60 acres in size.

Typically, the surface layer is very dark brown mucky very fine sandy loam about 7 inches thick. The upper part of the substratum is dark grayish brown, mottled very fine sandy loam; the next part is dark grayish brown, mottled loamy very fine sand and dark gray very fine sandy loam; and the lower part to a depth of about 60 inches is dark grayish brown, mottled sand. In some places the surface layer is muck, silt loam, loam, fine sandy loam, loamy sand, or the gravelly or mucky analogs of those textures. In other places strata of gravel or muck are throughout the profile. In some areas the soil is sandy throughout.

Included with this soil in mapping are small areas of Carbondale, Lupton, and Markey soils. These soils make up less than 15 percent of the unit. They are in depressions and basins. They have a higher content of organic material than the Fordum soil and have been subject to little or no alluvial deposition. Also included are some areas of a soil that is similar to the Fordum soil but is moderately well drained or somewhat poorly drained.

Permeability is moderate or moderately rapid in the upper part of the Fordum soil and rapid or very rapid in the lower part. The available water capacity is moderate, and natural fertility is medium. The seasonal high water table is within a depth of 1 foot.

Most areas support trees or wetland vegetation of marsh grasses, sedges, reeds, alder brush, and cattail. This soil is suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The soil is usually wet from fall to spring, is frequently flooded, and is characterized by low strength. Ruts form easily when wheeled skidders are used during the wet periods. Deep ruts restrict lateral drainage and expose tree roots. Access by machinery is limited to dry periods in summer or to periods in winter when the soil is frozen or has a thick cover of snow. All-weather roads require a gravel base. Culverts are needed to maintain the

natural drainage system. Because wetness, flooding, and low strength are severe limitations on landing sites, the better suited adjacent soils should be selected. Trees generally are not planted on this soil because of the wetness. Reforestation is limited to natural regeneration or hand planting. The seedling mortality caused by wetness and flooding can be minimized by planting vigorous nursery stock on the crest of cradle knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species also may be needed.

This soil generally is not suited to cultivated crops. The seasonal high water table, the ponding, the flooding, and the potential for frost action are management concerns.

This soil is generally unsuited to septic tank absorption fields, dwellings, and local roads and streets, mainly because of the ponding and flooding. Overcoming these limitations is difficult. A better suited site should be selected.

The land capability classification is VIw. The woodland ordination symbol is 2W. No habitat type is assigned.

GoB—Goodman silt loam, 1 to 6 percent slopes, stony. This nearly level and gently sloping, moderately well drained soil is on ridges and knolls on drumlins and moraines. Stones are in the surface layer in most areas. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 60 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is brown silt loam about 3 inches thick. The upper 12 inches of the subsoil is dark reddish brown and dark brown silt loam, the next 8 inches is brown, mottled silt loam, and the lower 15 inches is dark brown, mottled gravelly sandy loam and brown, mottled gravelly loamy sand. The substratum to a depth of about 60 inches is dark brown gravelly loamy sand that has a few pockets of sandy loam. In places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or loam. In some areas the substratum is sandy loam, very fine sandy loam, or loam. In other areas it is sandy loam, gravelly sandy loam, or loamy sand or is very gravelly, cobbly, or very cobbly sandy loam or loamy sand. In the south-central part of the county, the substratum is grayer. In a few areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of Monico, Padus, and Pence soils. These soils make up less than 10 percent of the unit. The somewhat poorly drained Monico soils are lower on the landscape than the Goodman soil. Padus and Pence soils are on flats, knolls, and short, uneven side slopes. They are underlain by stratified sand and gravel or gravelly coarse sand. Also included are some areas where the Goodman soil is well drained, is not stony, or is very stony or bouldery; a few areas where bedrock is within a depth of 60 inches; areas of stratified sandy, loamy, and silty material; and a few areas where the soil has firm layers in the subsoil or substratum.

Permeability is moderate in the Goodman soil. The available water capacity also is moderate, and natural fertility is medium. The depth to a perched seasonal high water table is 1.5 to 3.0 feet.

Most areas are used as woodland (fig. 3). Some small areas have been cleared of stones and are used as cropland or pasture. This soil is suited to trees. The main concerns in managing woodland are the equipment limitation and the windthrow hazard. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soil is dry or has a thick cover of snow. Unsurfaced roads are slippery. A gravel base is needed on sites for all-weather roads. If stabilized, landings can better withstand the repeated use of heavy equipment. In areas where stones limit the use of equipment, hand planting or yarding of the logs by cable may be necessary. Harvest methods that do not leave the remaining trees widely spaced reduce the risk of windthrow.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species also may be needed.

Because of the stoniness, this soil generally is not suited to cultivated crops. Areas where the surface stones have been removed and the nonstony included areas are suited to corn and small grain and to grasses and legumes for hay and pasture. Controlling water erosion is a management concern in cultivated areas

Figure 3.—Mixed hardwoods in an area of Goodman silt loam, 1 to 6 percent slopes, stony.

where the slope is more than about 2 percent. A conservation cropping sequence, contour farming, grassed waterways, cover crops, and a system of conservation tillage, such as offset disking, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and good soil tilth.

This soil is suited to pasture. A cover of pasture plants is effective in controlling water erosion. The stoniness can limit the use of machinery. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table. Where

the water table is below a depth of 2 feet, this limitation can be overcome by constructing a mound of suitable filtering material.

Because of the seasonal high water table, this soil is poorly suited to dwellings with basements and is only moderately suited to dwellings without basements. Constructing dwellings without basements on fill material, which raises the level of the site, and constructing basements above the level of wetness help to overcome this limitation. The wetness also can be overcome by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

Because of the seasonal high water table and the potential for frost action, this soil is only moderately suited to local roads and streets. These limitations can be overcome by adding suitable fill material, such as sand or gravel, which raises the roadbed above the level of wetness, and by providing adequate roadside ditches, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is VIs. The woodland ordination symbol is 3X. The primary habitat type is AViO, and the secondary habitat type is ATD.

GoC—Goodman silt loam, 6 to 15 percent slopes, stony. This sloping, moderately well drained soil is on ridges and knolls on drumlins and moraines. Stones are in the surface layer in most areas. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 160 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is brown silt loam about 2 inches thick. The upper 12 inches of the subsoil is dark reddish brown and dark brown silt loam, the next 3 inches is brown, mottled silt loam, and the lower 17 inches is dark brown, mottled gravelly sandy loam and brown, mottled gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly loamy sand that has a few pockets of sandy loam. In places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or loam. In some areas the substratum is sandy loam, gravelly sandy loam, or loamy sand or is very gravelly, cobbly, or very cobbly sandy loam or loamy sand. In the south-central part of the county, the substratum is grayer. In some areas the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are small areas of Padus and Pence soils on knolls and side slopes. These soils make up less than 10 percent of the unit. They are underlain by stratified sand and gravel or gravelly coarse sand. Also included are some areas where the Goodman soil is well drained, is not stony or is very stony or bouldery, or has firm layers in the subsoil or substratum; a few areas where bedrock is within a depth of 60 inches; areas of stratified sandy, loamy, and silty material; and small areas of wet soils in depressions.

Permeability is moderate in the Goodman soil. The available water capacity also is moderate, and natural fertility is medium. The depth to a seasonal high water table is 1.5 to 3.0 feet.

Most areas are used as woodland. Some small areas have been cleared of stones and are used as cropland or pasture. This soil is suited to trees. The main concerns in managing woodland are the equipment limitation and the windthrow hazard. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soil is dry or has a thick cover of snow. Unsurfaced roads are slippery. A gravel base is needed on sites for all-weather roads. The slope limits the selection of landing sites. Landings can be established in areas of the nearly level or gently sloping included or adjacent soils. In areas where stones limit the use of equipment, hand planting or yarding of the logs by cable may be necessary. Harvest methods that do not leave the remaining trees widely spaced reduce the risk of windthrow.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species also may be needed.

Because of the stoniness, this soil generally is not suited to cultivated crops. Areas where the surface stones have been removed and the nonstony included areas are suited to corn and small grain and to grasses and legumes for hay and pasture. Controlling water erosion is a management concern in cultivated areas. A conservation cropping sequence, contour farming, grassed waterways, cover crops, and a system of conservation tillage, such as offset disking, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and good soil tilth.

This soil is suited to pasture. A cover of pasture plants is effective in controlling water erosion. The stoniness can limit the use of machinery. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table. Where the water table is below a depth of 2 feet, this limitation can be overcome by constructing a mound of suitable filtering material.

Because of the seasonal high water table, this soil is poorly suited to dwellings with basements. It is only moderately suited to dwellings without basements because of the seasonal high water table and the slope. The slope can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land. The wetness can be overcome by adding fill material, which raises the level of the site; by constructing basements above the level of wetness; or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

Because of the seasonal high water table, the slope, and the potential for frost action, this soil is only moderately suited to local roads and streets. The wetness can be overcome by installing a good subsurface drainage system, which lowers the water table, or by adding fill material, which raises the roadbed above the level of wetness. Frost action can be controlled by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing adequate roadside ditches, which help to drain the roadbed and maintain the natural drainage system. The slope can be overcome by cutting and filling.

The land capability classification is VIs. The woodland ordination symbol is 3X. The primary habitat type is AViO, and the secondary habitat type is ATD.

GoD—Goodman silt loam, 15 to 25 percent slopes, stony. This moderately steep, well drained soil is on ridges and knolls on drumlins and moraines. Stones are in the surface layer in most areas. Individual areas are irregularly shaped and generally range from 10 to 70 acres in size.

Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is brown silt loam about 2 inches thick. The upper 12 inches of the subsoil is dark reddish brown and dark brown silt loam, the next 6 inches is brown silt loam, and the lower 15 inches is brown gravelly loamy sand and dark brown gravelly sandy loam. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or loam. In some areas the substratum is sandy loam, loamy sand, or gravelly sandy loam or is very gravelly, cobbly, or very cobbly sandy loam or loamy sand. In the south-central part of the county, the substratum is grayer. In some areas the slope is less than 15 or more than 25 percent.

Included with this soil in mapping are small areas of Padus and Pence soils on knolls and side slopes. These soils make up less than 10 percent of the unit. They are underlain by stratified sand and gravel or gravelly coarse sand. Also included are some areas where the Goodman soil is moderately well drained, is not stony or is very stony or bouldery, or has firm layers in the subsoil or substratum; a few areas where bedrock is within a depth of 60 inches; areas of stratified sandy, loamy, and silty material; and small areas of wet soils in depressions.

Permeability is moderate in the Goodman soil. The available water capacity also is moderate, and natural fertility is medium.

This soil is used as woodland. It is suited to trees. The main concern in managing woodland is the equipment limitation. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soil is dry or has a thick cover of snow. In areas where stones or the slope limits the use of equipment, hand planting and yarding of the logs by cable may be necessary.

The slope limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species also may be needed.

This soil generally is not suited to cultivated crops. The slope, the stoniness, and water erosion are management concerns.

This soil is suited to pasture. A cover of pasture plants is effective in controlling erosion. The stoniness and the slope can limit the use of machinery. Overgrazing or grazing when the soil is too wet can result in surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

Because of the slope, this soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets. Cutting and filling can minimize the slope,

but they may not be effective where the slope is more than about 20 percent. Better suited sites may be needed. Dwellings can be designed so that they conform to the natural slope of the land. Septic tank absorption fields and local roads and streets can be constructed on the contour.

The land capability classification is VIIs. The woodland ordination symbol is 3R. The primary habitat type is AViO, and the secondary habitat type is ATD.

Gr—Greenwood, Loxley, and Dawson peats, 0 to 1 percent slopes. These nearly level, very poorly drained soils are in depressions and basins on outwash plains and moraines. They are subject to ponding. Microrelief of as much as 18 inches is common. Individual areas are round, long and narrow, or irregularly shaped, and they generally range from 5 to 3,000 acres in size. Some areas are 50 to 60 percent Greenwood soil, 0 to 15 percent Loxley soil, and 10 to 20 percent Dawson soil. Some are 0 to 20 percent Greenwood soil, 50 to 65 percent Loxley soil, and 5 to 15 percent Dawson soil. Others are 0 to 15 percent Greenwood soil, 0 to 15 percent Loxley soil, and 50 to 60 percent Dawson soil. These soils have similar behavior characteristics for present or anticipated uses in the survey area; therefore, mapping them separately was not considered practical or necessary.

Typically, the Greenwood soil has a surface layer of brown peat about 9 inches thick. Below this to a depth of about 60 inches is dark brown mucky peat. In some places the surface layer is thicker. In other places it is mucky peat.

Typically, the Loxley soil has a surface layer of dark brown and dark yellowish brown peat about 4 inches thick. The next 43 inches is very dark brown muck. The next 4 inches is very dark brown mucky peat. Below this to a depth of about 60 inches is very dark brown muck. In some places the surface layer is thicker. In other places it is mucky peat or muck.

Typically, the Dawson soil has a surface layer of dark reddish brown peat about 4 inches thick. The next 31 inches is dark reddish brown and black muck. The substratum to a depth of about 60 inches is brown sand. In some places the surface layer is thicker. In other places it is mucky peat or muck. In some areas the substratum is sandy loam, loam, or silt loam.

Included with these soils in mapping are small areas of Au Gres, Carbondale, Kinross, Lupton, and Markey soils. These included soils make up less than 10 percent of the unit. The somewhat poorly drained Au Gres soils and the poorly drained Kinross soils are higher on the landscape than the Greenwood, Loxley, and Dawson soils. Au Gres soils formed in sandy deposits. Kinross soils formed mainly in sandy deposits. Carbondale, Lupton, and Markey soils are in positions on the landscape similar to those of the Greenwood, Loxley, and Dawson soils. They are less acid than those soils. Also included are small areas of other mineral soils and small areas of water.

Permeability is moderate or moderately rapid in the Greenwood soil. It is moderately slow to moderately rapid in the Loxley soil. It is moderately slow to moderately rapid in the organic layers of the Dawson soil and is rapid in the sandy substratum. Available water capacity is very high in all three soils, and natural fertility is low. The seasonal high water table is within a depth of 1 foot.

Most areas support wetland vegetation, including sphagnum moss, leatherleaf, laurel, bog rosemary, and stunted black spruce and tamarack (fig. 4). Some small areas have been cleared and are used for cranberries.

Because of extreme acidity and the seasonal high water table, these soils generally do not support trees of merchantable size or quality. They can be used for some recreational purposes or for wildlife habitat if the woody cover is properly managed.

Because of the extreme acidity, the ponding, the low natural fertility, the frost hazard, and the seasonal high water table, these soils are generally unsuited to cultivated crops, but they are suited to cranberries. Subsidence and soil blowing are management concerns if the soils are drained. Also, burning of the organic material is a concern when the soils are dry.

These soils are generally unsuited to septic tank absorption fields, dwellings, and local roads and streets, mainly because of the ponding, low soil strength, the potential for frost action, and subsidence. Overcoming these limitations is difficult. Better suited sites should be selected.

The land capability classification is VIw. No woodland ordination symbol or habitat type has been assigned.

KaB—Karlin loamy fine sand, 0 to 6 percent slopes. This nearly level and gently sloping, somewhat excessively drained soil is on flats, knolls, and short, uneven side slopes on outwash plains. Individual areas are irregularly shaped and generally range from 20 to 60 acres in size.

Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is brown loamy fine sand about 4 inches thick. The subsoil is dark reddish brown, dark brown, and brown loamy fine sand about 28 inches thick. The substratum to a depth of about 60 inches is brown sand. In some places the upper layers are sand, loamy sand, or sandy loam. In other places the substratum has layers of gravel. In some areas the soil is eroded. In other areas the slope is more than 6 percent.

Figure 4.—Stunted black spruce and tamarack on Greenwood, Loxley, and Dawson peats, 0 to 1 percent slopes.

Included with this soil in mapping are small areas of the moderately well drained Croswell and well drained Rousseau soils. These soils make up less than 15 percent of the unit. In some areas Croswell soils have a loamy substratum. They are on the lower flats and in depressions. Rousseau soils are in positions on the landscape similar to those of the Karlin soil. Their substratum has a higher content of fine sand than that of the Karlin soil. Also included are a few areas where the substratum has pockets or strata of loamy sand.

Permeability is moderately rapid in the subsoil of the Karlin soil and rapid in the substratum. The available water capacity and natural fertility are low.

Most areas are used as woodland. Some are used as cropland or pasture. This soil is suited to trees. No major hazards or limitations affect planting or harvesting. The low available water capacity, however, limits the growth of trees, especially hardwoods.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are

planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Droughtiness, the low natural fertility, and soil blowing are the main management concerns in cultivated areas. Cover crops, field windbreaks, a conservation cropping sequence, and a system of conservation tillage, such as chisel plowing, minimize soil loss, conserve soil moisture, and help to maintain the content of organic matter. Irrigation helps to overcome the droughtiness.

A cover of pasture plants or hay is effective in controlling soil blowing. Because of the low natural fertility and droughtiness, forage yields generally are somewhat limited. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

This soil is suited to dwellings and to local roads and streets. The effluent from septic tank systems drains satisfactorily through the soil, but it can pollute ground water because of the rapid permeability in the substratum.

The land capability classification is IIIs. The woodland ordination symbol is 3A. The habitat type is PMV.

KeB—Keweenaw sandy loam, 1 to 6 percent slopes, stony. This nearly level and gently sloping, moderately well drained soil is on knolls and ridges on drumlins and water-worked moraines. Stones are in the surface layer in most areas. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 300 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is brown sandy loam about 7 inches thick. The upper 13 inches of the subsoil is dark reddish brown and reddish brown sandy loam, the next 10 inches is dark brown and brown loamy sand, and the lower 29 inches is dark brown, mottled, firm gravelly sandy loam and brown, mottled, firm gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In some places the upper layers are loamy sand, fine sandy loam, or loam. In other places the substratum is gravelly sandy loam, sandy loam, loamy sand, sand, or gravelly sand or is very gravelly, cobbly, or very cobbly loamy sand or sand. In the south-central part of the county, the substratum is grayer. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of Monico, Padus, Pence, Pequaming, Sayner, Vilas, and Worcester soils. These soils make up less than 15 percent of the unit. The somewhat poorly drained Monico, Pequaming, and Worcester soils are lower on the landscape than the Keweenaw soil. The well drained and moderately well drained Padus soils, the well drained Pence soils, and the excessively drained Sayner and Vilas soils are on flats, knolls, and short, uneven side slopes. Padus and Sayner soils are underlain by stratified sand and gravel. Pence soils are underlain by gravelly coarse sand. Vilas soils are sandy throughout. Also included are areas where the Keweenaw soil is well drained, is not stony or is very stony or bouldery, or has firm layers in the substratum; a few areas where bedrock is within a depth of 60 inches; and areas of stratified sandy, loamy, and silty material.

Permeability is moderate or moderately rapid in the subsoil of the Keweenaw soil and moderately rapid in the substratum. The available water capacity is low, and natural fertility is medium. The depth to a perched seasonal high water table is 2.5 to 6.0 feet.

Most areas are used as woodland. Some small areas have been cleared of stones and are used as cropland or pasture. This soil is suited to trees. The main concern in managing woodland is the equipment limitation, which is caused by the stones. Hand planting or yarding of the logs by cable may be necessary.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

Because of the stoniness, this soil generally is not suited to cultivated crops. Areas where the surface stones have been removed and the nonstony included areas are suited to corn and small grain and to grasses and legumes for hay and pasture. Seasonal droughtiness and soil blowing are management concerns in cultivated areas. Controlling water erosion also is a management concern in areas where the slope is more than about 2 percent. A conservation cropping sequence, contour farming, grassed waterways, cover crops, field windbreaks, and a system of conservation tillage, such as offset disking, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and conserves soil moisture.

This soil is suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. The stoniness can limit the use of machinery. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

Because of a seasonal high water table, this soil is poorly suited to absorption fields. This limitation can be overcome by constructing a mound of suitable filtering material. Also, the septic tank system can be installed

in areas of the well drained included soils.

This soil is only moderately suited to dwellings, mainly because of large stones. The seasonal high water table is a concern on sites for dwellings with basements. This limitation can be overcome by constructing the basement above the level of wetness or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet. Machinery can be used to remove the large stones.

Because of the large stones, this soil is only moderately suited to local roads and streets. The stones can be removed by machinery or covered with fill.

The land capability classification is VIs. The woodland ordination symbol is 3X. The primary habitat type is PMV, and the secondary habitat type is AVVib.

KeC—Keweenaw sandy loam, 6 to 15 percent slopes, stony. This sloping, well drained soil is on knolls and ridges on drumlins and water-worked moraines. Stones are in the surface layer in most areas. Individual areas are long and narrow or are irregularly shaped, and they generally range from 5 to 300 acres in size.

Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is black sandy loam about 1 inch thick. The subsurface layer is dark brown loamy sand about 1 inch thick. The upper 21 inches of the subsoil is dark brown sandy loam and brown gravelly loamy sand, the next 12 inches is brown gravelly loamy sand and dark brown gravelly sandy loam, and the lower 20 inches is dark brown, firm gravelly sandy loam and brown, firm gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In some places the upper layers are loamy sand, fine sandy loam, or loam. In other places the substratum is sandy loam, gravelly sandy loam, sand, gravelly sand, or loamy sand or is very gravelly, cobbly, or very cobbly loamy sand or sand. In the south-central part of the county, the substratum is grayer. In some areas the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are small areas of Padus, Pence, Sayner, and Vilas soils on knolls and side slopes. These soils make up less than 15 percent of the unit. The well drained and moderately well drained Padus soils and the excessively drained Sayner soils are underlain by stratified sand and gravel. The well drained Pence soils are underlain by gravelly coarse sand. The excessively drained Vilas soils are sandy throughout. Also included are areas where the Keweenaw soil is moderately well drained, is not stony or is very stony or bouldery, or has firm layers in the substratum; a few areas where bedrock is within a depth of 60 inches; areas of stratified sandy, loamy, and silty material; and small areas of wet soils in depressions.

Permeability is moderate or moderately rapid in the subsoil of the Keweenaw soil and moderately rapid in the substratum. The available water capacity is low, and natural fertility is medium.

This soil is used as woodland. It is suited to trees. The main concern in managing woodland is the equipment limitation, which is caused by the stones. Hand planting or yarding of the logs by cable may be necessary. The slope limits the selection of landing sites. Landings can be established in areas of the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

Because of the stoniness, this soil generally is not suited to cultivated crops. Areas where the surface stones have been removed and the nonstony included areas are suited to corn and small grain and to grasses and legumes for hay and pasture. Droughtiness, soil blowing, and water erosion are management concerns in cultivated areas. A conservation cropping sequence, contour farming, grassed waterways, cover crops, field windbreaks, and a system of conservation tillage, such as offset disking, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and conserves soil moisture.

This soil is suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. The stoniness can limit the use of machinery. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

Because of the slope and the large stones, this soil is only moderately suited to septic tank absorption fields, dwellings, and local roads and streets. The slope can be overcome by cutting and filling, by installing a trench absorption system on the contour, and by designing dwellings so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway. The stones can be removed by machinery or covered with fill material.

The land capability classification is VIs. The woodland ordination symbol is 3X. The primary habitat type is PMV, and the secondary habitat type is AVVib.

KeD—Keweenaw sandy loam, 15 to 25 percent slopes, stony. This moderately steep, well drained soil

is on knolls and ridges on drumlins and water-worked moraines. Stones are in the surface layer in most areas. Individual areas are long and narrow or are irregularly shaped, and they generally range from 15 to 100 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is brown sandy loam about 1 inch thick. The upper 13 inches of the subsoil is dark brown sandy loam and loamy sand, the next 6 inches is dark brown, firm gravelly sandy loam and brown, firm gravelly loamy sand, and the lower 15 inches is brown gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In some places the upper layers are loamy sand, fine sandy loam, or loam. In other places the substratum is sandy loam, loamy sand, gravelly sandy loam, sand, or gravelly sand or is very gravelly, cobbly, or very cobbly loamy sand or sand. In the south-central part of the county, the substratum is grayer. In some areas the slope is less than 15 or more than 25 percent.

Included with this soil in mapping are small areas of Padus, Pence, Sayner, and Vilas soils on knolls and side slopes. These soils make up less than 15 percent of the unit. The well drained and moderately well drained Padus soils and the excessively drained Sayner soils are underlain by stratified sand and gravel. The well drained Pence soils are underlain by gravelly coarse sand. The excessively drained Vilas soils are sandy throughout. Also included are areas where the Keweenaw soil is moderately well drained, is not stony or is very stony or bouldery, or has firm layers in the substratum; a few areas where bedrock is within a depth of 60 inches; areas of stratified sandy, loamy, and silty material; and small areas of wet soils in depressions.

Permeability is moderate or moderately rapid in the subsoil of the Keweenaw soil and moderately rapid in the substratum. The available water capacity is low, and natural fertility is medium.

This soil is used as woodland. It is suited to trees. The main concern in managing woodland is the equipment limitation, which is caused by the stones and the slope. Hand planting or yarding of the logs by cable may be necessary.

The slope limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. Landings can be established in the areas of the less sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil generally is not suited to cultivated crops. Droughtiness, the slope, the stoniness, soil blowing, and water erosion are management concerns.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. The stoniness and the slope can limit the use of machinery. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

Because of the slope, this soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets. Cutting and filling can minimize the slope, but they may not be effective where the slope is more than about 20 percent. Better suited sites may be needed. Dwellings can be designed so that they conform to the natural slope of the land. Septic tank absorption fields and local roads and streets can be constructed on the contour.

The land capability classification is VIIs. The woodland ordination symbol is 3R. The primary habitat type is PMV, and the secondary habitat type is AVVib.

KnB—Keweenaw-Vilas complex, 1 to 6 percent slopes, stony. These nearly level and gently sloping soils are on flats, knolls, ridges, and short, uneven side slopes. The Keweenaw soil is moderately well drained. It is on drumlins and water-worked moraines. In most areas it has stones in the surface layer. The Vilas soil is excessively drained. It is on moraines, on outwash plains, and in areas of pitted outwash. Individual areas are long and narrow or are irregularly shaped, and they generally range from 5 to 120 acres in size. They are about 45 to 55 percent Keweenaw soil and 35 to 45 percent Vilas soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Keweenaw soil has a mat of partially decomposed forest litter about 2 inches thick at the surface. The surface layer is brown sandy loam about 7 inches thick. The upper 13 inches of the subsoil is dark reddish brown and reddish brown sandy loam, the next 10 inches is dark brown and brown loamy sand, and the lower 29 inches is dark brown, mottled, firm gravelly sandy loam and brown, mottled, firm gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In some places the upper layers are loamy sand, fine sandy loam, or loam. In other places the substratum is gravelly sandy loam, sandy loam, loamy sand, sand, or gravelly sand or is very gravelly, cobbly, or very cobbly loamy sand or sand. In the south-central part of the county, the

substratum is grayer. In some areas the slope is more than 6 percent.

Typically, the Vilas soil has a mat of partially decomposed forest litter about 1 inch thick at the surface. The surface layer is black loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 2 inches thick. The subsoil is about 27 inches thick. It is dark reddish brown and dark brown loamy sand in the upper part and strong brown sand in the lower part. The substratum to a depth of about 60 inches is brown sand. In some places the upper layers are sand, loamy fine sand, or sandy loam. In other places the substratum has thin strata of red, iron-stained sand or layers of gravel. In some areas the slope is more than 6 percent.

Included with these soils in mapping are small areas of Au Gres, Croswell, Padus, Pence, and Pequaming soils. These included soils make up less than 20 percent of the unit. The somewhat poorly drained Au Gres and Pequaming soils are lower on the landscape than the Keweenaw and Vilas soils. The moderately well drained Croswell soils are on the lower flats and in depressions. They are sandy throughout. The well drained and moderately well drained Padus soils and the well drained Pence soils are on flats, knolls, and short, uneven side slopes. They formed in loamy deposits underlain by stratified sand and gravel or gravelly coarse sand. Also included are some areas where the Keweenaw soil is well drained, is not stony or is very stony or bouldery, or has firm layers in the substratum; some areas where bedrock is within a depth of 60 inches; and areas of stratified sandy, loamy, and silty material.

Permeability is moderate or moderately rapid in the subsoil of the Keweenaw soil and moderately rapid in the substratum. It is rapid in the Vilas soil. The available water capacity is low in both soils. Natural fertility is medium in the Keweenaw soil and low in the Vilas soil. The depth to a perched seasonal high water table is 2.5 to 6.0 feet in the Keweenaw soil.

Most areas are used as woodland. Some small areas have been cleared of stones and are used as cropland or pasture. These soils are suited to trees. The main concern in managing wooded areas of the Keweenaw soil is the equipment limitation, which is caused by the stones. Hand planting or yarding of the logs by cable may be necessary. No major hazards or limitations affect planting or harvesting on the Vilas soil. The low available water capacity in both soils, however, limits the growth of trees, especially hardwoods.

After trees are cut, plant competition on the Keweenaw soil can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

Because of stoniness, these soils generally are not suited to cultivated crops. Areas where the surface stones have been removed and the nonstony included areas are suited to corn and small grain and to grasses and legumes for hay and pasture. Droughtiness and soil blowing are the main management concerns in cultivated areas. Controlling water erosion also is a management concern in areas where the slope is more than about 2 percent. A conservation cropping sequence, contour farming, grassed waterways, cover crops, field windbreaks, and a system of conservation tillage, such as offset disking, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and conserves soil moisture.

These soils are suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. The stoniness can limit the use of machinery. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

Because of the seasonal high water table, the Keweenaw soil is poorly suited to septic tank absorption fields. This limitation can be overcome by constructing a mound of suitable filtering material. The effluent from septic tank systems drains satisfactorily through the Vilas soil, but it can pollute ground water because of the rapid permeability.

The Vilas soil is suited to dwellings, but the Keweenaw soil is only moderately suited because of the large stones. Also, the seasonal high water table limits the Keweenaw soil as a site for dwellings with basements. The wetness can be overcome by constructing basements above the level of wetness or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet. Machinery can be used to remove the large stones.

The Vilas soil is suited to local roads and streets, but the Keweenaw soil is only moderately suited because of the large stones. The stones can be removed by machinery or covered with fill material.

The land capability classification is VIs. The woodland ordination symbol is 3X in areas of the Keweenaw soil and 6A in areas of the Vilas soil. The primary habitat type is PMV, and the secondary habitat type is AVVib.

KnC—Keweenaw-Vilas complex, 6 to 15 percent slopes, stony. These sloping soils are on knolls, ridges, and side slopes. Many slopes are complex. The Keweenaw soil is on drumlins and water-worked moraines. It is well drained. In most areas it has stones

are in the surface layer. The Vilas soil is on moraines, on outwash plains, and in areas of pitted outwash. It is excessively drained. Individual areas are long and narrow or are irregularly shaped, and they generally range from 5 to 100 acres in size. They are about 45 to 55 percent Keweenaw soil and 35 to 45 percent Vilas soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Keweenaw soil has a mat of partially decomposed forest litter about 1 inch thick at the surface. The surface layer is black sandy loam about 1 inch thick. The subsurface layer is dark brown loamy sand about 1 inch thick. The upper 21 inches of the subsoil is dark brown sandy loam and brown gravelly loamy sand, the next 12 inches is brown gravelly loamy sand and dark brown gravelly sandy loam, and the lower 20 inches is dark brown, firm gravelly sandy loam and brown, firm gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In some places the upper layers are loamy sand, fine sandy loam, or loam. In other places the substratum is sandy loam, gravelly sandy loam, sand, gravelly sand, or loamy sand or is very gravelly, cobbly, or very cobbly loamy sand or sand. In the south-central part of the county, the substratum is grayer. In some areas the slope is less than 6 or more than 15 percent.

Typically, the Vilas soil has a mat of partially decomposed forest litter about 1 inch thick at the surface. The surface layer is black loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 2 inches thick. The subsoil is about 19 inches thick. It is dark reddish brown and reddish brown loamy sand in the upper part and brown sand in the lower part. The substratum to a depth of about 60 inches is strong brown sand. In some places the upper layers are sand, loamy fine sand, or sandy loam. In other places the substratum has thin strata of red, iron-stained sand or layers of gravel. In some areas the slope is less than 6 or more than 15 percent.

Included with these soils in mapping are small areas of the well drained and moderately well drained Padus and well drained Pence soils on knolls and side slopes. These included soils make up less than 20 percent of the unit. They formed in loamy deposits underlain by stratified sand and gravel or gravelly coarse sand. Also included are some areas where the Keweenaw soil is moderately well drained, is not stony or is very stony or bouldery, or has firm layers in the substratum; areas where bedrock is within a depth of 60 inches; areas of stratified sandy, loamy, and silty material; and small areas of wet soils in depressions.

Permeability is moderate or moderately rapid in the subsoil of the Keweenaw soil and moderately rapid in the substratum. It is rapid in the Vilas soil. The available water capacity is low in both soils. Natural fertility is medium in the Keweenaw soil and low in the Vilas soil.

These soils are used as woodland. They are suited to trees. The main concern in managing wooded areas of the Keweenaw soil is the equipment limitation, which is caused by the stones. Hand planting or yarding of the logs by cable may be necessary. The low available water capacity in both soils limits the growth of trees, especially hardwoods. The slope limits the selection of landing sites. Landings can be established in areas of the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition on the Keweenaw soil can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

Because of the stoniness, these soils generally are not suited to cultivated crops. Areas where the surface stones have been removed and the nonstony included areas are suited to corn and small grain and to grasses and legumes for hay and pasture. Droughtiness, soil blowing, and water erosion are the main management concerns in cultivated areas. A conservation cropping sequence, contour farming, grassed waterways, cover crops, field windbreaks, and a system of conservation tillage, such as offset disking, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and conserves soil moisture.

These soils are suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. The stoniness can limit the use of machinery. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

The Keweenaw soil is only moderately suited to septic tank absorption fields because of the slope and the large stones. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour. Machinery can be used to remove the large stones. The effluent from septic tank systems drains satisfactorily through the Vilas soil, but it can pollute ground water because of the rapid permeability.

Because of the slope, these soils are only moderately suited to dwellings and to local roads and streets. The Keweenaw soil also is limited by the large stones. The slope can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway. The stones can be

removed by machinery or covered with fill material.

The land capability classification is VIs. The woodland ordination symbol is 3X in areas of the Keweenaw soil and 6A in areas of the Vilas soil. The primary habitat type is PMV, and the secondary habitat type is AVVib.

KrD—Keweenaw-Sayner complex, 15 to 30 percent slopes, stony. These moderately steep and steep soils are on knolls, ridges, and side slopes. Many slopes are complex. The Keweenaw soil is on drumlins and water-worked moraines. It is well drained. In most areas it has stones in the surface layer. The Sayner soil is on outwash plains, on moraines, and in areas of pitted outwash. It is excessively drained. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 300 acres in size. They are about 40 to 60 percent Keweenaw soil and 30 to 50 percent Sayner soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Keweenaw soil has a mat of partially decomposed forest litter about 2 inches thick at the surface. The surface layer is brown sandy loam about 1 inch thick. The upper 13 inches of the subsoil is dark brown sandy loam and loamy sand, the next 6 inches is dark brown, firm gravelly sandy loam and brown, firm gravelly loamy sand, and the lower 15 inches is brown gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In some places the upper layers are loamy sand, fine sandy loam, or loam. In other places the substratum is sandy loam, loamy sand, gravelly sandy loam, sand, or gravelly sand or is very gravelly, cobbly, or very cobbly loamy sand or sand. In the south-central part of the county, the substratum is grayer. In some areas the slope is less than 15 or more than 30 percent.

Typically, the Sayner soil has a surface layer of black loamy sand about 2 inches thick. The subsurface layer is brown loamy sand about 2 inches thick. The subsoil is about 18 inches thick. It is dark reddish brown loamy sand in the upper part and reddish brown sand and strong brown gravelly sand in the lower part. The substratum to a depth of about 60 inches is strong brown, light yellowish brown, and brownish yellow, stratified sand and gravel. In some places the upper layers are gravelly loamy sand. In other places they are sand, loamy fine sand, or the gravelly analogs of those textures. In some areas the substratum is very gravelly, cobbly, or very cobbly sand. In other areas it has little or no gravel. In places the slope is less than 15 or more than 30 percent.

Included with these soils in mapping are small areas of the well drained and moderately well drained Padus and well drained Pence soils on knolls and side slopes. These included soils make up less than 25 percent of the unit. They formed in loamy deposits underlain by stratified sand and gravel or gravelly coarse sand. Also included are some areas where the Keweenaw soil is moderately well drained, is not stony or is very stony or bouldery, or has firm layers in the substratum; areas where bedrock is within a depth of 60 inches; some areas of stratified sandy, loamy, and silty material; and small areas of wet soils in depressions.

Permeability is moderate or moderately rapid in the subsoil of the Keweenaw soil and moderately rapid in the substratum. It is moderately rapid in the subsoil of the Sayner soil and rapid or very rapid in the substratum. The available water capacity is low in both soils. Natural fertility is medium in the Keweenaw soil and low in the Sayner soil.

These soils are used as woodland. They are suited to trees. The main concern in managing woodland is the equipment limitation, which is caused by the slope and by the stones in areas of the Keweenaw soil. Seedling mortality and the hazard of water erosion also are concerns on the Sayner soil. Runoff concentrated on logging roads, skid trails, and landings results in erosion. Installing water bars, establishing out-sloping road surfaces, constructing ditches, installing culverts, and building logging roads and trails on the contour help to remove surface water and minimize erosion. Seeding exposed areas after the trees are logged helps to establish a protective plant cover. Hand planting or yarding of the logs by cable may be necessary in areas where the stones or the slope limits the use of equipment. Planting when the soils are moist and selecting containerized seedlings or vigorous nursery stock reduce the seedling mortality rate.

The slope limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

After trees are cut, plant competition on the Keweenaw soil can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils generally are not suited to cultivated crops. Droughtiness, the stoniness, the slope, soil blowing, and water erosion are the main management concerns.

These soils are suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water

erosion. The stoniness and the slope can limit the use of machinery. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

Because of the slope, these soils are poorly suited to septic tank absorption fields, dwellings, and local roads and streets. Cutting and filling can minimize the slope, but they may not be effective where the slope is more than about 20 percent. Better suited sites may be needed. The effluent from septic tank systems drains satisfactorily through the Sayner soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum. Dwellings can be designed so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIs. The woodland ordination symbol is 3R in areas of the Keweenaw soil and 7R in areas of the Sayner soil. The primary habitat type is PMV, and the secondary habitat type is AVVib.

Ks—Kinross muck, 0 to 2 percent slopes. This nearly level, poorly drained soil is on flats and in depressions on outwash plains. It is subject to ponding. Individual areas are long and narrow or are irregularly shaped, and they generally range from 5 to 175 acres in size.

Typically, the surface layer is black muck about 5 inches thick. The subsurface layer is brown, mottled sand about 5 inches thick. The subsoil is about 19 inches thick. The upper part is dark reddish brown and dark brown, mottled loamy sand, and the lower part is brown, mottled sand. The substratum to a depth of about 60 inches also is brown, mottled sand. In some places the surface layer is sand, loamy sand, sandy loam, or the mucky analogs of those textures. In other places the subsoil is sand throughout. In some areas the substratum is stratified sandy, loamy, and silty material. In other areas it is gravelly sand. In places the soil is fine sand or very fine sand throughout.

Included with this soil in mapping are small areas of Au Gres, Dawson, and Markey soils. These soils make up less than 10 percent of the unit. The somewhat poorly drained Au Gres soils are higher on the landscape than the Kinross soil. The very poorly drained Dawson and Markey soils are in the lower depressions and basins. They are organic to a depth of more than 16 inches and are underlain by sandy deposits.

Permeability is rapid in the Kinross soil. The available water capacity and natural fertility are low. The seasonal high water table is within a depth of 1 foot.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The use of equipment is restricted in spring and in other wet periods because of the seasonal high water table. Ruts form easily if wheeled vehicles are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Access by machinery is limited to dry periods in summer or to periods in winter when the soil is frozen or has a has a thick cover of snow. Trees generally are not planted on this soil because of the wetness, severe seedling mortality, and plant competition. Reforestation is limited to natural regeneration or hand planting. The seedling mortality caused by wetness can be minimized by planting vigorous nursery stock on the crest of cradle knolls or on prepared ridges. A shallow rooting depth, which is caused by the seasonal high water table, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species also may be needed.

This soil generally is not suited to cultivated crops. The seasonal high water table, the ponding, and the frost hazard are management concerns.

Because of the ponding, this soil generally is unsuitable as a site for septic tank absorption fields and dwellings. Overcoming this hazard is difficult. Better suited sites should be selected.

Because of the ponding, this soil is poorly suited to local roads and streets. Installing culverts, constructing ditches, and constructing the roads on fill material, which raises the roadway above the level of ponding, reduce surface wetness. The culverts also help to prevent road damage by equalizing the water level on both sides of the road.

The land capability classification is VIw. The woodland ordination symbol is 2W. No habitat type is assigned.

MaB—Magnor silt loam, 1 to 6 percent slopes, stony. This nearly level and gently sloping, somewhat poorly drained soil is on low ridges and foot slopes on moraines. Stones are in the surface layer in most areas. Individual areas are long and narrow, round, or irregularly shaped, and they generally range from 5 to 600 acres in size.

Typically, the surface layer is very dark grayish

brown silt loam about 4 inches thick. The subsurface layer is grayish brown, mottled silt loam about 4 inches thick. The next layer is grayish brown and dark brown, mottled silt loam about 9 inches thick. The subsoil is about 18 inches thick. It is dark brown and grayish brown, mottled silt loam in the upper part and dark brown, mottled sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled, firm sandy loam. In some places the upper layers are loam, very fine sandy loam, fine sandy loam, or sandy loam. In other places the lower part of the subsoil and the substratum have thin strata of loamy sand, sand, or sand and gravel. In some areas the substratum is loamy sand, gravelly loamy sand, or gravelly sandy loam. In other areas it has stratified sandy, loamy, and silty material.

Included with this soil in mapping are small areas of Cable, Goodman, Markey, and Worcester soils. These soils make up less than 10 percent of the unit. The poorly drained and very poorly drained Cable soils are in depressions and drainageways. The very poorly drained Markey soils are in depressions and basins. The well drained and moderately well drained Goodman soils are higher on the landscape than the Magnor soil. Worcester soils are on flats and in depressions. They are underlain by stratified sand and gravel. Also included are areas where the Magnor soil is not stony or is very stony or bouldery.

Permeability is moderate in the silty mantle of the Magnor soil and very slow in the substratum. The available water capacity is moderate, and natural fertility is medium. The depth to a perched seasonal high water table is 0.5 foot to 3.0 feet.

Most areas are used as woodland. Some small areas have been cleared of stones and are used as cropland or pasture. This soil is suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The use of equipment is restricted in spring, late in fall, and in other wet periods because of the seasonal high water table and low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts restrict lateral drainage and expose tree roots. Access by machinery is limited to dry periods in summer or to periods in winter when the soil is frozen or has a thick cover of snow. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. A gravel base is needed on sites for all-weather logging roads. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. The adjacent soils may be better sites for landings. Hand planting or yarding of the logs by cable may be necessary in areas where stones limit the use of equipment. The seedling mortality caused by wetness can be minimized by planting vigorous nursery stock on the crest of cradle knolls or on prepared ridges. A shallow rooting depth, which is caused by the seasonal high water table, can result in windthrow of many trees during periods when the soil is wet and winds are strong. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species also may be needed.

Because of the stoniness, this soil generally is not suited to cultivated crops. Areas where the surface stones have been removed and the nonstony included areas are suited to corn and small grain and to grasses and legumes for hay and pasture. A drainage system is needed for dependable crop production. In undrained areas the seasonal high water table limits yields and the kinds of crops that can be grown. Water erosion is a management concern in cultivated areas where the slope is more than about 2 percent. A conservation cropping sequence, contour farming, grassed waterways, cover crops, and a system of conservation tillage, such as offset disking, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and good soil tilth.

This soil is suited to pasture. A cover of pasture plants is effective in controlling water erosion. Excess water can damage forage species during wet periods. The stoniness can limit the use of machinery. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the very slow permeability and the seasonal high water table. Constructing a mound of suitable filtering material helps to overcome these limitations in areas where the water table is below a depth of 2 feet.

Because of the seasonal high water table, this soil is poorly suited to dwellings. Constructing dwellings without basements on fill material, which raises the level of the site, and constructing basements above the level of wetness help to overcome this limitation. The wetness also can be overcome by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

Because of the seasonal high water table and the

potential for frost action, this soil is poorly suited to local roads and streets. These limitations can be overcome by adding suitable fill material, such as sand or gravel, which raises the roadbed above the level of wetness, and by providing adequate roadside ditches, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is VIs. The woodland ordination symbol is 3X. The primary habitat type is AViO, and the secondary habitat type is TMC.

Mc—Minocqua silt loam, 0 to 2 percent slopes. This nearly level, poorly drained and very poorly drained soil is in depressions and drainageways on outwash plains. It is subject to ponding. Individual areas are long and narrow or are irregularly shaped, and they generally range from 5 to 70 acres in size.

Typically, the surface layer is black muck about 1 inch thick. The subsurface layer is grayish brown, mottled silt loam about 7 inches thick. The subsoil is about 16 inches thick. It is mottled. It is grayish brown silt loam in the upper part, light brownish gray loam in the next part, and dark grayish brown loamy coarse sand in the lower part. The substratum to a depth of about 60 inches is brown, mottled gravelly coarse sand. In some places the upper layers are loamy sand, sandy loam, fine sandy loam, or loam. In other places the substratum has strata of sandy loam or loamy sand.

Included with this soil in mapping are small areas of Dawson, Padus, Markey, and Worcester soils. These soils make up less than 8 percent of the unit. The very poorly drained Dawson and Markey soils are in depressions and basins. They are organic to a depth of more than 16 inches and are underlain by sandy deposits. The well drained and moderately well drained Padus soils and the somewhat poorly drained Worcester soils are higher on the landscape than the Minocqua soil. Also included are a few areas where the Minocqua soil is stony.

Permeability is moderate in the subsoil of the Minocqua soil and rapid or very rapid in the substratum. The available water capacity is moderate, and natural fertility is medium. The seasonal high water table is within a depth of 1 foot.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The soil is usually wet from fall to spring. Ruts form easily when wheeled skidders are used when the soil is wet. Deep ruts restrict lateral drainage and expose tree roots. Access by machinery is limited to dry periods in summer or to periods in winter when the soil is frozen or has a thick cover of snow. All-weather roads require a gravel base. Culverts are needed to maintain the natural drainage system. Wetness and low soil strength are severe limitations on landing sites. The adjacent soils may be better sites for landings. Trees generally are not planted on this soil because of the wetness. Reforestation is limited to natural regeneration or hand planting. The seedling mortality caused by wetness can be minimized by planting vigorous nursery stock on the crest of cradle knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species also may be needed.

This soil generally is not suited to cultivated crops. The seasonal high water table, the ponding, and the frost hazard are management concerns.

Mainly because of the ponding, this soil generally is unsuitable as a site for septic tank absorption fields and dwellings. Overcoming this hazard is difficult. Better suited sites should be selected.

This soil is poorly suited to local roads and streets because of the ponding and the potential for frost action. Culverts and ditches help to remove surface water. The culverts also help to prevent road damage by equalizing the water level on both sides of the road. Adding fill material can raise the roads above the level of ponding. The potential for frost action can be reduced by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by installing a surface drainage system.

The land capability classification is VIw. The woodland ordination symbol is 7W. No habitat type is assigned.

MoB—Monico loam, 1 to 6 percent slopes, stony. This nearly level and gently sloping, somewhat poorly drained soil is on low ridges, on foot slopes, and in depressions on drumlins and moraines. Stones are in the surface layer in most areas. Individual areas are long and narrow or are irregularly shaped, and they generally range from 5 to 80 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is black loam about 1 inch thick. The subsurface layer is brown loam about 2 inches thick. The subsoil is mottled. The upper 11 inches is dark reddish brown and dark

brown silt loam, the next 9 inches is brown silt loam, and the lower 6 inches is dark brown sandy loam. The substratum to a depth of about 60 inches is dark brown, mottled sandy loam. In places the upper layers are loamy sand, sandy loam, fine sandy loam, or silt loam. In some areas the lower part of the subsoil and the substratum are loamy sand or are gravelly, very gravelly, cobbly, or very cobbly sandy loam or loamy sand. In other areas they have layers of sand and gravel or are stratified with sandy, loamy, and silty material. In the south-central part of the county, the substratum is grayer.

Included with this soil in mapping are small areas of Cable and Goodman soils. These soils make up less than 10 percent of the unit. The poorly drained and very poorly drained Cable soils are lower on the landscape than the Monico soil. The well drained and moderately well drained Goodman soils are on the higher parts of the landscape. Also included are some areas where bedrock is within a depth of 60 inches and some areas where the Monico soil is not stony or is very stony or bouldery.

Permeability is moderate in the Monico soil. The available water capacity also is moderate, and natural fertility is medium. The depth to a perched seasonal high water table is 1 to 3 feet.

Most areas are used as woodland. Some small areas have been cleared of stones and are used as cropland or pasture. This soil is suited to trees. The main concerns in managing woodland are the equipment limitation and the windthrow hazard. The use of equipment is restricted in spring, late in fall, and in other wet periods because of the seasonal high water table and low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts restrict lateral drainage and expose tree roots. Access by machinery is limited to dry periods in summer or to periods in winter when the soil is frozen or has a thick cover of snow. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. A gravel base is needed on sites for all-weather logging roads. Landings can better withstand the repeated use of heavy equipment if they are stabilized with gravel. The adjacent soils may be better sites for landings. Hand planting or yarding of the logs by cable may be necessary in areas where stones limit the use of equipment. A shallow rooting depth, which is caused by the seasonal high water table, can result in windthrow of many trees during periods when the soil is wet and winds are strong. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

Because of the stoniness, this soil generally is not suited to cultivated crops. Areas where the surface stones have been removed and the nonstony included areas are suited to corn and small grain and to grasses and legumes for hay and pasture. A drainage system is needed for dependable crop production. In undrained areas the seasonal high water table limits yields and the kinds of crops that can be grown. Water erosion is a management concern in cultivated areas where the slope is more than about 2 percent. A conservation cropping sequence, contour farming, grassed waterways, cover crops, and a system of conservation tillage, such as offset disking, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and good soil tilth.

This soil is suited to pasture. A cover of pasture plants is effective in controlling water erosion. Excess water can damage forage species during wet periods. The stoniness can limit the use of machinery. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table. In areas where the water table is below a depth of 2 feet, this limitation can be overcome by constructing a mound of suitable filtering material.

Because of the seasonal high water table, this soil is poorly suited to dwellings. This limitation can be overcome by constructing dwellings without basements on fill material, which raises the level of the site; by constructing basements above the level of wetness; and by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

Because of the potential for frost action, this soil is poorly suited to local roads and streets. The road damage caused by frost action can be minimized by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing adequate roadside ditches, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is VIs. The woodland ordination symbol is 3X. The primary habitat type is AViO, and the secondary habitat type is TMC.

PaB—Padus loam, 0 to 6 percent slopes. This nearly level and gently sloping, moderately well drained soil is on flats, knolls, and short, uneven side slopes on outwash plains and in areas of pitted outwash.

Individual areas are irregularly shaped and generally range from 15 to 300 acres in size.

Typically, the surface layer is black loam about 3 inches thick. The subsurface layer is brown loam about 4 inches thick. The subsoil is about 26 inches thick. The upper part is reddish brown and dark brown loam, the next part is dark brown and brown loam and dark brown and brown, mottled loam, and the lower part is brown gravelly loamy sand. The substratum to a depth of about 60 inches is strong brown and brown, stratified sand and gravel. In some places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or silt loam. In other places the lower part of the subsoil and the substratum have little or no gravel. In some areas the soil is eroded. In other areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of Pence and Worcester soils. These soils make up less than 10 percent of the unit. The well drained Pence soils are in positions on the landscape similar to those of the Padus soil. They are shallower to sand and gravel than the Padus soil. The somewhat poorly drained Worcester soils are on the lower flats and in depressions. Also included are areas of stratified sandy, loamy, and silty material and some areas where the Padus soil is cobbly or stony, is deeper to sand and gravel, is well drained, or has firm layers in the subsoil or substratum.

Permeability is moderate or moderately rapid in the subsoil of the Padus soil and rapid or very rapid in the substratum. The available water capacity is moderate, and natural fertility is medium. The depth to a perched seasonal high water table is 2.5 to 4.0 feet.

Most areas are used as woodland. Some areas are used as cropland or pasture. This soil is suited to trees. The main concern in managing woodland is the equipment limitation. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soil is dry or has a thick cover of snow. On unsurfaced roads ruts form easily during wet periods. A gravel base is needed on sites for all-weather roads. If stabilized, landings can better withstand the repeated use of heavy equipment.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Droughtiness is a management concern in some years. Water erosion also is a management concern in cultivated areas where the slope is more than about 2 percent. Irrigation can help to overcome the droughtiness. A conservation cropping sequence, contour farming, grassed waterways, cover crops, and a system of conservation tillage, such as chisel plowing, help to prevent excessive soil loss. Conservation tillage also helps to conserve soil moisture and maintain the content of organic matter and good soil tilth.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and a poor filtering capacity, which results from the rapid or very rapid permeability in the substratum. These limitations can be overcome by constructing a mound of suitable filtering material.

This soil is suited to dwellings without basements. Because of the seasonal high water table, it is only moderately suited to dwellings with basements. This limitation can be overcome by constructing basements above the level of wetness or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. The road damage caused by frost action can be minimized by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing adequate roadside ditches, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is IIe. The woodland ordination symbol is 3L. The primary habitat type is AViO, and the secondary habitat type is ATD.

PaC—Padus loam, 6 to 15 percent slopes. This sloping, well drained soil is on knolls and side slopes on outwash plains and in areas of pitted outwash. Many slopes are complex. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 600 acres in size.

Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is brown loam about 2 inches thick. The subsoil is about 28 inches thick. The upper part is dark reddish brown and dark brown loam, the next part is dark brown and brown loam, and the lower part is dark brown and strong brown gravelly loamy sand. The substratum to a

depth of about 60 inches is strong brown, stratified sand and gravel. In some places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or silt loam. In other places the lower part of the subsoil and the substratum have little or no gravel. In some areas the soil is eroded. In other areas the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are small areas of Pence and Sayner soils. These soils make up less than 10 percent of the unit. The well drained Pence soils and the excessively drained Sayner soils are in positions on the landscape similar to those of the Padus soil. They are shallower to sand and gravel than the Padus soil. Also included are areas of stratified sandy, loamy, and silty material; some areas where the Padus soil is cobbly or stony, is deeper to sand and gravel, is moderately well drained, or has firm layers in the subsoil or substratum; and small areas of wet soils in depressions.

Permeability is moderate or moderately rapid in the subsoil of the Padus soil and rapid or very rapid in the substratum. The available water capacity is moderate, and natural fertility is medium.

Most areas are used as woodland. Some areas are used as cropland or pasture. This soil is suited to trees. The main concern in managing woodland is the equipment limitation. The use of equipment is restricted in spring and other wet periods because of low soil strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soil is dry or has a thick cover of snow. On unsurfaced roads ruts form easily during wet periods. A gravel base is needed on sites for all-weather roads. The slope limits the selection of landing sites. Landings can be established in areas of the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Water erosion is a management concern in cultivated areas. Droughtiness is a concern in some years. A conservation cropping sequence, contour farming, grassed waterways, cover crops, and a system of conservation tillage, such as chisel plowing, help to prevent excessive soil loss. Conservation tillage also helps to conserve soil moisture and maintain the content of organic matter and good soil tilth.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

The effluent from septic tank systems drains satisfactorily through this soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum.

This soil is only moderately suited to dwellings because of the slope. This limitation can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

This soil is only moderately suited to local roads and streets because of the potential for frost action and the slope. The road damage caused by frost action can be minimized by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing adequate roadside ditches, which help to drain the roadway and maintain the natural drainage system. The slope can be shaped by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is IIIe. The woodland ordination symbol is 3L. The primary habitat type is AViO, and the secondary habitat type is ATD.

PaD—Padus loam, 15 to 25 percent slopes. This moderately steep, well drained soil is on knolls and side slopes on outwash plains and in areas of pitted outwash. Many slopes are complex. Individual areas are long and narrow or are irregularly shaped, and they generally range from 20 to 160 acres in size.

Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is brown loam about 3 inches thick. The subsoil is about 27 inches thick. The upper part is dark reddish brown and reddish brown loam, the next part is brown and dark brown loam, and the lower part is strong brown and dark brown loamy sand. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In some places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or silt loam. In other places the substratum has little or no gravel. In some areas the soil is eroded. In other areas the slope is less than 15 or more than 25 percent.

Included with this soil in mapping are small areas of the well drained Pence and excessively drained Sayner soils. These soils make up less than 10 percent of the unit. They are in positions on the landscape similar to those of the Padus soil. They are shallower to sand and gravel than the Padus soil. Also included are areas of stratified sandy, loamy, and silty material; some areas where the Padus soil is cobbly or stony, is deeper to

sand and gravel, or has firm layers in the subsoil or substratum; and small areas of wet soils in depressions.

Permeability is moderate or moderately rapid in the subsoil of the Padus soil and rapid or very rapid in the substratum. The available water capacity is moderate, and natural fertility is medium.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are the erosion hazard and the equipment limitation. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. Installing water bars, establishing out-sloping road surfaces, constructing ditches, installing culverts, and building logging roads on the contour help to minimize erosion. Seeding exposed areas after the trees are logged helps to establish a protective plant cover. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soil is dry or has a thick cover of snow. In areas where the slope limits the use of equipment, hand planting and yarding of logs by cable may be necessary.

The slope limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil generally is not suited to cultivated crops. The slope and water erosion are the main management concerns.

This soil is suited to pasture. A cover of pasture plants is effective in controlling water erosion. The slope can limit the use of machinery. Overgrazing or grazing when the soil is too wet can result in surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields and dwellings because of the slope. Cutting and filling can minimize this limitation, but they may not be effective where the slope is more than about 20 percent. Better suited sites may be needed. Dwellings can be designed so that they conform to the natural slope of the land. The effluent from septic tank systems drains satisfactorily through the soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum.

Because of the slope, this soil is poorly suited to local roads and streets. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIe. The woodland ordination symbol is 3R. The primary habitat type is AViO, and the secondary habitat type is ATD.

PbB—Padus-Goodman complex, 1 to 6 percent slopes, stony. These nearly level and gently sloping, moderately well drained soils are on flats, ridges, knolls, and short, uneven side slopes. The Padus soil is on moraines, on outwash plains, and in areas of pitted outwash. The Goodman soil is on moraines. In most areas it has stones in the surface layer Individual areas are irregularly shaped and generally range from 10 to 80 acres in size. They are about 60 to 70 percent Padus soil and 20 to 30 percent Goodman soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Padus soil has a surface layer of black loam about 3 inches thick. The subsurface layer is brown loam about 4 inches thick. The subsoil is about 26 inches thick. The upper part is reddish brown and dark brown loam, the next part is dark brown and brown, mottled loam, and the lower part is brown gravelly loamy sand. The substratum to a depth of about 60 inches is strong brown and brown, stratified sand and gravel. In some places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or silt loam. In other places the lower part of the subsoil and the substratum have little or no gravel. In some areas the slope is more than 6 percent.

Typically, the Goodman soil has a mat of partially decomposed forest litter about 2 inches thick at the surface. The surface layer is brown silt loam about 3 inches thick. The upper 12 inches of the subsoil is dark reddish brown and dark brown silt loam, the next 8 inches is brown, mottled silt loam; and the lower 15 inches is dark brown, mottled gravelly sandy loam and brown, mottled gravelly loamy sand. The substratum to a depth of about 60 inches is dark brown gravelly loamy sand that has a few pockets of sandy loam. In some places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or loam. In other places the substratum is sandy loam, gravelly sandy loam, or loamy sand or is very gravelly, cobbly, or very cobbly sandy loam or loamy sand. In the south-central part of the county, the substratum is grayer. In some areas the slope is more than 6 percent.

Included with these soils in mapping are small areas

of Monico, Pence, Sayner, and Worcester soils. These included soils make up less than 15 percent of the unit. The somewhat poorly drained Monico and Worcester soils are lower on the landscape than the Padus and Goodman soils. The well drained Pence soils and the excessively drained Sayner soils are on flats, knolls, and side slopes. Pence soils are sandy loam in the surface layer and the upper part of the subsoil. They are underlain by gravelly coarse sand. Sayner soils are loamy sand in the upper part and stratified sand and gravel in the lower part. Also included are areas of stratified sandy, loamy, and silty material; some areas where the Padus and Goodman soils are well drained or have firm layers in the subsoil or substratum; and some areas where the Goodman soil is not stony or is very stony or bouldery.

Permeability is moderate or moderately rapid in the subsoil of the Padus soil and rapid or very rapid in the substratum. It is moderate in the Goodman soil. The available water capacity is moderate in both soils, and natural fertility is medium. The depth to a perched seasonal high water table is 2.5 to 4.0 feet in the Padus soil and 1.5 to 3.0 feet in the Goodman soil.

Most areas are used as woodland. Some small areas have been cleared of stones and are used as cropland or pasture. These soils are suited to trees. The main concerns in managing woodland are the equipment limitation and the windthrow hazard on the Goodman soil. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soils are dry or have a thick cover of snow. On unsurfaced roads ruts form easily during wet periods. A gravel base is needed on sites for all-weather roads. If stabilized, landings can better withstand the repeated use of heavy equipment. Hand planting of trees or yarding of the logs by cable may be necessary in areas of the Goodman soil where stones limit the use of equipment. Harvest methods that do not leave the remaining trees widely spaced reduce the risk of windthrow on the Goodman soil.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. On the Goodman soil, subsequent control of invading species also may be needed.

Because of the stoniness, these soils generally are not suited to cultivated crops. Areas where the surface stones have been removed and the nonstony included areas are suited to corn and small grain and to grasses and legumes for hay and pasture. In cultivated areas where the slope is more than about 2 percent, water erosion is the main management concern. A conservation cropping sequence, contour farming, grassed waterways, cover crops, and a system of conservation tillage, such as offset disking, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and good soil tilth.

These soils are suited to pasture. A cover of pasture plants is effective in controlling water erosion. The stoniness can limit the use of machinery. Overgrazing or grazing when the soils are too wet can cause surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

Because of the seasonal high water table, these soils are poorly suited to septic tank absorption fields. In areas of the Padus soil, a poor filtering capacity also is a concern. In areas where the water table is below a depth of 2 feet, these limitations can be overcome by constructing a mound of suitable filtering material.

The Padus soil is suited to dwellings without basements, but the Goodman soil is only moderately suited because of the seasonal high water table. Because of the water table, the Padus soil is only moderately suited to dwellings with basements and the Goodman soil is poorly suited. Constructing dwellings without basements on fill material, which raises the level of the site, and constructing basements above the level of wetness help to overcome this limitation. The wetness also can be overcome by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

Because of the potential for frost action, these soils are only moderately suited to local roads and streets (fig. 5). The Goodman soil also is limited by the seasonal high water table. These limitations can be overcome by adding suitable fill material, such as sand or gravel, which raises the roadbed above the level of wetness, and by providing adequate roadside ditches, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is VIs. The woodland ordination symbol is 3L in areas of the Padus soil and 3X in areas of the Goodman soil. The primary habitat type is AViO, and the secondary habitat type is ATD.

PbC—Padus-Goodman complex, 6 to 15 percent slopes, stony. These sloping soils are on ridges, knolls, and side slopes. Many slopes are complex. The Padus soil is on moraines, on outwash plains, and in areas of

Figure 5.—Road damage caused by frost action in an area of Padus-Goodman complex, 1 to 6 percent slopes, stony.

pitted outwash. It is well drained. The Goodman soil is on moraines. It is moderately well drained. In most areas it has stones in the surface layer. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 300 acres in size. They are about 60 to 70 percent Padus soil and 20 to 30 percent Goodman soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Padus soil has a mat of partially decomposed forest litter about 1 inch thick at the surface. The surface layer is brown loam about 2 inches thick. The subsoil is about 28 inches thick. The upper part is dark reddish brown and dark brown loam, the next part is dark brown and brown loam, and the lower part is dark brown and strong brown gravelly loamy sand. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In some places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or silt loam. In other places the lower part of the subsoil and the substratum have little or no gravel. In some areas the slope is less than 6 or more than 15 percent.

Typically, the Goodman soil has a mat of partially decomposed forest litter about 2 inches thick at the surface. The surface layer is brown silt loam about 2

inches thick. The upper 12 inches of the subsoil is dark reddish brown and dark brown silt loam, the next 3 inches is brown, mottled silt loam, and the lower 17 inches is dark brown, mottled gravelly sandy loam and brown, mottled gravelly loamy sand. The substratum to a depth of about 60 inches is brown gravelly loamy sand that has a few pockets of sandy loam. In some places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or loam. In other places the substratum is sandy loam, gravelly sandy loam, or loamy sand or is very gravelly, cobbly, or very cobbly sandy loam or loamy sand. In the south-central part of the county, the substratum is grayer. In some areas the slope is less than 6 or more than 15 percent.

Included with these soils in mapping are small areas of the well drained Pence and excessively drained Sayner soils on knolls and side slopes. These included soils make up less than 15 percent of the unit. Pence soils are sandy loam in the surface layer and the upper part of the subsoil. They are underlain by gravelly coarse sand. Sayner soils are loamy sand in the upper part and stratified sand and gravel in the lower part. Also included are areas of stratified sandy, loamy, and silty material; some areas where the Goodman soil is well drained, is not stony, or is very stony or bouldery; some areas where the Padus soil is moderately well drained or has firm layers in the subsoil and substratum; and small areas of wet soils in depressions.

Permeability is moderate or moderately rapid in the subsoil of the Padus soil and rapid or very rapid in the substratum. It is moderate in the Goodman soil. The available water capacity is moderate in both soils, and natural fertility is medium. The depth to a perched seasonal high water table is 1.5 to 3.0 feet in the Goodman soil.

Most areas are used as woodland. Some small areas have been cleared of stones and are used as cropland or pasture. These soils are suited to trees. The main concerns in managing woodland are the equipment limitation and the windthrow hazard on the Goodman soil. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soils are dry or have a thick cover of snow. On unsurfaced roads ruts form easily during wet periods. A gravel base is needed on sites for all-weather roads. The slope limits the selection of landing sites. Landings can be established in areas of the nearly level or gently sloping included or adjacent soils. Hand planting of trees or yarding of the logs by cable may be necessary in areas of the Goodman soil where stones limit the use of equipment. Harvest methods that do not leave the remaining trees widely spaced reduce the risk of windthrow on the Goodman soil.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. On the Goodman soil, subsequent control of invading species also may be needed.

Because of the stoniness, these soils generally are not suited to cultivated crops. Areas where the surface stones have been removed and the nonstony included areas are suited to corn and small grain and to grasses and legumes for hay and pasture. Water erosion is the main management concern in cultivated areas. A conservation cropping sequence, contour farming, grassed waterways, cover crops, and a system of conservation tillage, such as offset disking, help to prevent excessive soil loss. Conservation tillage also helps to maintain the content of organic matter and good soil tilth.

These soils are suited to pasture. A cover of pasture plants is effective in controlling water erosion. The stoniness can limit the use of machinery. Overgrazing or grazing when the soils are too wet can cause surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

The Goodman soil is poorly suited to septic tank absorption fields because of the seasonal high water table. In areas where the water table is below a depth of 2 feet, this limitation can be overcome by constructing a mound of suitable filtering material. The effluent from septic tank systems drains satisfactorily through the Padus soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum.

Because of the slope, the Padus soil is only moderately suited to dwellings. The Goodman soil is poorly suited to dwellings with basements because of the seasonal high water table. It is only moderately suited to dwellings without basements because of the seasonal high water table and the slope. The slope can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land. The wetness can be overcome by adding fill material, which raises the site; by constructing basements above the level of wetness; or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

These soils are only moderately suited to local roads and streets because of the potential for frost action and the slope. The Goodman soil also is limited by the

seasonal high water table. The wetness can be overcome by providing adequate roadside ditches and culverts, which help to drain the roadbed and maintain the natural drainage system, and by adding fill material, which raises the roadbed above the level of wetness. The road damage caused by frost action can be minimized by covering or replacing the upper part of the soils with coarse textured base material, such as sand or gravel, and by providing adequate roadside ditches, which drain the roadbed. The slope can be overcome by cutting and filling.

The land capability classification is VIs. The woodland ordination symbol is 3L in areas of the Padus soil and 3X in areas of the Goodman soil. The primary habitat type is AViO, and the secondary habitat type is ATD.

PbD—Padus-Goodman complex, 15 to 25 percent slopes, stony. These moderately steep, well drained soils are on ridges, knolls, and side slopes. Many slopes are complex. The Padus soil is on moraines, on outwash plains, and in areas of pitted outwash. The Goodman soil is on moraines. In most areas it has stones in the surface layer. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 150 acres in size. They are about 60 to 70 percent Padus soil and 20 to 30 percent Goodman soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Padus soil has a mat of partially decomposed forest litter about 1 inch thick at the surface. The surface layer is brown loam about 3 inches thick. The subsoil is about 27 inches thick. The upper part is dark reddish brown and reddish brown loam, the next part is brown and dark brown loam, and the lower part is strong brown and dark brown loamy sand. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In some places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or silt loam. In other places the substratum has little or no gravel. In some areas the slope is less than 15 or more than 25 percent.

Typically, the Goodman soil has a mat of partially decomposed forest litter about 1 inch thick at the surface. The surface layer is brown silt loam about 2 inches thick. The upper 12 inches of the subsoil is dark reddish brown and dark brown silt loam, the next 6 inches is brown silt loam, and the lower 15 inches is brown gravelly loamy sand and dark brown gravelly sandy loam. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In some places the upper layers are sandy loam, fine sandy loam, very fine sandy loam, or loam. In other places the substratum is sandy loam, loamy sand, or gravelly sandy loam or is very gravelly, cobbly, or very cobbly sandy loam or loamy sand. In the south-central part of the county, the substratum is grayer. In some areas the slope is less than 15 or more than 25 percent.

Included with these soils in mapping are small areas of the well drained Pence and excessively drained Sayner soils on knolls and side slopes. These included soils make up less than 15 percent of the unit. Pence soils are sandy loam in the surface layer and the upper part of the subsoil. They are underlain by gravelly coarse sand. Sayner soils are loamy sand in the upper part and stratified sand and gravel in the lower part. Also included are areas of stratified sandy, loamy, and silty material; some areas of Padus and Goodman soils that have firm layers in the subsoil or substratum; some areas where the Goodman soil is moderately well drained, is not stony, or is very stony or bouldery; and small areas of wet soils in depressions.

Permeability is moderate or moderately rapid in the subsoil of the Padus soil and rapid or very rapid in the substratum. It is moderate in the Goodman soil. The available water capacity is moderate in both soils, and natural fertility is medium.

These soils are used as woodland. They are suited to trees. The main concerns in managing woodland are the erosion hazard on the Padus soil and the equipment limitation on both soils. Runoff concentrated on logging roads, skid trails, and landings results in erosion. Installing water bars, establishing out-sloping road surfaces, constructing ditches, installing culverts, and building logging roads on the contour minimize erosion. Seeding exposed areas after the trees are logged helps to establish a protective plant cover. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soils are wet. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soils are dry or have a thick cover of snow. Yarding of the logs by cable or hand planting may be necessary in areas where the slope limits the use of equipment. Hand planting of trees or yarding of the logs by cable may be necessary in areas of the Goodman soil where stones limit the use of equipment.

The slope limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. Landings can be established in areas of the included or less sloping adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be

needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. On the Goodman soil, subsequent control of invading species also may be needed.

These soils generally are not suited to cultivated crops. The slope, the stones in the Goodman soil, and water erosion are the main management concerns.

These soils are suited to pasture. A cover of pasture plants is effective in controlling water erosion. The stoniness and the slope can limit the use of machinery. Overgrazing or grazing when the soils are too wet can result in surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

Because of the slope, these soils are poorly suited to septic tank absorption fields, dwellings, and local roads and streets. Cutting and filling can minimize the slope but may not be effective where the slope is more than about 20 percent. Better suited sites should be selected. The effluent from septic tank systems drains satisfactorily through the Padus soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum. Dwellings can be designed so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIs. The woodland ordination symbol is 3R. The primary habitat type is AViO, and the secondary habitat type is ATD.

PeB—Padus-Pence sandy loams, 1 to 6 percent slopes. These nearly level and gently sloping, well drained soils are on flats, knolls, and short, uneven side slopes on outwash plains and in areas of pitted outwash. Individual areas are irregularly shaped and generally range from 20 to 400 acres in size. They are about 60 to 70 percent Padus soil and 20 to 30 percent Pence soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Padus soil has a surface layer of black sandy loam about 1 inch thick. The subsurface layer is brown sandy loam about 4 inches thick. The upper 28 inches of the subsoil is dark reddish brown, dark brown, and brown sandy loam, and the lower 2 inches is dark brown gravelly loamy sand. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In some places the upper layers are loamy sand, fine sandy loam, or loam. In other places the lower part of the subsoil and the substratum have little or no gravel. In some areas the soil is eroded. In other areas the slope is more than 6 percent.

Typically, the Pence soil has a surface layer of black sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 3 inches thick. The subsoil is about 16 inches thick. It is dark reddish brown and reddish brown sandy loam in the upper part and yellowish red loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish red and strong brown gravelly sand. In some places the upper layers are loam or fine sandy loam. In other places the soil is eroded. In some areas the substratum is very gravelly sand, and in other areas it has little or no gravel. In places the slope is more than 6 percent.

Included with these soils in mapping are small areas of Sayner, Vilas, and Worcester soils. These included soils make up less than 20 percent of the unit. The excessively drained Sayner and Vilas soils are in positions on the landscape similar to those of the Padus and Pence soils. Sayner soils are loamy sand in the upper part. Vilas soils are sandy throughout. The somewhat poorly drained Worcester soils are on the lower flats and in depressions. Also included are areas of stratified sandy, loamy, and silty material; a few areas where the Padus soil is more than 40 inches deep to sand and gravel or has pockets of loamy sand in the substratum; and some areas where the Padus and Pence soils are moderately well drained, are cobbly or stony, or have firm layers in the subsoil or substratum.

Permeability is moderate or moderately rapid in the subsoil of the Padus soil and moderately rapid in the subsoil of the Pence soil. It is rapid or very rapid in the substratum of both soils. The available water capacity is moderate in the Padus soil and low in the Pence soil. Natural fertility is medium in both soils.

Most areas are used as woodland. Some areas are used as cropland or pasture. These soils are suited to trees. No major hazards or limitations affect planting or harvesting on the Pence soil. The low available water capacity, however, limits the growth of trees, especially hardwoods. The main concern in managing wooded areas of the Padus soil is the equipment limitation. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soils are dry or have a thick cover of snow. On unsurfaced roads ruts form easily during wet periods. A gravel base is needed on sites for all-weather roads. If stabilized, landings can better withstand the repeated use of heavy equipment.

After trees are cut, plant competition on the Padus soil can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing

plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Droughtiness and soil blowing are management concerns. Water erosion also is a concern in cultivated areas where the slope is more than about 2 percent. A conservation cropping sequence, contour farming, grassed waterways, cover crops, field windbreaks, and a system of conservation tillage, such as chisel plowing, minimize soil loss, conserve soil moisture, and help to maintain the content of organic matter. Irrigation can help to overcome the droughtiness.

A cover of pasture plants or hay is effective in controlling soil blowing and water erosion. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

The effluent from septic tank systems drains satisfactorily through these soils, but it can pollute ground water because of the rapid or very rapid permeability in the substratum.

These soils are suited to dwellings. The Pence soil is suited to local roads and streets, but the Padus soil is only moderately suited because of the potential for frost action. The road damage caused by frost action can be minimized by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing adequate roadside ditches and culverts, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is IIIe. The woodland ordination symbol is 3L in areas of the Padus soil and 3A in areas of the Pence soil. The primary habitat type is ATD, and the secondary habitat type is ATM.

PeC—Padus-Pence sandy loams, 6 to 15 percent slopes. These sloping, well drained soils are on knolls and side slopes, on outwash plains, and in areas of pitted outwash. Many slopes are complex. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 900 acres in size. They are about 55 to 65 percent Padus soil and 25 to 35 percent Pence soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Padus soil has a surface layer of dark brown sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 1 inch thick. The subsoil is sandy loam about 25 inches thick. The upper part is dark reddish brown and reddish brown, the next part is brown, and the lower part is dark brown. The substratum to a depth of about 60 inches is brown, stratified sand and gravel. In some places the upper layers are loamy sand, fine sandy loam, or loam. In other places the substratum has little or no gravel. In some areas the soil is eroded. In other areas the slope is less than 6 or more than 15 percent.

Typically, the Pence soil has a surface layer of dark reddish brown sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 5 inches thick. The subsoil is about 13 inches thick. The upper part is dark reddish brown sandy loam, the next part is reddish brown gravelly sandy loam, and the lower part is yellowish red gravelly coarse sand. The substratum to a depth of about 60 inches is yellowish red and reddish yellow gravelly coarse sand. In places the upper layers are loam or fine sandy loam. In some areas the substratum is very gravelly sand, and in other areas it has little or no gravel. In some places the soil is eroded. In other places the slope is less than 6 or more than 15 percent.

Included with these soils in mapping are small areas of the excessively drained Sayner and Vilas soils. These included soils make up less than 20 percent of the unit. They are in positions on the landscape similar to those of the Padus and Pence soils. Sayner soils are loamy sand in the upper part. Vilas soils are sandy throughout. Also included are areas of stratified sandy, loamy, and silty material; a few areas where the Padus soil is more than 40 inches deep to sand and gravel or has pockets of loamy sand in the substratum; some areas where the Padus and Pence soils are moderately well drained, are cobbly or stony, or have firm layers in the subsoil or substratum; and small areas of wet soils in depressions.

Permeability is moderate or moderately rapid in the subsoil of the Padus soil and moderately rapid in the subsoil of the Pence soil. It is rapid or very rapid in the substratum of both soils. The available water capacity is moderate in the Padus soil and low in the Pence soil. Natural fertility is medium in both soils.

Most areas are used as woodland. Some areas are used as cropland or pasture. These soils are suited to trees. No major hazards or limitations affect planting or harvesting on the Pence soil. The low available water capacity, however, limits the growth of trees, especially hardwoods. The main concern in managing wooded areas of the Padus soil is the equipment limitation. The use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soils are dry or have a thick cover of snow. On unsurfaced roads ruts form easily during wet periods. A gravel base

is needed on sites for all-weather roads. The slope limits the selection of landing sites on both soils. Landings can be established in areas of the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition on the Padus soil can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Droughtiness, soil blowing, and water erosion are management concerns in cultivated areas. A conservation cropping sequence, contour farming, grassed waterways, cover crops, field windbreaks, and a system of conservation tillage, such as chisel plowing, minimize soil loss, conserve soil moisture, and help to maintain the content of organic matter.

A cover of pasture plants or hay is effective in controlling soil blowing and water erosion. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

The effluent from septic tank systems drains satisfactorily through these soils, but it can pollute ground water because of the rapid or very rapid permeability in the substratum.

Because of the slope, these soils are only moderately suited to dwellings and to local roads and streets. In areas of the Padus soil, the potential for frost action also is a concern. Dwellings can be designed so that they conform to the natural slope of the land. The road damage caused by frost action can be minimized by replacing the upper part of the Padus soil with coarse textured base material, such as sand or gravel, and by providing adequate roadside ditches, which help to drain the roadbed and maintain the natural drainage system. The slope can be shaped by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is IVe. The woodland ordination symbol is 3L in areas of the Padus soil and 3A in areas of the Pence soil. The primary habitat type is ATD, and the secondary habitat type is ATM.

PeD—Padus-Pence sandy loams, 15 to 45 percent slopes. These moderately steep and steep, well drained soils are on knolls and side slopes on outwash plains and in areas of pitted outwash. Many slopes are complex. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 400 acres in size. They are about 50 to 60 percent Padus soil and 30 to 40 percent Pence soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Padus soil has a surface layer of very dark grayish brown sandy loam about 2 inches thick. The subsurface layer is dark grayish brown sandy loam about 1 inch thick. The subsoil is about 25 inches thick. The upper part is dark reddish brown and dark brown sandy loam, the next part is dark brown and brown sandy loam, and the lower part is brown loamy sand. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In some places the upper layers are loamy sand, fine sandy loam, or loam. In other places the substratum has little or no gravel. In some areas the soil is eroded. In other areas the slope is less than 15 or more than 45 percent.

Typically, the Pence soil has a mat of partially decomposed forest litter about 1 inch thick at the surface. The surface layer is black sandy loam about 1 inch thick. The subsurface layer is dark reddish gray sandy loam about 1 inch thick. The subsoil is about 18 inches thick. The upper part is dark brown and strong brown sandy loam, and the lower part is strong brown gravelly loamy sand. The substratum to a depth of about 60 inches is strong brown gravelly sand. In some places the upper layers are loam or fine sandy loam. In other places the soil is eroded. In some areas the substratum is very gravelly sand. In other areas it has little or no gravel. In places the slope is less than 15 or more than 45 percent.

Included with these soils in mapping are small areas of the excessively drained Sayner and Vilas soils. These included soils make up less than 20 percent of the unit. They are in positions on the landscape similar to those of the Padus and Pence soils. Sayner soils are loamy sand in the upper part. Vilas soils are sandy throughout. Also included are areas of stratified sandy, loamy, and silty material; a few areas where the Padus soil is more than 40 inches deep to sand and gravel or has pockets of loamy sand in the substratum; small areas of wet soils in depressions; and some areas where the Padus and Pence soils are cobbly or stony or have firm layers in the subsoil or substratum.

Permeability is moderate or moderately rapid in the subsoil of the Padus soil and moderately rapid in the subsoil of the Pence soil. It is rapid or very rapid in the substratum of both soils. The available water capacity is moderate in the Padus soil and low in the Pence soil. Natural fertility is medium in both soils.

These soils are used as woodland. They are suited to trees. The main concerns in managing woodland are the hazard of water erosion and the equipment limitation. Runoff concentrated on logging roads, skid trails, and landings results in erosion. Installing water

bars, establishing out-sloping road surfaces, constructing ditches, installing culverts, and building logging roads on the contour minimize erosion. Seeding exposed areas after the trees are logged helps to establish a protective plant cover. In areas of the Padus soil, the use of equipment is restricted in spring and in other wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soils are wet. Deep ruts restrict lateral drainage and expose tree roots. Machinery should be used only when the soils are dry or have a thick cover of snow. Yarding of the logs by cable or hand planting may be necessary in areas where the slope limits the use of equipment.

The slope limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

After trees are cut, plant competition on the Padus soil can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils generally are not suited to cultivated crops. The slope, droughtiness, soil blowing, and water erosion are management concerns.

These soils are suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. The slope can limit the use of machinery. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

Because of the slope, these soils are poorly suited to septic tank absorption fields, dwellings, and local roads and streets. Cutting and filling can minimize the slope, but they may not be effective where the slope is more than about 20 percent. Better suited sites should be selected. The effluent from septic tank systems drains satisfactorily through these soils, but it can pollute ground water because of the rapid or very rapid permeability in the substratum. Dwellings can be designed so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIe. The woodland ordination symbol is 3R. The primary habitat type is ATD, and the secondary habitat type is ATM.

PrB—Pequaming loamy sand, 1 to 3 percent slopes, stony. This nearly level and gently sloping, somewhat poorly drained soil is on low ridges, on foot slopes, and in depressions on drumlins and water-worked moraines. Stones are in the surface layer in most areas. Individual areas are long and narrow or are irregularly shaped, and they generally range from 5 to 95 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is brown loamy sand about 3 inches thick. The upper 21 inches of the subsoil is dark brown and strong brown, mottled loamy sand, and the lower 8 inches is brown, mottled loamy sand and dark brown, mottled sandy loam. The substratum extends to a depth of about 60 inches. It is dark brown, mottled loamy sand in the upper part and reddish brown sandy loam in the lower part. In some places the upper layers are sand or sandy loam. In other places the substratum is sand or is gravelly, very gravelly, cobbly, or very cobbly loamy sand or sandy loam. In some areas the substratum is stratified sandy, loamy, and silty material. In the south-central part of the county, the substratum is grayer. In places the slope is more than 3 percent.

Included with this soil in mapping are small areas of Cable, Keweenaw, and Markey soils. These soils make up less than 10 percent of the unit. The well drained and moderately well drained Keweenaw soils are higher on the landscape than the Pequaming soil. The poorly drained and very poorly drained Cable soils and the very poorly drained Markey soils are in the lower positions. Cable soils have more silt and clay than the Pequaming soil. Markey soils are organic to a depth of more than 16 inches. Also included are some areas where bedrock is within a depth of 60 inches, some areas of a soil that is similar to the Pequaming soil but is poorly drained, and some areas where the Pequaming soil is not stony or is very stony or bouldery.

Permeability is moderately rapid or rapid in the Pequaming soil. The available water capacity and natural fertility are low. The depth to a perched seasonal high water table is 0.5 foot to 1.5 feet.

This soil is used mainly as woodland. It is suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The use of equipment is restricted in spring and in other wet periods because of the seasonal high water table. Ruts form easily when wheeled vehicles are used during these periods. Deep ruts restrict lateral drainage and expose tree roots. Access by machinery is limited to dry periods in summer or to periods in winter when the soil is frozen or has a thick cover of snow. Hand planting or yarding of the logs by cable may be necessary in areas where stones limit the use of equipment. The seedling mortality caused by wetness can be minimized by planting vigorous nursery stock on the crest of cradle knolls or on prepared

ridges. A shallow rooting depth, which is caused by the seasonal high water table, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species also may be needed.

Because of the stoniness, this soil generally is not suited to cultivated crops. Areas where the surface stones have been removed and the nonstony included areas are suited to corn and small grain and to grasses and legumes for hay and pasture. A drainage system is needed for dependable crop production. In undrained areas the seasonal high water table limits yields and the kinds of crops that can be grown. If the soil is drained and cultivated, soil blowing is a hazard during dry periods. Cover crops, field windbreaks, and a system of conservation tillage, such as offset disking, minimize soil loss, conserve soil moisture, and help to maintain the content of organic matter.

This soil is suited to pasture. Maintaining forage stands is difficult, however, because of the low natural fertility, the seasonal high water table, and droughtiness. A cover of pasture plants is effective in controlling soil blowing. The stoniness can limit the use of machinery. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and a poor filtering capacity in the rapidly permeable sandy layers. Overcoming these limitations is difficult. A better suited site should be selected.

Because of the seasonal high water table, this soil is poorly suited to dwellings. Constructing dwellings without basements on fill material, which raises the level of the site, and constructing basements above the level of wetness help to overcome this limitation. The wetness also can be overcome by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

This soil is poorly suited to local roads and streets because of the seasonal high water table. This limitation can be overcome by providing coarse textured fill material, such as sand or gravel, which raises the roadbed above the level of wetness, and by providing adequate roadside ditches, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is VIs. The woodland ordination symbol is 4X. The habitat type is TMC.

Pt—Pits, gravel. This unit consists of excavations from which sand, gravel, glacial till, and glacial drift have been removed. Individual areas are irregularly shaped and generally range from about 5 to 30 acres in size.

Typically, the material on the bottom and sides of the pits is sand, stratified sand and gravel, or sandy or loamy glacial till or glacial drift.

Included in this unit in mapping are small areas of spoil. The spoil includes soil material pushed from the pits before excavation and piles of material discarded because it did not have enough gravel or otherwise was considered unsuitable. Also included in some pits are areas where stones and boulders are too large to be crushed.

Many pits are still active. Some have been abandoned and are overgrown with brush and weeds or are used as sanitary landfills. A few pits are filled with water. The main management concern is reclamation of the sites after excavation. Before most areas can support a plant cover, land shaping and additions of suitable topsoil are needed.

Onsite investigation is needed to determine the suitability of this unit for septic tank absorption fields, dwellings, and local roads and streets.

No land capability classification, woodland ordination symbol, or habitat type is assigned.

PvA—Plover fine sandy loam, 0 to 3 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on flats and in depressions on glacial lake plains, outwash plains, and moraines. In some areas it is subject to rare flooding. Individual areas are irregularly shaped and generally range from 5 to 60 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is brown fine sandy loam about 2 inches thick. The upper 3 inches of the subsoil is dark brown fine sandy loam, the next 18 inches is brown, mottled loamy fine sand and dark brown, mottled fine sandy loam, and the lower 6 inches is dark brown, mottled fine sandy loam. The substratum to a depth of about 60 inches is brown, mottled, stratified fine sand, very fine sandy loam, and silt loam. In some places the upper layers are very fine sandy loam, sandy loam, loamy fine sand, loamy very fine sand, loam, or silt loam. In other places the soil is silt loam throughout. In some areas the substratum is loamy sand, sandy loam, or sand and gravel. In other areas the slope is more than 3 percent.

Included with this soil in mapping are small areas of the moderately well drained Alcona and well drained Rousseau soils. These soils make up less than 10 percent of the unit. They are higher on the landscape than the Plover soil. Rousseau soils are sandy throughout. Also included are areas where the Plover soil is stony and areas of a soil that is similar to the Plover soil but is poorly drained.

Permeability is moderate in the Plover soil. The available water capacity is high, and natural fertility is medium. The depth to a perched seasonal high water table is 1 to 3 feet.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are the equipment limitation and the windthrow hazard. The use of equipment is restricted in spring, late in fall, and in other wet periods because of the seasonal high water table and low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts restrict lateral drainage and expose tree roots. Access by machinery is limited to dry periods in summer or to periods in winter when the soil is frozen or has a thick cover of snow. When the soil is wet, unsurfaced roads tend to be slippery. A gravel base is needed on sites for all-weather logging roads. Also, large culverts are needed to maintain the natural drainage system. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. The better suited adjacent soils can be selected as sites for landings. A shallow rooting depth, which is caused by the seasonal high water table, can result in windthrow of many trees during periods when the soil is wet and winds are strong. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species also may be needed.

If drained, this soil is suited to corn, small grain, and specialty crops and to grasses and legumes for hay and pasture. In undrained areas the seasonal high water table limits yields and the kinds of crops that can be grown. A system of conservation tillage, such as chisel plowing, helps to maintain the content of organic matter and good soil tilth.

This soil is suited to pasture. Excess water can damage forage species during wet periods. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Rotation grazing, proper stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

Because of the seasonal high water table, this soil is poorly suited to septic tank absorption fields. In areas where the water table is below a depth of 2 feet, this limitation can be overcome by constructing a mound of suitable filtering material.

Because of the seasonal high water table and the flooding, this soil is poorly suited to dwellings. The wetness can be overcome by installing a subsurface drainage system that has a gravity outlet or another dependable outlet, by using fill material to raise the site, and by constructing basements above the level of wetness. The flooding can be overcome by directing water away from the dwellings with a diversion or dike and by shaping the construction site so that surface water is removed.

Because of the potential for frost action, this soil is poorly suited to local roads and streets. The road damage caused by frost action can be minimized by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing adequate roadside ditches, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is IIw. The woodland ordination symbol is 3W. The habitat type is TMC.

RsB—Rousseau loamy fine sand, 0 to 6 percent slopes. This nearly level and gently sloping, well drained soil is on flats, knolls, and short, uneven side slopes on glacial lake plains, outwash plains, and moraines. Individual areas are irregularly shaped and generally range from 5 to 40 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is brown loamy fine sand about 2 inches thick. The subsoil is about 19 inches thick. It is dark brown loamy fine sand in the upper part and dark brown and strong brown fine sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown fine sand. In some places the upper layers are loamy sand, very fine sandy loam, fine sandy loam, or loamy very fine sand. In other places the substratum is very fine sand, sand, or sand and gravel. in some areas the soil is eroded. In other areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of Alcona, Au Gres, and Vilas soils. These soils make up less than 10 percent of the unit. The moderately well drained Alcona soils and the excessively drained Vilas soils are in positions on the landscape similar to those of Rousseau soil. Alcona soils have more silt and clay than the Rousseau soil, and Vilas soils have a lower content of fine sand. The somewhat poorly drained Au

Gres soils are on the lower flats and in depressions. Also included are some areas of a soil that is similar to the Rousseau soil but is moderately well drained.

Permeability is rapid in the Rousseau soil. The available water capacity and natural fertility are low.

Most areas are used as woodland. Some small areas are used as cropland or pasture. This soil is suited to trees. The main concern in managing woodland is the seedling mortality caused by droughtiness. Planting when the soil is moist and selecting containerized seedlings or vigorous nursery stock reduce the seedling mortality rate.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Droughtiness, the low natural fertility, and soil blowing are the main management concerns in cultivated areas. A conservation cropping sequence, cover crops, field windbreaks, and a system of conservation tillage, such as chisel plowing, minimize soil loss, conserve soil moisture, and help to maintain the content of organic matter. Irrigation helps to overcome the droughtiness.

A cover of pasture plants or hay is effective in controlling soil blowing. Forage yields generally are limited because of the low natural fertility and droughtiness. Rotation grazing, restricted use during dry periods, and proper stocking rates help to keep the pasture in good condition.

This soil is suited to dwellings and to local roads and streets. The effluent from septic tank systems drains satisfactorily through the soil, but it can pollute ground water because of the rapid permeability.

The land capability classification is IIIs. The woodland ordination symbol is 5S. The primary habitat type is AQV, and the secondary habitat type is PMV.

RsC—Rousseau loamy fine sand, 6 to 15 percent slopes. This sloping, well drained soil is on knolls and side slopes on glacial lake plains, outwash plains, and moraines. Some slopes are complex. Individual areas are irregularly shaped and generally range from 10 to 40 acres in size.

Typically, the surface layer is black loamy fine sand about 2 inches thick. The subsurface layer is reddish gray loamy fine sand about 3 inches thick. The subsoil is about 19 inches thick. The upper part is dark reddish brown and reddish brown loamy fine sand, and the lower part is strong brown fine sand. The substratum to a depth of about 60 inches is brown fine sand. In some places the upper layers are loamy sand, very fine sandy loam, fine sandy loam, or loamy very fine sand. In other places the substratum is very fine sand, sand, or sand and gravel. In some areas the soil is eroded. In other areas the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are small areas of the moderately well drained Alcona and excessively drained Vilas soils. These soils make up less than 15 percent of the unit. They are in positions on the landscape similar to those of the Rousseau soil. Alcona soils have more silt and clay than the Rousseau soil, and Vilas soils have a lower content of fine sand. Also included are a few areas of a soil that is similar to the Rousseau soil but is moderately well drained and has wet spots in depressions.

Permeability is rapid in the Rousseau soil. The available water capacity and natural fertility are low.

This soil is used mainly as woodland. It is suited to trees. The main concern in managing woodland is the seedling mortality caused by droughtiness. Planting when the soil is moist and selecting containerized seedlings or vigorous nursery stock reduce the seedling mortality rate. The slope limits the selection of landing sites. Landings can be established in areas of the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Droughtiness, the low natural fertility, soil blowing, and water erosion are management concerns in cultivated areas. A conservation cropping sequence, cover crops, grassed waterways, contour farming, field windbreaks, and a system of conservation tillage, such as chisel plowing, minimize soil loss, conserve soil moisture, and help to maintain the content of organic matter.

A cover of pasture plants or hay is effective in controlling soil blowing and water erosion. Forage yields generally are limited because of the low natural fertility and droughtiness. Rotation grazing, restricted use during dry periods, and proper stocking rates help to keep the pasture in good condition.

The effluent from septic tank systems drains satisfactorily through this soil, but it can pollute ground water because of the rapid permeability in the substratum.

Because of the slope, this soil is only moderately suited to dwellings and to local roads and streets. This limitation can be overcome by cutting and filling and by designing dwellings so that they conform to the natural

slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is IIIe. The woodland ordination symbol is 5S. The primary habitat type is AQV, and the secondary habitat type is PMV.

SaB—Sayner loamy sand, 0 to 6 percent slopes. This nearly level and gently sloping, excessively drained soil is on flats, knolls, and short, uneven side slopes on moraines, on outwash plains, and in areas of pitted outwash. Individual areas are irregularly shaped and generally range from 10 to 500 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is brown loamy sand about 2 inches thick. The subsoil is dark reddish brown and brown loamy sand about 20 inches thick. The substratum to a depth of about 60 inches is brown, stratified sand and gravel. In places the upper layers are gravelly loamy sand or are sand, loamy fine sand, or the gravelly analogs of those textures. In some areas the substratum is very gravelly, cobbly, or very cobbly sand. In other areas it has little or no gravel. In some places the soil is eroded. In other places the slope is more than 6 percent.

Included with this soil in mapping are small areas of the well drained and moderately well drained Padus and well drained Pence soils. These soils make up less than 15 percent of the unit. They are in positions on the landscape similar to those of the Sayner soil. They formed in loamy deposits underlain by stratified sand and gravel or gravelly coarse sand. Also included are areas of stratified sandy and loamy deposits, areas of a soil that is similar to the Sayner soil but is moderately well drained, and areas of soils that have strata or pockets of loamy sand in the substratum.

Permeability is moderately rapid in the subsoil of the Sayner soil and rapid or very rapid in the substratum. The available water capacity and natural fertility are low.

Most areas are used as woodland. Some small areas are used as cropland or pasture. This soil is suited to trees. The main concern in managing woodland is the seedling mortality resulting from droughtiness. Planting when the soil is moist and selecting containerized seedlings or vigorous nursery stock reduce the seedling mortality rate.

This soil is suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Droughtiness, the low natural fertility, and soil blowing are the main management concerns in cultivated areas. Cover crops, field windbreaks, and a system of conservation tillage, such as chisel plowing, minimize soil loss, conserve soil moisture, and help to maintain the content of organic matter. Irrigation helps to overcome the droughtiness.

A cover of pasture plants or hay is effective in controlling soil blowing. Forage yields generally are limited because of the low natural fertility and droughtiness. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

This soil is suited to dwellings and to local roads and streets. The effluent from septic tank systems drains satisfactorily through the soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum.

The land capability classification is IVs. The woodland ordination symbol is 7S. The primary habitat type is AQV, and the secondary habitat type is PMV.

SaC—Sayner loamy sand, 6 to 15 percent slopes. This sloping, excessively drained soil is on knolls and side slopes on moraines, on outwash plains, and in areas of pitted outwash. Many slopes are complex. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 400 acres in size.

Typically, the surface layer is very dark gray loamy sand about 2 inches thick. The subsurface layer is reddish gray loamy sand about 3 inches thick. The subsoil is about 17 inches thick. The upper part is dark reddish brown and reddish brown loamy sand, and the lower part is yellowish red gravelly sand. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In places the upper layers are gravelly loamy sand or are sand, loamy fine sand, or the gravelly analogs of those textures. In some areas the substratum is very gravelly, cobbly, or very cobbly sand. In other areas it has little or no gravel. In some places the soil is eroded. In other places the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are small areas of the well drained and moderately well drained Padus and well drained Pence soils. These soils make up less than 10 percent of the unit. They are in positions on the landscape similar to those of the Sayner soil. They formed in loamy deposits underlain by stratified sand and gravel or gravelly coarse sand. Also included are areas of stratified sandy and loamy deposits, some areas where the Sayner soil is stony, small areas of wet soils in depressions, and some areas that have strata or pockets of loamy sand in the substratum.

Permeability is moderately rapid in the subsoil of the Sayner soil and rapid or very rapid in the substratum. The available water capacity and natural fertility are low.

Most areas are used as woodland. Some small areas

are used as cropland or pasture. This soil is suited to trees. The main concern in managing woodland is the seedling mortality resulting from droughtiness. Planting when the soil is moist and selecting containerized seedlings or vigorous nursery stock reduce the seedling mortality rate. The slope limits the selection of landing sites. Landings can be established in areas of the nearly level or gently sloping included or adjacent soils.

This soil generally is not suited to cultivated crops. Droughtiness, the low natural fertility, soil blowing, and water erosion are management concerns.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Forage yields generally are limited because of the low natural fertility and droughtiness. Rotation grazing, restricted use during dry periods, and proper stocking rates help to keep the pasture in good condition.

The effluent from septic tank systems drains satisfactorily through this soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum.

Because of the slope, this soil is only moderately suited to dwellings and to local roads and streets. This limitation can be overcome by cutting and filling and by designing dwellings so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIs. The woodland ordination symbol is 7S. The primary habitat type is AQV, and the secondary habitat type is PMV.

SaD—Sayner loamy sand, 15 to 45 percent slopes. This moderately steep and steep, excessively drained soil is on knolls and side slopes on moraines, on outwash plains, and in areas of pitted outwash. Many slopes are complex. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 100 acres in size.

Typically, the surface layer is black loamy sand about 2 inches thick. The subsurface layer is brown loamy sand about 2 inches thick. The subsoil is about 18 inches thick. The upper part is dark reddish brown loamy sand, the next part is reddish brown sand, and the lower part is strong brown gravelly sand. The substratum to a depth of about 60 inches is strong brown, light yellowish brown, and brownish yellow, stratified sand and gravel. In places the upper layers are gravelly loamy sand or are sand, loamy fine sand, or the gravelly analogs of those textures. In some areas the substratum is very gravelly, cobbly, or very cobbly sand. In other areas it has little or no gravel. In some places the soil is eroded. In other places the slope is less than 15 or more than 45 percent.

Included with this soil in mapping are small areas of the well drained and moderately well drained Padus and well drained Pence soils. These soils make up less than 10 percent of the unit. They are in positions on the landscape similar to those of the Sayner soil. They formed in loamy deposits underlain by stratified sand and gravel or gravelly coarse sand. Also included are areas of stratified sandy and loamy deposits, some areas where the Sayner soil is stony, small areas of wet soils in depressions, and some areas of soils that have strata or pockets of loamy sand in the substratum.

Permeability is moderately rapid in the subsoil of the Sayner soil and rapid or very rapid in the substratum. The available water capacity and natural fertility are low.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are the hazard of water erosion, seedling mortality, and the equipment limitation. Runoff concentrated on logging roads, skid trails, and landings results in erosion. Installing water bars, establishing out-sloping road surfaces, constructing ditches, installing culverts, and building logging roads and trails on the contour minimize erosion. Seeding exposed areas after the trees are logged helps to establish a protective plant cover. The rate of seedling mortality resulting from droughtiness can be reduced by planting when the soil is moist and selecting containerized seedlings or vigorous nursery stock.

Yarding of the logs by cable or hand planting may be necessary in areas where the slope limits the use of equipment. The slope also limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

This soil generally is not suited to cultivated crops. Droughtiness, the low natural fertility, the slope, soil blowing, and water erosion are management concerns.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Forage yields generally are somewhat limited because of the low natural fertility and droughtiness. The slope can limit the use of machinery. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

Because of the slope, this soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets. Cutting and filling can minimize the slope, but they may not be effective where the slope is more than about 20 percent. Better suited sites should be selected. The effluent from septic tank systems drains

satisfactorily through the soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum. Dwellings can be designed so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIs. The woodland ordination symbol is 7R. The primary habitat type is AQV, and the secondary habitat type is PMV.

UdB—Udorthents, nearly level and gently sloping. These soils are primarily in or near cities and villages where the landscape has been altered by excavation, filling, or leveling. Individual areas are irregular in shape and generally range from 5 to more than 100 acres in size.

These soils vary widely in thickness and color. They are dominantly sandy or loamy and are gravelly or very gravelly in some areas.

Included with these soils in mapping are areas of cinders, broken concrete, and industrial waste.

Permeability, the available water capacity, natural fertility, and the depth to a seasonal high water table vary in the Udorthents.

Most areas are used for urban development (fig. 6). Some small areas are used for gardens, lawns, or ornamental trees and shrubs.

The suitability of these soils for septic tank absorption fields, dwellings, and local roads and streets can be ascertained only by onsite investigation.

No land capability classification, woodland ordination symbol, or habitat type is assigned.

VsB—Vilas loamy sand, 0 to 6 percent slopes. This nearly level and gently sloping, excessively drained soil is on flats, knolls, and short, uneven side slopes on moraines, on outwash plains, and in areas of pitted outwash. Individual areas are irregularly shaped and generally range from 10 to 160 acres in size.

Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is black loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 2 inches thick. The subsoil is about 27 inches thick. The upper part is dark reddish brown and dark brown loamy sand, and the lower part is strong brown sand. The substratum to a depth of about 60 inches is brown sand. In some places the upper layers are sand, loamy fine sand, or sandy loam. In other places the substratum has thin strata of red, iron-stained sand or has layers of gravel. In some areas the soil is eroded. In other areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the moderately well drained Croswell and well drained Rousseau soils. These soils make up less than 10 percent of the unit. In some areas Croswell soils have a loamy substratum. They are on the lower flats and in depressions. Rousseau soils are in positions on the landscape similar to those of Vilas soil. They have a higher content of fine sand than the Vilas soil. Also included are a few areas where the substratum has strata or pockets of loamy sand.

Permeability is rapid in the Vilas soil. The available water capacity and natural fertility are low.

Most areas are used as woodland. Some small areas are used as cropland or pasture. This soil is suited to trees. No major hazards or limitations affect planting or harvesting. The low available water capacity, however, limits the growth of trees, especially hardwoods.

This soil is suited to corn, specialty crops, and small grain and to grasses and legumes for hay and pasture. Droughtiness, the low natural fertility, and soil blowing are the main management concerns in cultivated areas. Cover crops, field windbreaks, and a system of conservation tillage, such as chisel plowing, minimize soil loss, conserve soil moisture, and help to maintain the content of organic matter. Irrigation helps to overcome the droughtiness.

A cover of pasture plants or hay is effective in controlling soil blowing. Forage yields generally are limited because of the low natural fertility and droughtiness. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

This soil is suited to dwellings and to local roads and streets. The effluent from septic tank systems drains satisfactorily through the soil, but it can pollute ground water because of the rapid permeability.

The land capability classification is IVs. The woodland ordination symbol is 6A. The habitat type is AQV.

VsC—Vilas loamy sand, 6 to 15 percent slopes. This sloping, excessively drained soil is on knolls and side slopes on moraines, on outwash plains, and in areas of pitted outwash. Many slopes are complex. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 200 acres in size.

Typically, a mat of partially decomposed forest litter about 1 inch thick is at the surface. The surface layer is black loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 2 inches thick. The subsoil is about 19 inches thick. The upper part is dark reddish brown and reddish brown loamy sand, and the lower part is brown sand. The substratum to a depth of

Figure 6.—An area of Udorthents, nearly level and gently sloping, near Rhinelander.

about 60 inches is strong brown sand (fig. 7). In some places the upper layers are sand, loamy fine sand, or sandy loam. In other places the substratum has thin strata of red, iron-stained sand or has layers of gravel. In some areas the soil is eroded. In other areas the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are small areas of the well drained Rousseau soils. These soils make up less than 15 percent of the unit. They are in positions on the landscape similar to those of the Vilas soil. They have a higher content of fine sand than the Vilas soil. Also included are areas of stratified sandy and loamy deposits, small areas of wet soils in depressions, and some areas where the substratum has strata or pockets of loamy sand.

Permeability is rapid in the Vilas soil. The available water capacity and natural fertility are low.

Most areas are used as woodland. Some small areas are used as cropland or pasture. This soil is suited to trees. No major hazards or limitations affect planting or harvesting. The low available water capacity, however, limits the growth of trees, especially hardwoods. The slope limits the selection of landing sites. Landings can be established in areas of the nearly level or gently sloping included or adjacent soils.

This soil generally is not suited to cultivated crops. Droughtiness, the low natural fertility, soil blowing, and water erosion are management concerns.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water

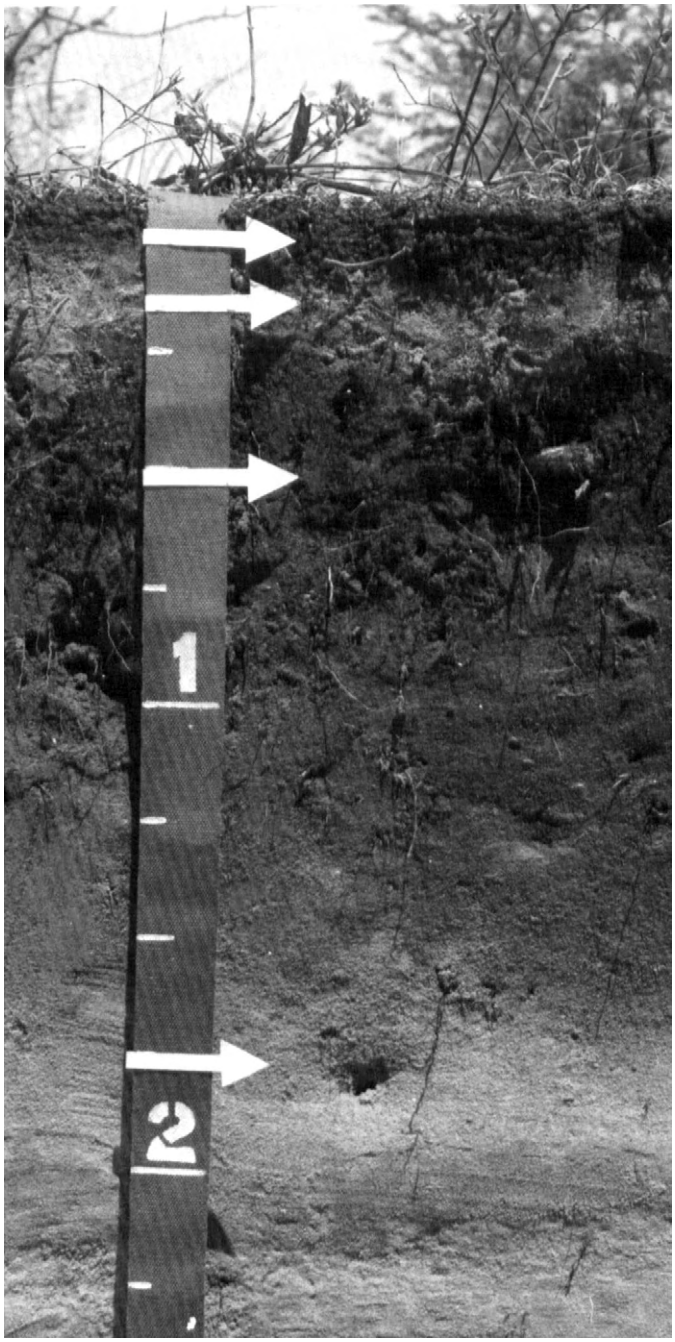

Figure 7.—Profile of Vilas loamy sand, 6 to 15 percent slopes. Depth is marked in feet.

erosion. Forage yields generally are limited because of the low natural fertility and droughtiness. Rotation grazing, restricted use during dry periods, and proper stocking rates help to keep the pasture in good condition.

The effluent from septic tank systems drains satisfactorily through this soil, but it can pollute ground water because of the rapid permeability.

Because of the slope, this soil is only moderately suited to dwellings and to local roads and streets. The slope can be overcome by cutting and filling and by designing dwellings so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIs. The woodland ordination symbol is 6A. The habitat type is AQV.

VsD—Vilas loamy sand, 15 to 25 percent slopes. This moderately steep, excessively drained soil is on knolls and side slopes on moraines, on outwash plains, and in areas of pitted outwash. Many slopes are complex. Individual areas are long and narrow or are irregularly shaped, and they generally range from 5 to 90 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is black loamy sand about 3 inches thick. The subsurface layer is brown sand about 3 inches thick. The subsoil is about 19 inches thick. The upper part is reddish brown and dark brown loamy sand, and the lower part is strong brown sand. The substratum to a depth of about 60 inches is light brown sand. In some places the upper layers are sand, loamy fine sand, or sandy loam. In other places the substratum has thin strata of red, iron-stained sand or has layers of gravel. In some areas the soil is eroded. In other areas the slope is less than 15 or more than 25 percent.

Included with this soil in mapping are small areas of the well drained Rousseau soils. These soils make up less than 15 percent of the unit. They are in positions on the landscape similar to those of the Vilas soil. They have a higher content of fine sand than the Vilas soil. Also included are areas of stratified sandy and loamy deposits, small areas of wet soils in depressions, and some areas where the substratum has strata or pockets of loamy sand.

Permeability is rapid in the Vilas soil. The available water capacity and natural fertility are low.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are the hazard of water erosion and the equipment limitation. Runoff concentrated on logging roads, skid trails, and landings results in erosion. Installing water bars, establishing out-sloping road surfaces, constructing ditches, installing culverts, and building logging roads and trails on the contour minimize erosion. Seeding exposed areas after the trees are logged helps to establish a protective plant cover.

Yarding of the logs by cable or hand planting may be necessary in areas where the slope limits the use of equipment. The slope also limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

This soil generally is not suited to cultivated crops. Droughtiness, the low natural fertility, the slope, soil blowing, and water erosion are management concerns.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Forage yields generally are limited because of the low natural fertility and droughtiness. The slope can limit the use of machinery. Rotation grazing, proper stocking rates, and restricted use during dry periods help to keep the pasture in good condition.

Because of the slope, this soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets. Cutting and filling can minimize the slope, but they may not be effective where the slope is more than about 20 percent. Better suited sites should be selected. The effluent from septic tank systems drains satisfactorily through the soil, but it can pollute ground water because of the rapid permeability. Dwellings can be designed so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIs. The woodland ordination symbol is 6R. The habitat type is AQV.

WoA—Worcester sandy loam, 0 to 3 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on flats and in depressions on outwash plains. In some areas it is subject to rare flooding. Individual areas are long and narrow or are irregularly shaped, and they generally range from 10 to 180 acres in size.

Typically, a mat of partially decomposed forest litter about 2 inches thick is at the surface. The surface layer is reddish gray sandy loam about 3 inches thick. The subsoil is about 23 inches thick. It is mottled. The upper part is dark reddish brown and dark brown sandy loam, the next part is pinkish gray sandy loam, and the lower part is dark brown loam and sandy loam. The substratum to a depth of about 60 inches is brown, stratified sand and gravel. In places the upper layers are fine sandy loam, loamy sand, loam, or silt loam. In some areas the substratum is sand, loamy sand, or sandy loam. In other areas it is stratified sandy, loamy, and silty material.

Included with this soil in mapping are small areas of Minocqua and Padus soils. These soils make up less than 10 percent of the unit. The poorly drained and very poorly drained Minocqua soils are lower on the landscape than the Worcester soil. The well drained and moderately well drained Padus soils are on the higher parts of the landscape. Also included are some areas where the Worcester soil is cobbly or stony or is less than 24 inches deep to sand and gravel.

Permeability is moderate in the subsoil of the Worcester soil and rapid or very rapid in the substratum. The available water capacity is moderate, and natural fertility is medium. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are used as woodland. Some small areas are used as cropland or pasture. This soil is suited to trees. The main concerns in managing woodland are the equipment limitation and the windthrow hazard. The use of equipment is restricted in spring, late in fall, and in other wet periods because of the seasonal high water table and low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts restrict lateral drainage and expose tree roots. Access by machinery is limited to dry periods in summer or to periods in winter when the soil is frozen or has a thick cover of snow. When the soil is wet, unsurfaced roads tend to be slippery. A gravel base is needed on sites for all-weather logging roads. Also, large culverts are needed to maintain the natural drainage system. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. They can be established in areas of the better suited adjacent soils. A shallow rooting depth, which is caused by the high water table, can result in windthrow of many trees during periods when the soil is wet and winds are strong. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If drained, this soil is suited to corn, small grain, and specialty crops and to grasses and legumes for hay and pasture. In undrained areas the seasonal high water table limits yields and the kinds of crops that can be grown. A system of conservation tillage, such as chisel plowing, helps to maintain the content of organic matter and good soil tilth.

This soil is suited to pasture. Excess water can damage forage species during wet periods. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Rotation grazing, proper

stocking rates, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and a poor filtering capacity, which results from the rapid or very rapid permeability in the substratum. In areas where the water table is below a depth of 2 feet, constructing a mound of suitable filtering material helps to overcome these limitations. In some areas the effluent can be pumped to an absorption field established on better suited soils on the higher parts of the landscape.

This soil is poorly suited to dwellings because of the seasonal high water table and the flooding. The wetness can be overcome by installing a subsurface drainage system that has a gravity outlet or another dependable outlet, by using fill material to raise the site, and by constructing basements above the level of wetness. The flooding can be overcome by directing water away from the dwellings with a diversion or dike and by shaping the construction site so that surface water is removed.

Because of the potential for frost action, this soil is poorly suited to local roads and streets. The road damage caused by frost action can be minimized by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing adequate roadside ditches, which help to drain the roadbed and maintain the natural drainage system.

The land capability classification is IIw. The woodland ordination symbol is 2W. The habitat type is TMC.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 27,900 acres in Oneida County, or nearly 3.9 percent of the land area, is prime farmland. Scattered areas of this land are throughout the county, mainly in soil associations 4 and 7, which are described under the heading "General Soil Map Units." Most of this land is used as woodland. Some areas are used for crops, mainly potatoes, oats, and hay.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

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

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

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

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

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

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

Woodland Management and Productivity

Forest resources are of major importance in Oneida County. About 73 percent of the land area in the county was forested in 1983 *(14)*. Approximately 94 percent of the forested acreage was commercial forest, and about 24 percent of the acreage of commercial forest was publicly owned.

In 1983, the composition of the commercial forest, by stand-size class, was 19 percent sawtimber, 42 percent poletimber, and 38 percent saplings and seedlings. About 1 percent of the forest land was nonstocked. The sawtimber species were dominantly red pine, white pine, and aspen and some oak, fir, birch, jack pine, and sugar maple. The poletimber, seedling, and sapling species were dominantly aspen and birch and some maple, red pine, fir, white pine, spruce, and oak. By timber type, the composition of the forest land in 1983 was about 43 percent aspen-white birch, 26 percent spruce-fir and other conifers, 15 percent sugar maple-basswood-birch, 11 percent pine, 3 percent elm-ash and other lowland hardwoods, and 2 percent oak.

In 1983, the growing stock in the county had a volume of 484,290,000 cubic feet, an annual growth of 17,015,000 cubic feet, and an annual removal of 14,693,000 cubic feet. Sawtimber had a volume of 968,341,000 board feet, an annual growth of 45,810,000 board feet, and an annual removal of 36,612,000 board feet.

Northern hardwoods are dominant in areas of soil associations 1, 2, 4, 7, 8, and 9, which are described under the heading "General Soil Map Units." Sugar maple is the dominant tree species in areas of associations 1, 2, and 4. Other important northern hardwoods in these areas include basswood, yellow birch, and white ash. The stands also include minor amounts of red maple, hemlock, balsam fir, American elm, black cherry, and white spruce. Aspen and birch stands are common but are generally replaced through natural succession by sugar maple and other northern hardwoods unless the stands are disturbed.

Sugar maple and red oak are dominant in most of the stands in areas of associations 7, 8, and 9. Basswood, hemlock, yellow birch, paper birch, red maple, white pine, red pine, white spruce, aspen, and balsam fir are in most of the stands in areas of association 7. Paper birch, red maple, white pine, red pine, aspen, and balsam fir are common in areas of

associations 8 and 9. Aspen, white birch, and red maple stands that have an understory of balsam fir also are in areas of these associations.

Associations 5 and 6 support all of the timber species evident in the county, but they are dominated by aspen and pine. The most common species are jack pine, red pine, white pine, aspen, paper birch, red maple, red oak, pin oak, and balsam fir. Repeated fires and attacks by insects and disease, past management, and the complex pattern of the different soils in these associations account for the diversity of timber species and for the changes that occur in the composition of the stands.

Pine trees originally covered much of the county. As a result of logging activities and fires, most of these trees have been replaced by aspen and paper birch.

Wooded swamps are in scattered areas throughout the county. The tree species in these areas are mainly black spruce, balsam fir, tamarack, and northern whitecedar. Some stands support red maple, American elm, black ash, paper birch, and yellow birch.

Proper management of different soils for forest products should be determined by the tree species in the stand, the suitability of the soil for the species, and the objective of the landowner. Current alternatives include selection harvest for sawlogs and even-aged management for sawlog or pulpwood production. Even-aged management that favors pine species and northern red oak is desirable if significant amounts of these species are in the stands. Other management alternatives favor northern whitecedar for the production of posts and pilings or balsam fir for the production of pulpwood. Controlling erosion, planting trees in areas where natural regeneration is unreliable, controlling the vegetation that competes with natural or artificial regeneration, increasing the seedling survival rate, minimizing windthrow in the wetter areas, timely harvesting and thinning (fig. 8), controlling the damage caused by insects and diseases, removing cull trees and undesirable species, and maintaining an optimal basal area help to keep the stands in good condition.

Water erosion can occur as a result of site preparation and cutting if the soil is exposed along roads, skid trails, and fire lanes and on landings. Burned areas also are subject to erosion. Erosion generally is a hazard on forest land if the slope is 15 percent or more and the soil is not stony. Emmert soils and some areas of Padus, Pence, Sayner, and Vilas soils are subject to erosion. Planting the trees on the contour and carefully locating skid trails and roads during harvest can help to prevent excessive soil loss.

Soil wetness can increase the seedling mortality rate and the hazard of windthrow, limit the use of equipment, and increase plant competition. Wetness results from flooding, ponding, or a water table that is at or near the surface. It is a concern on very poorly drained, poorly drained, and somewhat poorly drained soils. The seedling mortality rate can be minimized by planting vigorous nursery stock on prepared ridges or on cradle knolls. Shelterwood and strip-cut harvest methods reduce the risk of windthrow for the remaining trees and improve natural regeneration. In areas where wetness limits the use of equipment, trees should be hand planted if natural regeneration is unreliable. The use of equipment on very poorly drained, poorly drained, and somewhat poorly drained soils is frequently limited to periods when the soil is frozen, has a thick cover of snow, or is dry. Ruts form if wheeled vehicles are used during wet periods. Deep ruts restrict lateral drainage and expose tree roots.

Water ponds in small swales between cradle knolls in some areas of the somewhat poorly drained Au Gres, Magnor, Monico, Pequaming, Plover, and Worcester soils. The seedling mortality rate is high in the swales. Hand planting of trees on the cradle knolls and machine planting on prepared ridges may be needed if natural regeneration is unreliable.

Soil droughtiness can cause seedling mortality. Steep south- or west-facing slopes are especially droughty because of high temperatures and high evaporation rates. Droughtiness is a concern in areas of Croswell, Emmert, Rousseau, and Sayner soils. The seedling survival rate can be increased by planting containerized seedlings or vigorous nursery stock when the soil is moist. Reinforcement planting may be needed on very dry sites.

Slope, stoniness, and soil strength can limit the use of forestry equipment. The slope is a limitation if it is 15 percent or more. Stones on and in Cable, Goodman, Keweenaw, Magnor, Monico, and Pequaming soils interfere with the use of equipment. Trees can be planted by hand and logs yarded by cable in areas where the slope or stones limit the use of equipment. Low soil strength during the spring thaw period and during periods of high rainfall limits the use of forestry equipment. Using wheeled vehicles only when the soil is dry or has a thick cover of snow helps to prevent the formation of ruts. Deep ruts restrict lateral drainage and expose tree roots.

Soil productivity is so high on most of the forest land in the county that competition from undesirable plants is a concern where openings are made in the canopy. Plant competition can delay or prevent regeneration of desirable natural or planted species. It can be controlled by chemical or mechanical means and by a selective harvest that maintains most of the tree canopy. Skidding can destroy competing vegetation and expose mineral soil, thus allowing rapid natural regeneration.

Figure 8.—A thinned stand of pine in an area of Sayner loamy sand, 0 to 6 percent slopes.

Tables 6 and 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. Table 6 lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*; low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 6, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones and boulders on the surface, rock outcrops, soil wetness, cobble content, depth to bedrock, flooding, potential frost action, and texture. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the upper 20 inches, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in 50 years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings (fig. 9). They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Table 7 gives information about the operation of harvesting or thinning equipment in logging areas and on skid trails, log landings, and haul roads. Ratings are given for the most limiting season, and the preferred operating seasons are indicated. The most limiting seasons in Oneida County generally are spring and late fall.

In table 7, a rating of *slight* indicates that the use of conventional logging equipment is not restricted if normal logging methods are used. A rating of *moderate* indicates that the use of equipment is restricted because of one or more soil factors. If wetness is a limitation, high flotation equipment or special procedures may be needed to prevent the formation of ruts. A rating of *severe* indicates that the kinds of equipment that can be used are highly restricted.

Logging areas and skid trails include areas where some or all of the trees are being cut. Generally, equipment traffic is least intensive in logging areas. Skid trails, which generally are within the logging area, are roads or trails over which the logs are dragged or hauled from the stump to a log landing.

Log landings are areas where the logs are assembled

Figure 9.—Boring a jack pine, which is a common species on Sayner loamy sand, 0 to 6 percent slopes.

after they are cut. Wheeled equipment can be used more frequently in these areas than in any other areas used during logging activities.

Haul roads are access roads that extend from primary or other surfaced roads to the logging areas. They are constructed for use by wheeled logging equipment and logging trucks. They generally are unpaved roads, but some are graveled.

The *preferred operating seasons* are the periods when harvesting or thinning activities are likely to cause the least amount of soil damage. These seasons generally are periods when the soil is not too wet or when it is frozen or partly frozen or has a thick cover of snow.

Additional information about woodland management and productivity can be obtained from the Wisconsin Department of Natural Resources, the Soil Conservation Service, or the Cooperative Extension Service.

Forest Habitat Types

John Kotar, associate scientist, Department of Forestry, University of Wisconsin-Madison, helped prepare this section.

The types of habitat in Oneida County are classified according to the forest communities and the sites on which they develop. The classification system is derived from the "Field Guide to Forest Habitat Types of Northern Wisconsin" *(6)*. It is a systematic interpretation of the natural vegetation, especially the understory species. It is used primarily to assess the biological potential of forest sites for management of various natural resources. Although soil map units do not coincide exactly with habitat types, there is a strong correlation between them. Information about habitat types, therefore, is valuable in forest management.

The guide describes 17 upland habitat types. It provides keys to habitat type identification based on the presence or absence of diagnostic understory species; describes the understory species composition, the prevalent forest cover types (successional stages), and the expected successional trends; and summarizes the management implications for each habitat type. In combination with various tables and diagrams, the guide can be used in identifying those habitat types that are particularly well suited to management of specific tree species. Potential competing vegetation and inherent site capability are management considerations.

In the section "Detailed Soil Map Units," habitat types are assigned to the map units in the county that are used as woodland. In areas where two habitat types are associated with a soil, they are identified as primary and secondary. The primary habitat type is the one that is most common. The following paragraphs describe the habitat types in the county.

ATD—Acer-Tsuga/Dryopteris habitat type. The presumed climax overstory of this habitat type is dominated by sugar maple, eastern hemlock, and yellow birch. Although most hardwoods grow well once they are established, sugar maple tends to dominate both young and mature stands. For this reason, management is difficult for intolerant and moderately tolerant species.

The understory generally is poorly developed. There normally is no shrub layer, and the ground vegetation is sparse. The most conspicuous species are spinulose shield fern, ladyfern, wild lily of the valley, and sugar maple seedlings.

ATM—Acer-Tsuga/Maianthemum habitat type. The presumed climax overstory of this habitat type is dominated by eastern hemlock, sugar maple, and yellow birch. Successional stages, however, can be very diverse because many native tree species grow well in areas of this habitat type. Management options generally are determined by the condition of current stands rather than by site limitations.

The diversity of understory species is relatively low. The most common species are wild lily of the valley, wild sarsaparilla, large-leaved aster, and beaked hazelnut.

AQV—Acer-Quercus/Vaccinium habitat type. The presumed climax overstory of this habitat type is dominated by red maple and northern red oak and generally includes some eastern white pine. The present stands are dominated almost entirely by early successional species, such as aspen, white birch, jack pine, red pine, and eastern white pine.

The understory vegetation consists primarily of beaked hazelnut, brackenfern, blueberries, wild lily of the valley, and large-leaved aster.

This habitat type is suitable for management of the native species, including pine, aspen, and white birch. Of the hardwoods, only northern red oak and red maple are suitable for fiber production or wildlife habitat.

AViO—Acer/Viola-Osmorhiza habitat type. The presumed climax overstory of this habitat type is dominated by sugar maple. Early and mid successional stages may have a mixture of several hardwood species, including American basswood, white ash, yellow birch, and northern red oak. Except for eastern hemlock, conifers generally do not grow in areas of this habitat type. The growth potential for all native hardwoods is very high.

The understory vegetation generally is well developed, and the diversity of species is high. The most characteristic species are sweet cicely, trillium, yellow violet, ladyfern, spinulose shield fern, hairy and false Solomons seal, jack in the pulpit, and blue cohosh.

AVVib—Acer/Vaccinium-Viburnum habitat type. The presumed climax overstory of this habitat type consists of sugar maple, red maple, and northern red oak.

The shrub layer consists of mapleleaf viburnum, beaked hazelnut, and leatherwood. The ground cover tends to be poorly developed. It commonly includes large-leaved aster, brackenfern, and wild sarsaparilla.

Before the present logging activities, this habitat type was dominated by eastern white pine and red pine. Yields were very high. The present stands are dominated most commonly by aspen or mixtures of northern red oak, red maple, and sugar maple. Although sugar maple is in areas of this habitat type, it grows

slowly and tends to be deformed. The optimal species for management are northern red oak, eastern white pine, and aspen. Yields of red pine also are high, but plant competition is a concern.

PMV—Pinus/Maianthemum-Vaccinium habitat type. The presumed climax overstory of this habitat type is dominated by eastern white pine but includes balsam fir, white spruce, and red maple. Northern red oak constitutes a second canopy. The present stands are dominated mainly by mixtures of jack pine, red pine, eastern white pine, aspen, red maple and northern red oak. The understory vegetation is similar to that of the AQV habitat type, but the herb layer generally is better developed.

This habitat type is considered optimal for the management of red pine or eastern white pine because yields are nearly as high as those in areas of the more mesic habitat types. The potential for competition from hardwood species, however, is much lower. Except for northern red oak, hardwoods are suitable only for fiber production or for wildlife habitat. The potential for the production of aspen is very high.

TMC—Tsuga/Maianthemum-Coptis habitat type. The presumed climax overstory of this habitat type consists of eastern hemlock, yellow birch, red maple, and sugar maple. This habitat type commonly occurs in low areas within many of the other habitat types and as a transitional type in areas between lakeshores or swamps and the uplands. Conifers, such as balsam fir, northern whitecedar, and white spruce, also grow in areas of this habitat type. The characteristic understory species are wild lily of the valley, goldthread, bunchberry, clubmoss, and yellow beadlily. Blueberries, brackenfern, and large-leaved aster are abundant in some areas.

Eastern hemlock and yellow birch have the highest potential for forestry products, and northern whitecedar, balsam fir, and white spruce are suitable as wildlife habitat elements or for fiber production. Although sugar maple reproduces in areas of this habitat type, it grows poorly and tends to be deformed. The better drained soils are well suited to eastern white pine.

Crops and Pasture

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

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

In 1986, about 40,000 acres in Oneida County was farmland. Of this total, 100 acres was used for corn silage, 1,200 acres for oats, 1,900 acres for alfalfa hay, 1,400 acres for other hay crops, 2,150 acres for potatoes, and 1,800 acres for snap beans. The rest was used for other crops, pasture, and woodlots. Rye, wheat, and barley are grown on small acreages in some years. A short growing season limits cropping mainly to forage species, small grain, and suitable vegetables or specialty crops.

The acreage used for crops and pasture has been decreasing gradually. Many areas that formerly were used as cropland are reverting naturally to woodland. A few areas have been planted to pine trees.

The potential of the soils in Oneida County for increased food production is good. Many areas that are currently used as woodland could be cleared and used for crop production. Also, the organic soils could be used for cranberries. Food production could be increased considerably by applying the latest crop production technology to all of the cropland in the county.

Water erosion is the major management concern on about 65 percent of the cropland and pasture in the county. The erosion caused by runoff is a hazard in areas where the slope is more than about 2 percent.

Most of the soils in the county have a thin surface layer over a less fertile subsurface layer. For this reason, minimizing erosion is very important. Control of erosion minimizes the pollution of streams and lakes by sediment and protects the quality of water for municipal use, for recreation, and for fish and wildlife.

Erosion-control practices maintain a protective cover, minimize runoff, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the soil for extended periods can hold soil losses to amounts that do not reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, including grasses and legumes in the cropping sequence helps to control erosion in sloping areas, provides nitrogen to the soil, and improves soil tilth.

Contour farming slows runoff and thus helps to control erosion. Because the slopes in the county are generally short and irregular, contour stripcropping and terracing are impractical. Grassed waterways help to

prevent excessive erosion in channels and increase the rate of water infiltration by slowing runoff. Conservation tillage systems that leave protective amounts of crop residue on the surface, such as chisel planting and disk planting, increase the rate or water infiltration and help to control runoff and erosion. These systems can be used on most of the soils in the county.

Soil blowing is a concern on many of the soils in the county, especially the sandy Croswell, Karlin, Rousseau, Sayner, and Vilas soils. Areas of these soils that are cleared and used as cropland are subject to soil blowing, especially where the fields are large. Planting windbreaks or leaving natural stands of trees reduces the hazard of soil blowing. A system of conservation tillage that includes small grain and green manure crops helps to maintain a protective cover and increases the content of organic matter.

Soil drainage is a major management concern in some of the areas used for crops and pasture in the county. The poorly drained Kinross soils, the poorly drained and very poorly drained Cable, Fordum, and Minocqua soils, and the very poorly drained Carbondale, Dawson, Greenwood, Markey, Loxley, and Lupton soils are naturally so wet that production of the crops commonly grown in the county is difficult. Cranberries can be grown on some of these soils if the level of the water table is controlled. The organic Dawson, Greenwood, and Loxley soils are well suited to cranberries. If the organic soils are drained, they oxidize, subside, and are subject to soil blowing when the pore space is filled with air. Special drainage systems are needed to control the depth to the water table and the period of drainage. Keeping the water table at the level required by the crops during the growing season and raising it to the surface during other parts of the year minimizes soil blowing, oxidation, and subsidence.

Unless drained, the somewhat poorly drained Au Gres, Magnor, Monico, Pequaming, Plover, and Worcester soils are so wet that the kinds of crops that can be grown and their yields are limited during most years.

The design of both surface and subsurface drainage systems varies with the kind of soil and the particular site conditions. Draining some is impossible or impractical because of a lack of suitable outlets.

Soil fertility is naturally low in sandy soils, such as Au Gres, Croswell, Sayner, and Vilas soils. Generally, it is medium in such soils as Goodman, Magnor, Padus, Plover, and Worcester soils. The soils in the county are dominantly acid. Applications of lime are needed in areas used for alfalfa or other crops that grow best in neutral soils. The level of available potassium is naturally low in most of the soils in the county. Additions of lime and fertilizer should be based on the results of soil tests, the needs of the crops, and the desired level of yields.

Soil tilth is an important factor affecting the germination of seeds, the emergence of seedlings, and the infiltration of water. Soils that have good tilth are granular and porous. Tilling or grazing when the soil is too wet can result in poor tilth, especially if the surface layer is loam or silt loam. During periods of intensive rainfall, a crust can form in areas where the surface is bare. The crust reduces the rate of water infiltration and increases the runoff rate and the hazard of erosion. Maintaining good tilth is more difficult in eroded soils than in uneroded soils because of a lower content of organic matter. Returning crop residue to the soil and regularly adding manure or other organic material improve soil structure and tilth.

Irrigation helps to maintain a sufficient amount of available water for specialty crops, such as potatoes, snap beans, and strawberries, in areas of Croswell, Karlin, Padus, Pence, Rousseau, Sayner, and Vilas soils. Irrigation water generally is drawn from wells and ponds. Strong winds can prevent the uniform application of water from sprinkler systems. Field windbreaks and vegetative row barriers help to deflect the wind and conserve water.

Hay is an important crop for the few beef and dairy herds in the county. Mixtures of bromegrass and alfalfa or timothy and red clover are dominant. Improved pasture in the county consists of grass-legume mixtures similar to those used for hay. Unimproved pasture and pasture in the more sloping areas consist of native vegetation, which generally is of poor quality for forage.

Renovation is needed on most of the pasture in the uplands. It can be achieved by preparing a good seedbed and planting suitable mixtures of grasses and legumes. In areas of the droughty Croswell, Karlin, Rousseau, Sayner, and Vilas soils, forage yields generally are limited. The pasture should be seeded early in spring, before the surface layer has a chance to become dry. Restricted use during dry periods helps to keep the pasture in good condition. Overgrazing reduces the extent of the plant cover and increases the risks of water erosion and soil blowing. Applications of fertilizer, renovation, and controlled grazing help to maintain the plant cover. On the wetter soils, such as Au Gres, Magnor, Monico, Pequaming, Plover, and Worcester soils, grazing should be restricted during wet periods.

The specialty crops grown commercially in the county include potatoes, snap beans, cranberries, and strawberries. Potatoes commonly are grown in large, nearly level or gently sloping areas of Padus and Pence soils. These areas are suitable for the use of large

Figure 10.—Sprinkler irrigation in an area of Padus-Pence sandy loams, 1 to 6 percent slopes, used for potatoes.

equipment and for irrigation (fig. 10). Snap beans are grown in rotation with potatoes. Cranberries are grown on the acid, organic soils, such as Dawson, Greenwood, and Loxley soils (fig. 11). Strawberries are grown on a small acreage of sandy soils. Other fruits and vegetables also can be grown in the county. Blueberries, a potential specialty crop, grow wild in the county.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 8. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

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

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of

Figure 11.—Cranberry beds in an area of Greenwood, Loxley, and Dawson peats, 0 to 1 percent slopes.

weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

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

Crops other than those shown in table 8 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops *(12)*. Crops that require special management are excluded. The soils are grouped according to their

limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

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

Class I soils have few limitations or hazards that restrict their use.

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

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

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

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

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

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

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

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

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

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Windbreaks and Environmental Plantings

Oneida County has few windbreaks because it is mainly wooded and individual tracts of cropland are surrounded by natural woodland. Most homesites also are surrounded by woodland. As a result, there is little need for windbreaks, shelterbelts, or environmental plantings in the county.

A few windbreaks have been planted in areas where Padus, Pence, Sayner, and Vilas soils are used for specialty crops. Norway spruce and red pine are the most common species. The trees are planted dominantly on the western or northern side of the cropped areas. The windbreaks commonly consist of two to six rows of trees.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

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

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

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service, the Wisconsin Department of Natural Resources, or the Cooperative Extension Service or from a commercial nursery.

Recreation

Because of its lakes, rivers, streams, and woodland, Oneida County is a popular vacation area. Water

sports, such as fishing, boating, waterskiing, and swimming, are especially important. Areas near the many lakes, rivers, and streams in the county are used as sites for homes and recreational facilities. The county has more than 1,100 lakes, including two well known chains of lakes—the Three Lakes Chain and the Minocqua Chain. Three popular manmade water areas are the Willow Reservoir, the Rhinelander Flowage, and the Rainbow Flowage. Many streams in the county offer excellent opportunities for trout fishing. Muskellunge inhabit many of the lakes and the Wisconsin River.

The large wooded areas in the county provide opportunities for hunting ruffed grouse, deer, and bear. The Northern Highland American Legion State Forest, the Oneida County Forest, the Nicolet National Forest, and many large paper company holdings provide areas for camping, hiking, and hunting. A public golf course is in an area of Padus and Pence soils west of Rhinelander, near Harshaw. During winter, residents and visitors enjoy snowmobiling and cross-country skiing on the many miles of groomed trails in the county (fig. 12). Ice fishing also is very popular.

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

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

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

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

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

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

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

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

Wildlife Habitat

Thomas P. Thrall, biologist, Soil Conservation Service, helped prepare this section.

The wildlife species in Oneida County are those characteristic of the northern forested areas. The mammals include black bear, white-tailed deer, coyote, porcupine, bobcat, beaver, red fox, snowshoe hare, otter, raccoon, skunk, gray squirrel, red squirrel, mink, muskrat, and many small animals. Timber wolves also have been sighted in the county.

Ruffed grouse and woodcock are common upland

Figure 12.—A cross-country ski trail in an area of Padus loam, 0 to 6 percent slopes.

game birds. The county is a migration path but not a principal flyway for ducks and geese. Wood ducks, mallards, black ducks, and blue-winged teal are throughout the county. Mergansers, loons, and herons are common. Good populations of bald eagles and ospreys nest in the county. Several species of hawks, owls, woodpeckers, and songbirds also inhabit the county.

The abundance of wildlife species in a given area in the county depends on the types of timber and the stages of tree growth. Harvest methods directly affect these factors and thus affect the kinds of wildlife species that can thrive.

Soil affects wildlife habitat through its effect on tree species. Although there is no clear-cut division of wildlife populations based on soil map units, certain general statements can be made regarding the relationship between soils and wildlife. The following paragraphs specify the tree and wildlife species characteristic of the soil associations described under the heading "General Soil Map Units."

The Magnor-Greenwood-Cable association has a fairly good mixture of upland and lowland hardwoods and conifers and a fair amount of aspen. Because of the diversity of woodland types, the diversity of wildlife is generally good. Cut-over areas of aspen provide

habitat for ruffed grouse and white-tailed deer. Black bear also inhabit areas of this association. The extremely acid Greenwood soils generally support wetland plant species, such as sphagnum moss, leatherleaf, and scattered black spruce and tamarack. They provide habitat for some wetland wildlife species.

The uplands in the Goodman-Monico-Cable association primarily support hardwoods, such as sugar maple and American basswood. This association is not particularly well suited to habitat for white-tailed deer or ruffed grouse. The habitat for bear and bobcat is good, especially in areas where upland hardwoods are interspersed with wooded swamps.

The extremely acid Greenwood and Dawson soils in the Greenwood-Dawson-Carbondale association generally support only wetland plant species, such as sphagnum moss, leatherleaf, and scattered black spruce and tamarack. The overall value of the areas of these soils as wildlife habitat is uncertain, but the soils support some rare and interesting plants that some wildlife species specifically rely on for habitat. The nonacid Carbondale soils in this association support balsam fir, black spruce, northern whitecedar, and tag alder. These soils are extremely important to several wildlife species, including white-tailed deer, ruffed grouse, snowshoe hare, bear, and bobcat.

The Padus-Goodman association supports hardwoods, such as sugar maple and American basswood, and aspen and pine. Cut-over areas of aspen provide habitat for white-tailed deer and ruffed grouse.

The Au Gres-Croswell-Kinross association supports primarily eastern white pine, jack pine, red pine, and aspen. Balsam fir, northern whitecedar, tamarack, and spruce grow in the lowland areas. This association provides good range for white-tailed deer. Areas of aspen provide good habitat for ruffed grouse.

The Sayner-Vilas association supports native jack pine, red pine, aspen, and northern pin oak. This combination of tree species provides some of the best deer range in the county. Retaining the native jack pine and regenerating aspen by clearcutting improve the habitat for white-tailed deer, ruffed grouse, and other wildlife species.

The Padus-Pence association supports a wide range of timber types, including aspen, sugar maple, American basswood, yellow birch, and pine. It generally is considered good deer range. Some of the better grouse habitat is in areas where cuttings have fostered the development of young stands of aspen and hardwoods. Openings in this cover provide habitat for white-tailed deer and ruffed grouse.

The Keweenaw-Vilas association supports a wide variety of timber types. The soils in this association support northern pin oak and northern red oak, which provide valuable mast for squirrels, white-tailed deer, and other wildlife species.

The Goodman-Keweenaw association supports hardwoods, such as sugar maple and American basswood. Cut-over areas of aspen provide important habitat for white-tailed deer and ruffed grouse. Northern red oak provides valuable mast for squirrels, deer, and other wildlife species.

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

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

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

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

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

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

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are lambsquarters, goldenrod, and common yarrow.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, aspen, cherry, dogwood, raspberry, blackberry, beaked hazelnut, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian olive, highbush cranberry, and crabapple.

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

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

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

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

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include meadowlark, field sparrow, cottontail, and red fox.

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

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

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

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

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

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

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt

fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

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

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

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

Building Site Development

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

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

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

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

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

Sanitary Facilities

Table 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if

soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

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

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

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

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

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

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

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

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

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as

final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

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

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

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

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

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

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

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

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes

of more than 15 percent, or have a seasonal high water table at or near the surface.

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

Water Management

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

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

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

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

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

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

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

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

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

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

Soil Properties

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

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

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

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

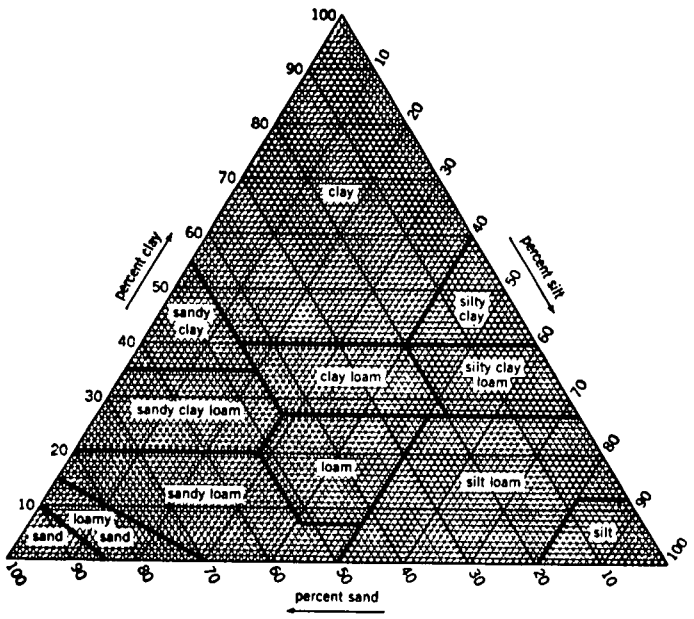

Figure 13.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

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

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

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 13). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

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

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

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

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

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

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

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

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

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

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

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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

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

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

fertility and stabilization, and in determining the risk of corrosion.

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

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

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

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

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

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

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

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

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

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist

mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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

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

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

If a soil is assigned to two hydrologic groups in table 18, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

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

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months.

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

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

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 18 shows the expected total subsidence, which usually is a result of drainage and oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

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

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or

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

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

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

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Wisconsin Department of Transportation, Division of Highways and Transportation Facilities.

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

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

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(13)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Spodosol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquod (*Aqu*, meaning water, plus *od*, from Spodosol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquods (*Hapl*, meaning minimal horizonation, plus *aquod*, the suborder of the Spodosols that has an aquic moisture regime).

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

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

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

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(11)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(13)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

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

Alcona Series

The Alcona series consists of moderately well drained soils on glacial lake plains, outwash plains, and moraines. These soils formed in loamy and sandy deposits underlain by stratified loamy, silty, and sandy

lacustrine deposits. Permeability is moderate or moderately rapid in the upper part of the profile and moderate in the lower part of the subsoil and in the substratum. Slope ranges from 0 to 15 percent.

Typical pedon of Alcona fine sandy loam, 6 to 15 percent slopes, 1,600 feet north of the southwest corner of sec. 10, T. 37 N., R. 9 E.

Oe—2 inches to 0; mat of partially decomposed forest litter.
E—0 to 3 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/1) dry; weak medium platy structure; very friable; many roots; strongly acid; abrupt wavy boundary.
Bs1—3 to 6 inches; dark brown (7.5YR 4/4) fine sandy loam; moderate medium subangular blocky structure; friable; many roots; strongly acid; clear wavy boundary.
Bs2—6 to 9 inches; strong brown (7.5YR 5/6) fine sandy loam; moderate medium subangular blocky structure; friable; many roots; medium acid; clear wavy boundary.
E'—9 to 16 inches; brown (10YR 5/3) loamy fine sand; weak medium subangular blocky structure; very friable; common roots; medium acid; clear wavy boundary.
Bt—16 to 29 inches; dark brown (10YR 4/3) fine sandy loam; moderate medium subangular blocky structure; friable; few roots; thin patchy dark brown (10YR 3/3) clay films on faces of some peds; brown (10YR 5/3) coatings of loamy fine sand on faces of some peds; medium acid; abrupt wavy boundary.
BC—29 to 35 inches; dark yellowish brown (10YR 4/4) loamy fine sand; weak medium subangular blocky structure; very friable; medium acid; gradual wavy boundary.
C—35 to 60 inches; dark yellowish brown (10YR 4/4), brown (10YR 5/3), and yellowish brown (10YR 5/4), stratified very fine sandy loam and silt loam; many medium distinct and prominent strong brown (7.5YR 4/6) mottles; massive; friable; medium acid.

The solum ranges from 24 to 45 inches in thickness. It is dominantly fine sandy loam, but it has strata of silt loam, sandy loam, very fine sandy loam, loamy fine sand, or very fine sand in most pedons.

Some pedons have an A horizon. This horizon has hue of 10YR, value of 3, and chroma of 1 or 2. It is less than 4 inches thick. The E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 or 3. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 4 to 6. The E' horizon has hue of 10YR or 7.5YR and chroma of 2 to 4. The Bt horizon has hue of 10YR or 7.5YR and chroma of 3 or 4. It is fine sandy loam or sandy loam. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It typically is stratified very fine sandy loam and silt loam, but in some pedons it is stratified loamy fine sand, fine sandy loam, silt, sandy loam, or sand.

Au Gres Series

The Au Gres series consists of somewhat poorly drained, rapidly permeable soils on outwash plains. These soils formed in sandy glacial outwash. Slope ranges from 0 to 2 percent.

Typical pedon of Au Gres loamy sand, 0 to 2 percent slopes, 2,300 feet west and 1,300 feet north of the southeast corner of sec. 14, T. 38 N., R. 11 E.

Oe—2 inches to 0; mat of partially decomposed forest litter.
A—0 to 3 inches; black (10YR 2/1) loamy sand, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; very friable; many roots; many uncoated sand grains; very strongly acid; abrupt smooth boundary.
E—3 to 7 inches; brown (7.5YR 5/2) sand, pinkish gray (7.5YR 7/2) dry; weak medium subangular blocky structure; very friable; many roots; very strongly acid; abrupt smooth boundary.
Bhs—7 to 10 inches; dark reddish brown (5YR 3/3) loamy sand; common fine distinct yellowish red (5YR 5/6) and few medium distinct pinkish gray (5YR 6/2) mottles; weak medium subangular blocky structure; very friable; many roots; very strongly acid; clear wavy boundary.
Bs—10 to 14 inches; dark reddish brown (5YR 3/4) sand; many medium distinct yellowish red (5YR 5/6) and common medium distinct pinkish gray (5YR 6/2) mottles; weak medium subangular blocky structure; very friable; common roots; very strongly acid; clear wavy boundary.
BC—14 to 25 inches; strong brown (7.5YR 5/6) sand; many coarse distinct yellowish red (5YR 5/6) and common medium prominent pinkish gray (5YR 6/2) mottles; weak coarse subangular blocky structure; very friable; few roots; medium acid; gradual wavy boundary.
C—25 to 60 inches; brown (7.5YR 5/4) sand; common fine and medium prominent yellowish red (5YR 5/6) and pinkish gray (5YR 6/2) mottles; single grain; loose; medium acid.

The solum ranges from 20 to 42 inches in thickness. The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. It is less than 4 inches thick. The E horizon has hue of 10YR or 7.5YR, value of 5 or

6, and chroma of 1 or 2. The Bs horizon has hue of 7.5YR or 5YR, value of 3 to 5, and chroma of 4 to 6. In some pedons it has small, discontinuous fragments of ortstein, which generally make up less than 20 percent of the volume. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4.

Cable Series

The Cable series consists of poorly drained and very poorly drained soils on moraines. These soils formed in loamy deposits and in the underlying sandy loam glacial till. Permeability is moderate or moderately slow in the subsoil and is moderately slow in the substratum. Slope ranges from 0 to 3 percent. Stones are in the surface layer in most areas.

Typical pedon of Cable muck, 0 to 3 percent slopes, stony, 1,300 feet north and 1,950 feet west of the southeast corner of sec. 3, T. 36 N., R. 11 E.

Oa—0 to 3 inches; sapric material, black (10YR 2/1) broken face and rubbed; about 20 percent fiber, 5 percent rubbed; weak fine granular structure; very friable; many roots; very strongly acid (pH by Truog method); clear smooth boundary.

A—3 to 5 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; many roots; very strongly acid; abrupt wavy boundary.

Eg—5 to 10 inches; dark gray (10YR 4/1) loam, light brownish gray (10YR 6/2) dry; moderate thick platy structure; friable; many roots; very strongly acid; abrupt wavy boundary.

Bg1—10 to 20 inches; dark grayish brown (10YR 4/2) loam; common fine faint light brownish gray (10YR 6/2) and many medium prominent yellowish brown (10YR 5/8) mottles; moderate medium and coarse subangular blocky structure; friable; few roots; very strongly acid; clear wavy boundary.

Bg2—20 to 31 inches; grayish brown (10YR 5/2) loam; many medium prominent red (2.5YR 5/8), few fine faint light brownish gray (10YR 6/2), and many medium prominent strong brown (7.5YR 5/8) mottles; moderate coarse subangular blocky structure; friable; strongly acid; clear wavy boundary.

2BC—31 to 34 inches; brown (7.5YR 5/2) sandy loam; many medium distinct dark brown (7.5YR 4/4), many coarse prominent yellowish red (5YR 4/6), and many medium prominent yellowish red (5YR 5/8) mottles; moderate thick platy structure; friable; about 10 percent gravel and cobbles; medium acid; clear wavy boundary.

2C—34 to 60 inches; dark brown (7.5YR 4/4) sandy loam; many coarse prominent yellowish red (5YR 5/8 and 4/6) and many medium distinct brown (7.5YR 5/2) mottles; massive; friable; about 10 percent gravel and cobbles; medium acid.

The solum ranges from 18 to 36 inches in thickness. Cobbles and stones are throughout the profile in most areas.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is less than 6 inches thick. The Eg horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 1 or 2. The Bg horizon also has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 1 or 2. It is sandy loam, loam, or silt loam. The 2C horizon has hue of 7.5YR or 5YR, value of 3 to 6, and chroma of 2 to 4. It is sandy loam, loamy sand, or the gravelly analogs of those textures.

Carbondale Series

The Carbondale series consists of very poorly drained soils in depressions and basins on outwash plains and moraines. These soils formed primarily in herbaceous material. Permeability is moderately slow to moderately rapid. Slope is 0 to 1 percent.

Typical pedon of Carbondale muck, in an area of Carbondale, Lupton, and Markey mucks, 0 to 1 percent slopes, 2,000 feet west and 2,100 feet north of the southeast corner of sec. 36, T. 36 N., R. 8 E.

Oa1—0 to 21 inches; sapric material, black (10YR 2/1) broken face and rubbed; about 25 percent fiber, 5 percent rubbed; weak medium subangular blocky structure; primarily herbaceous fibers; slightly acid (pH by Truog method); clear smooth boundary.

Oa2—21 to 35 inches; sapric material, black (10YR 2/1) broken face and rubbed; about 40 percent fiber, 10 percent rubbed; massive; primarily herbaceous fibers; slightly acid (pH by Truog method); clear wavy boundary.

Oe—35 to 60 inches; hemic material, very dark grayish brown (10YR 3/2) broken face, very dark brown (10YR 2/2) rubbed; about 60 percent fiber, 25 percent rubbed; massive; primarily herbaceous fibers; slightly acid (pH by Truog method).

The organic material is more than 51 inches thick. It has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The surface tier is primarily sapric material, but some pedons have thin layers of hemic or fibric material in the upper part. The subsurface tier is dominantly sapric material, but some pedons have layers of hemic material. The bottom tier commonly is hemic material,

but some pedons have thin layers of sapric material. In some pedons thin layers of fibric material are in the subsurface tier, the bottom tier, or both.

Croswell Series

The Croswell series consists of moderately well drained soils on outwash plains. These soils formed in sandy glacial outwash. Permeability is rapid in most areas. In areas where the soil has a loamy substratum, however, permeability is rapid in the sandy upper part of the profile and moderately slow in the underlying stratified silty, loamy, and sandy deposits. Slope ranges from 0 to 3 percent.

Typical pedon of Croswell sand, 0 to 3 percent slopes, 700 feet north and 1,400 feet east of the southwest corner of sec. 31, T. 39 N., R. 11 E.

Oe—1 inch to 0; mat of partially decomposed forest litter.
E—0 to 4 inches; brown (7.5YR 5/2) sand, pinkish gray (7.5YR 6/2) dry; weak fine subangular blocky structure; very friable; many roots; very strongly acid; clear wavy boundary.
Bs1—4 to 8 inches; dark reddish brown (5YR 3/4) loamy sand; weak medium subangular blocky structure; very friable; many roots; strongly acid; clear wavy boundary.
Bs2—8 to 22 inches; dark brown (7.5YR 4/4) sand; weak fine subangular blocky structure; very friable; common roots; medium acid; clear wavy boundary.
BC—22 to 38 inches; strong brown (7.5YR 5/6) sand; few fine distinct strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; very friable; few roots; slightly acid; clear wavy boundary.
C1—38 to 50 inches; yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4) sand; many medium prominent strong brown (7.5YR 5/8) mottles; single grain; loose; medium acid; gradual wavy boundary.
C2—50 to 60 inches; pale brown (10YR 6/3) sand; many coarse prominent strong brown (7.5YR 5/8) and common fine faint light gray (10YR 7/2) mottles; single grain; loose; medium acid.

The solum ranges from 24 to 40 inches in thickness. Some pedons have an A horizon. This horizon has hue of 10YR to 5YR, value of 2 or 3, and chroma of 1 or 2. It is less than 4 inches thick. The E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 1 or 2. It is sand or loamy sand. The Bs horizon has hue of 7.5YR or 5YR, value of 3 to 5, and chroma of 4 to 6. It is loamy sand or sand. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. Some pedons have stratified very fine sandy loam, fine sandy loam, silt loam, very fine sand, or fine sand below a depth of 40 inches.

Dawson Series

The Dawson series consists of very poorly drained soils in depressions and basins on outwash plains and moraines. These soils formed primarily in herbaceous material and sphagnum moss over sandy glacial outwash. Permeability is moderately slow to moderately rapid in the organic material and is rapid in the sandy substratum. Slope is 0 to 1 percent.

Typical pedon of Dawson peat, in an area of Greenwood, Loxley, and Dawson peats, 0 to 1 percent slopes, 1,200 feet west and 650 feet north of the southeast corner of sec. 31, T. 38 N., R. 8 E.

Oi—0 to 4 inches; fibric material, dark reddish brown (5YR 3/4) broken face and rubbed; about 95 percent fiber, 90 percent rubbed; massive; primarily sphagnum moss fibers; extremely acid (pH by Truog method); abrupt smooth boundary.
Oa1—4 to 14 inches; sapric material, dark reddish brown (5YR 2/2) broken face and rubbed; about 40 percent fiber, 4 percent rubbed; weak thick platy structure; primarily herbaceous fibers; few charcoal fragments; extremely acid (pH by Truog method); abrupt wavy boundary.
Oa2—14 to 24 inches; sapric material, dark reddish brown (5YR 2/2) broken face and rubbed; about 20 percent fiber, 3 percent rubbed; weak thick platy structure; primarily herbaceous fibers; about 5 percent sand; few charcoal fragments; extremely acid (pH by Truog method); clear wavy boundary.
Oa3—24 to 33 inches; sapric material, black (5YR 2/1) broken face and rubbed; about 10 percent fiber, 3 percent rubbed; massive; primarily herbaceous fibers; about 5 percent sand; extremely acid (pH by Truog method); clear wavy boundary.
Oa4—33 to 35 inches; sapric material, dark reddish brown (5YR 2/2) broken face and rubbed; about 10 percent fiber, 3 percent rubbed; massive; primarily herbaceous fibers; about 10 percent sand; extremely acid (pH by Truog method); abrupt smooth boundary.
C1—35 to 44 inches; brown (10YR 4/3) sand; single grain; loose; about 5 percent gravel; slightly acid; clear wavy boundary.
C2—44 to 60 inches; brown (10YR 5/3) sand; single grain; loose; about 3 percent gravel; slightly acid.

The thickness of the organic material commonly is 20 to 39 inches, but it ranges from 16 to 51 inches. The

surface tier has hue of 10YR, 7.5YR, or 5YR, value of 2 to 4, and chroma of 1 to 4. The subsurface and bottom tiers have hue of 10YR, 7.5YR, or 5YR, value of 2 to 4, and chroma of 1 to 3. They are primarily sapric material, but some pedons have thin layers of fibric or hemic material. The C horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 4 to 6, and chroma of 1 to 4, or it is neutral in hue and has value of 4 to 6.

Emmert Series

The Emmert series consists of excessively drained, very rapidly permeable soils in areas of pitted outwash and on eskers and eskerlike ridges. These soils formed in outwash of very gravelly sand. Slope ranges from 20 to 45 percent.

Typical pedon of Emmert very gravelly sand, 20 to 45 percent slopes, 2,000 feet south and 1,950 feet east of the northwest corner of sec. 19, T. 38 N., R. 10 E.

A—0 to 2 inches; black (10YR 2/1) very gravelly sand, very dark gray (10YR 3/1) dry; weak very fine granular structure; very friable; many roots; about 40 percent gravel; medium acid; abrupt wavy boundary.
Bw—2 to 22 inches; reddish brown (5YR 4/4) and yellowish red (5YR 4/6) very gravelly sand; single grain; loose; common roots; about 55 percent gravel and cobbles; strongly acid; clear wavy boundary.
C—22 to 60 inches; yellowish red (5YR 4/6) very gravelly sand; single grain; loose; few roots; about 60 percent gravel and cobbles; slightly acid.

The solum ranges from 12 to 28 inches in thickness. The content of gravel and cobbles ranges from 35 to 60 percent in the B and C horizons.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 or 4, and chroma of 2 to 6. The C horizon has hue of 7.5YR or 5YR, value of 3 to 5, and chroma of 3 to 6.

Fordum Series

The Fordum series consists of poorly drained and very poorly drained soils on flood plains. These soils formed primarily in loamy alluvium. Permeability is moderate or moderately rapid in the upper part of the profile and rapid or very rapid in the lower part. Slope ranges from 0 to 2 percent.

Typical pedon of Fordum mucky very fine sandy loam, 0 to 2 percent slopes, 100 feet west and 200 feet south of the northeast corner of sec. 14, T. 36 N., R. 8 E.

A—0 to 7 inches; very dark brown (10YR 2/2) mucky very fine sandy loam, grayish brown (10YR 5/2) dry; weak medium and coarse granular structure; very friable; many roots; neutral; abrupt wavy boundary.
Cg1—7 to 28 inches; dark grayish brown (10YR 4/2) very fine sandy loam; many medium and coarse distinct dark yellowish brown (10YR 4/6) mottles; massive; very friable; few roots; mildly alkaline; abrupt wavy boundary.
Cg2—28 to 37 inches; dark grayish brown (10YR 4/2) loamy very fine sand; few fine distinct yellowish brown (10YR 5/6) mottles; massive; very friable; moderately alkaline; abrupt wavy boundary.
Cg3—37 to 39 inches; dark gray (10YR 4/1) very fine sandy loam; massive; very friable; moderately alkaline; abrupt wavy boundary.
Cg4—39 to 60 inches; dark grayish brown (10YR 4/2) sand; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; moderately alkaline.

The depth to sand or loamy sand ranges from 24 to 40 inches. The A horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 2 or 3, and chroma of 1 to 3, or it is neutral in hue and has value of 2 or 3. It is less than 10 inches thick. Some pedons have a surface layer of muck as much as 6 inches thick.

The C or Cg horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 1 to 3. In the upper part it is primarily stratified silt loam, loam, sandy loam, fine sandy loam, or very fine sandy loam, but many pedons have subhorizons of fine sand, very fine sand, loamy fine sand, loamy very fine sand, or the mucky analogs of those textures and some pedons have thin layers of muck. The lower part of the C or Cg horizon is typically sand, but in some pedons it is fine sand, loamy sand, loamy fine sand, gravelly sand, or very gravelly sand.

Goodman Series

The Goodman series consists of well drained and moderately well drained soils on drumlins and moraines. These soils formed in silty material and in the underlying gravelly loamy sand or gravelly sandy loam glacial till. Permeability is moderate. Slope ranges from 1 to 25 percent. Stones are in the surface layer in most areas.

Typical pedon of Goodman silt loam, 1 to 6 percent slopes, stony, 50 feet south and 2,260 feet west of the northeast corner of sec. 10, T. 36 N., R. 11 E.

Oe—2 inches to 0; mat of partially decomposed forest litter.
E—0 to 3 inches; brown (7.5YR 5/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium

subangular blocky structure; very friable; many roots; medium acid; clear wavy boundary.
Bs1—3 to 8 inches; dark reddish brown (5YR 3/4) silt loam; weak medium subangular blocky structure; very friable; many roots; about 5 percent gravel; strongly acid; clear wavy boundary.
Bs2—8 to 15 inches; dark brown (7.5YR 4/4) silt loam; weak medium subangular blocky structure; very friable; common roots; about 5 percent gravel; medium acid; clear wavy boundary.
E′—15 to 23 inches; brown (7.5YR 5/3) silt loam, pink (7.5YR 7/3) dry; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium and thick platy structure; friable; few roots; about 8 percent gravel; medium acid; clear wavy boundary.
2B/E—23 to 38 inches; about 65 percent dark brown (7.5YR 4/4) gravelly sandy loam (Bt); about 35 percent tongues and coatings of brown (7.5YR 5/3) gravelly loamy sand on faces of some peds, pink (7.5YR 7/3) dry (E′); common fine and medium distinct strong brown (7.5YR 5/6) mottles; moderate medium and coarse subangular blocky structure; friable; clay bridges between some sand grains; about 30 percent gravel and cobbles; strongly acid; gradual irregular boundary.
2C—38 to 60 inches; dark brown (7.5YR 4/4) gravelly loamy sand; massive; friable; few pockets of sandy loam throughout the horizon; about 30 percent gravel and cobbles; medium acid.

The solum ranges from 30 to 50 inches in thickness. The thickness of the silty mantle ranges from 15 to 35 inches. Cobbles and stones are throughout the profile in most areas.

Some pedons have an A horizon. This horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 to 3, or it is neutral in hue and has value of 2 or 3. It is less than 4 inches thick. The E horizon has hue of 7.5YR or 5YR and value of 5 or 6. The E′ horizon has hue of 10YR or 7.5YR and chroma of 2 or 3. The E′ part of the 2B/E horizon has hue of 10YR or 7.5YR and chroma of 3 or 4. It is sandy loam, loamy sand, or the gravelly analogs of those textures. The Bt part of this horizon has hue of 7.5YR or 5YR. In some pedons the lower part of the sequum is characterized by brittleness similar to that of a fragipan. The 2C horizon has hue of 7.5YR or 5YR and value of 3 to 5. It is sandy loam, loamy sand, or the gravelly analogs of those textures.

Greenwood Series

The Greenwood series consists of very poorly drained soils in depressions and basins on outwash plains and moraines. These soils formed primarily in herbaceous material and sphagnum moss. Permeability is moderate or moderately rapid. Slope is 0 to 1 percent.

Typical pedon of Greenwood peat, in an area of Greenwood, Loxley, and Dawson peats, 0 to 1 percent slopes, 1,200 feet south and 1,150 feet east of the northwest corner of sec. 3, T. 36 N., R. 8 E.

Oi—0 to 9 inches; fibric material, brown (10YR 4/3) broken face, dark yellowish brown (10YR 4/4) rubbed; about 95 percent fiber, 85 percent rubbed; massive; primarily live roots and sphagnum moss fibers; extremely acid (pH by Truog method); abrupt wavy boundary.
Oe1—9 to 42 inches; hemic material, dark brown (7.5YR 3/2) broken face and rubbed; about 75 percent fiber, 30 percent rubbed; massive; primarily herbaceous fibers; extremely acid (pH by Truog method); clear wavy boundary.
Oe2—42 to 60 inches; hemic material, dark brown (7.5YR 3/2) broken face and rubbed; about 50 percent fiber, 25 percent rubbed; massive; primarily herbaceous fibers; extremely acid (pH by Truog method).

The organic material is more than 51 inches thick. The surface tier has hue of 10YR, 7.5YR, or 5YR, value of 3 or 4, and chroma of 2 to 4. The subsurface and bottom tiers have hue of 10YR, 7.5YR, or 5YR and value and chroma of 2 or 3. They are dominantly hemic material, but some pedons have thin layers of sapric or fibric material.

Karlin Series

The Karlin series consists of somewhat excessively drained soils on outwash plains. These soils formed primarily in sandy glacial outwash. Permeability is moderately rapid in the subsoil and rapid in the substratum. Slope ranges from 0 to 6 percent.

Typical pedon of Karlin loamy fine sand, 0 to 6 percent slopes, 5,080 feet south and 3,860 feet west of the northeast corner of sec. 30, T. 37 N., R. 10 E.

Oe—1 inch to 0; mat of partially decomposed forest litter.
E—0 to 4 inches; brown (7.5YR 4/2) loamy fine sand, brown (7.5YR 5/2) dry; weak very thick platy structure parting to moderate medium subangular blocky; very friable; many roots; very strongly acid; abrupt wavy boundary.
Bhs—4 to 6 inches; dark reddish brown (5YR 3/3) loamy fine sand; moderate medium and coarse subangular blocky structure; very friable; many

roots; strongly acid; clear wavy boundary.
Bs—6 to 17 inches; dark brown (7.5YR 4/4) loamy fine sand; weak medium subangular blocky structure; very friable; common roots; medium acid; gradual wavy boundary.
BC—17 to 32 inches; brown (7.5YR 4/4) loamy fine sand; weak fine subangular blocky structure; very friable; few roots; medium acid; gradual wavy boundary.
C—32 to 60 inches; brown (7.5YR 5/4) sand; single grain; loose; medium acid.

The solum ranges from 20 to 40 inches in thickness. Some pedons have an A horizon. This horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2. It is less than 4 inches thick. The E horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 or 5, and chroma of 1 or 2. The Bs horizon has hue of 7.5YR or 5YR and value and chroma of 3 or 4. The Bhs and Bs horizons are loamy sand, loamy fine sand, or sandy loam. The C horizon has hue of 10YR or 7.5YR and value and chroma of 4 to 6.

Keweenaw Series

The Keweenaw series consists of well drained and moderately well drained soils on drumlins and water-worked moraines. These soils formed in loamy and sandy deposits and in the underlying gravelly loamy sand glacial drift. Permeability is moderate or moderately rapid in the subsoil and moderately rapid in the substratum. Slope ranges from 1 to 30 percent. Stones are in the surface layer in most areas.

Typical pedon of Keweenaw sandy loam, 6 to 15 percent slopes, stony, 2,400 feet east and 500 feet north of the southwest corner of sec. 18, T. 36 N., R. 7 E.

Oe—1 inch to 0; mat of partially decomposed forest litter.
A—0 to 1 inch; black (N 2/0) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many roots; about 10 percent gravel and cobbles; very strongly acid; clear wavy boundary.
E—1 to 2 inches; dark brown (7.5YR 4/2) loamy sand, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; very friable; many roots; about 10 percent gravel and cobbles; very strongly acid; clear wavy boundary.
Bs1—2 to 5 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; many roots; about 5 percent gravel; strongly acid; clear wavy boundary.
Bs2—5 to 23 inches; brown (7.5YR 4/4) gravelly loamy sand; weak medium subangular blocky structure; very friable; many roots; about 25 percent gravel and cobbles; strongly acid; clear wavy boundary.
E/B—23 to 35 inches; about 70 percent brown (7.5YR 5/3) gravelly loamy sand, pink (7.5YR 7/3) dry (E′); about 30 percent isolated remnants of dark brown (7.5YR 4/4) gravelly sandy loam (Bt); moderate fine and medium subangular blocky structure; firm; few roots; slightly brittle; clay bridges between some sand grains; about 30 percent gravel and cobbles; medium acid; gradual irregular boundary.
B/E—35 to 55 inches; about 60 percent dark brown (7.5YR 4/4) gravelly sandy loam (Bt); about 40 percent tongues and coatings of brown (7.5YR 5/3) gravelly loamy sand on faces of some peds, pink (7.5YR 7/3) dry (E′); moderate medium and coarse subangular blocky structure; firm; slightly brittle; clay bridges between some sand grains; about 35 percent gravel and cobbles; medium acid; gradual irregular boundary.
C—55 to 60 inches; brown (7.5YR 4/4) gravelly loamy sand; massive; friable; about 30 percent gravel and cobbles; medium acid.

The solum ranges from 30 to 55 inches in thickness. Cobbles and stones are throughout the profile in most areas.

The A horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 7.5YR or 5YR and value of 4 to 6. The Bs horizon has hue of 7.5YR or 5YR, value of 3 to 5, and chroma of 4 to 6. The E′ part of the E/B and B/E horizons has hue of 7.5YR or 5YR, value of 5 or 6, and chroma of 2 or 3. It is sand, loamy sand, loamy fine sand, or the gravelly analogs of those textures. The Bt part of these horizons has hue of 7.5YR or 5YR and value and chroma of 3 or 4. It is sandy loam, loamy sand, fine sandy loam, or the gravelly analogs of those textures. The C horizon has hue of 7.5YR or 5YR and value and chroma of 4 to 6. It is dominantly loamy sand or gravelly loamy sand, but some pedons have pockets or strata of sandy loam.

Kinross Series

The Kinross series consists of poorly drained soils on outwash plains. These soils formed in sandy glacial outwash. Permeability is rapid. Slope ranges from 0 to 2 percent.

Typical pedon of Kinross muck, 0 to 2 percent slopes, 700 feet west and 3,600 feet north of the southeast corner of sec. 31, T. 37 N., R. 10 E.

Oa—0 to 5 inches; sapric material, black (10YR 2/1) broken face and rubbed; about 25 percent fiber, 5 percent rubbed; weak fine granular structure; very friable; many roots; very strongly acid (pH by Truog method); clear smooth boundary.

E—5 to 10 inches; brown (7.5YR 5/2) sand, light gray (10YR 7/1) dry; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; many roots; very strongly acid; clear wavy boundary.

Bhs—10 to 13 inches; dark reddish brown (5YR 3/3) loamy sand; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; common roots; very strongly acid; clear wavy boundary.

Bs—13 to 17 inches; dark brown (7.5YR 4/4) loamy sand; many medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; few roots; very strongly acid; clear wavy boundary.

BC—17 to 29 inches; brown (7.5YR 5/4) sand; many fine distinct strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; very friable; strongly acid; clear wavy boundary.

C—29 to 60 inches; brown (10YR 5/3) sand; few fine and medium prominent strong brown (7.5YR 5/6) mottles; single grain; loose; slightly acid.

The solum ranges from 16 to 40 inches in thickness. The Oa horizon is less than 6 inches thick. Some pedons have an A horizon. This horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. It is less than 6 inches thick. The E horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 5 or 6, and chroma of 1 or 2. The Bhs horizon has hue of 7.5YR or 5YR and value and chroma of 2 or 3. The Bs horizon has hue of 7.5YR or 5YR, value of 3 to 5, and chroma of 4 to 6. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4.

Loxley Series

The Loxley series consists of very poorly drained soils in depressions and basins on outwash plains and moraines. These soils formed primarily in herbaceous material and sphagnum moss. Permeability is moderately slow to moderately rapid. Slope is 0 to 1 percent.

Typical pedon of Loxley peat, in an area of Greenwood, Loxley, and Dawson peats, 0 to 1 percent slopes, 2,540 feet north and 1,420 feet east of the southwest corner of sec. 2, T. 39 N., R. 6 E.

Oi—0 to 4 inches; fibric material, dark brown (10YR 3/3) and dark yellowish brown (10YR 3/4) broken face and rubbed; about 95 percent fiber, 90 percent rubbed; massive; primarily sphagnum moss fibers; few branches and twigs; very strongly acid (pH by Truog method); abrupt smooth boundary.

Oa1—4 to 7 inches; sapric material, very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; about 45 percent fiber, 10 percent rubbed; massive; primarily herbaceous fibers; few branches and twigs; extremely acid (pH by Truog method); clear wavy boundary.

Oa2—7 to 47 inches; sapric material, very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; about 35 percent fiber, 8 percent rubbed; massive; primarily herbaceous fibers; few branches and twigs; extremely acid (pH by Truog method); clear wavy boundary.

Oe—47 to 51 inches; hemic material, very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; about 60 percent fiber, 20 percent rubbed; massive; primarily herbaceous fibers; few branches and twigs; very strongly acid (pH by Truog method); clear wavy boundary.

Oa'—51 to 60 inches; sapric material, very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; about 50 percent fiber, 4 percent rubbed; massive; primarily herbaceous fibers; few branches and twigs; very strongly acid (pH by Truog method).

The organic material is more than 51 inches thick. The surface tier has hue of 10YR, 7.5YR, or 5YR and value and chroma of 2 to 4. The subsurface and bottom tiers have hue of 10YR, 7.5YR, or 5YR and value and chroma of 2 or 3. They are dominantly sapric material, but some pedons have thin layers of hemic or fibric material.

Lupton Series

The Lupton series consists of very poorly drained soils in depressions and basins on outwash plains and moraines. These soils formed primarily in woody organic material. Permeability is moderately slow to moderately rapid. Slope is 0 to 1 percent.

Typical pedon of Lupton muck, in an area of Carbondale, Lupton, and Markey mucks, 0 to 1 percent slopes, 1,600 feet north and 400 feet east of the southwest corner of sec. 30, T. 35 N., R. 11 E.

Oa1—0 to 12 inches; sapric material, black (N 2/0) broken face, black (5YR 2/1) rubbed; about 15 percent fiber, 5 percent rubbed; weak medium subangular blocky structure parting to weak fine granular; primarily woody fibers; common branches

and twigs; neutral (pH by Truog method); clear smooth boundary.

Oa2—12 to 40 inches; sapric material, black (N 2/0) broken face, dark reddish brown (5YR 2/2) rubbed; about 20 percent fiber, 5 percent rubbed; weak medium and fine subangular blocky structure; primarily woody fibers; few branches and twigs; neutral (pH by Truog method); clear smooth boundary.

Oa3—40 to 60 inches; sapric material, black (5YR 2/1) broken face and rubbed; about 30 percent fiber, 6 percent rubbed; massive; primarily woody fibers; common branches and twigs; slightly acid (pH by Truog method).

The organic material is more than 51 inches thick. The surface tier has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. It is primarily sapric material, but some pedons have a thin layer of fibric or hemic material in the upper part. The subsurface and bottom tiers have hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 to 3, or they are neutral in hue and have value of 2 or 3. They are dominantly sapric material, but some pedons have thin layers of fibric or hemic material.

Magnor Series

The Magnor series consists of somewhat poorly drained soils on moraines. These soils formed in silty material and in the underlying loamy glacial till. Permeability is moderate in the silty mantle and very slow in the substratum. Slope ranges from 1 to 6 percent. Stones are in the surface layer in most areas.

Typical pedon of Magnor silt loam, 1 to 6 percent slopes, stony, 2,600 feet west and 100 feet north of the southeast corner of sec. 30, T. 36 N., R. 4 E.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; many roots; very strongly acid; clear wavy boundary.

E—4 to 8 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; few fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; many roots; many wormcasts; very strongly acid; clear wavy boundary.

E/B—8 to 17 inches; about 70 percent grayish brown (10YR 5/2) silt loam (E); about 30 percent isolated remnants of dark brown (7.5YR 4/4) silt loam (Bt); many medium and coarse prominent strong brown (7.5YR 4/6) and few fine faint pinkish gray (7.5YR 6/2) mottles; moderate medium platy structure; friable; few roots; very strongly acid; clear wavy boundary.

B/E—17 to 29 inches; about 70 percent dark brown (7.5YR 4/4) silt loam (Bt); about 30 percent coatings of grayish brown (10YR 5/2) silt loam on faces of some peds (E); many medium and coarse prominent yellowish red (5YR 5/8) and many fine and medium distinct pinkish gray (7.5YR 6/2) mottles; moderate medium and coarse subangular blocky structure; friable; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of some peds; strongly acid; clear wavy boundary.

2Bt—29 to 35 inches; dark brown (7.5YR 4/4) sandy loam; common medium distinct strong brown (7.5YR 4/6) and common medium and coarse distinct pinkish gray (7.5YR 6/2) mottles; moderate coarse subangular blocky structure; friable; thin discontinuous dark yellowish brown (10YR 3/4) clay films on faces of some peds; about 8 percent gravel and cobbles; medium acid; clear wavy boundary.

2Cd—35 to 60 inches; reddish brown (5YR 4/4) sandy loam; many medium and coarse distinct yellowish red (5YR 5/6) and few fine distinct strong brown (7.5YR 5/6) mottles; massive; firm; about 13 percent gravel and cobbles; slightly acid.

The solum ranges from 30 to 50 inches in thickness. The thickness of the loess mantle ranges from 15 to 30 inches. Cobbles and stones are throughout the profile in most areas.

The A horizon has value of 2 or 3. It is less than 5 inches thick. Some pedons have an Ap horizon. This horizon has value of 3 or 4 and chroma of 2 or 3. The E horizon has value of 4 to 6 and chroma of 2 or 3. The E part of the E/B and B/E horizons has value of 4 to 6 and chroma of 2 or 3. The Bt part has hue of 7.5YR or 10YR. The 2Bt horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. It is loam, sandy loam, or the gravelly analogs of those textures. The 2Cd horizon has hue of 5YR or 7.5YR and value and chroma of 3 to 5. It is sandy loam, loam, or the gravelly analogs of those textures.

Markey Series

The Markey series consists of very poorly drained soils in depressions and basins on outwash plains and moraines. These soils formed primarily in herbaceous material underlain by sandy glacial outwash. Permeability is moderately slow to moderately rapid in the organic material and is rapid in the sandy substratum. Slope is 0 to 1 percent.

Typical pedon of Markey muck, in an area of Carbondale, Lupton, and Markey mucks, 0 to 1 percent

slopes, 20 feet south and 100 feet east of the northwest corner of sec. 7, T. 39 N., R. 4 E.

Oa1—0 to 11 inches; sapric material, black (N 2/0) broken face and rubbed; about 20 percent fiber, 10 percent rubbed; weak medium and coarse granular structure; primarily herbaceous fibers; about 10 percent sand; medium acid (pH by Truog method); clear wavy boundary.

Oa2—11 to 26 inches; sapric material, black (N 2/0) broken face and rubbed; about 10 percent fiber, 5 percent rubbed; massive; primarily herbaceous fibers; about 15 percent sand; neutral (pH by Truog method); abrupt smooth boundary.

C1—26 to 29 inches; dark gray (N 4/0) and brown (7.5YR 4/2) loamy sand; weak medium subangular blocky structure; very friable; about 5 percent gravel; mildly alkaline; clear wavy boundary.

C2—29 to 60 inches; brown (7.5YR 4/4 and 5/4) sand; single grain; loose; few thin strata and pockets of loamy sand; about 5 percent gravel; mildly alkaline.

The thickness of the organic material commonly is 20 to 40 inches, but it ranges from 16 to 51 inches. Some pedons have small amounts of woody fragments.

The organic material has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 to 3, or it is neutral in hue and has value of 2 or 3. The surface, subsurface, and bottom tiers are dominantly sapric material. Some pedons have a thin layer of hemic or fibric material in the upper part of the surface tier or have thin layers of hemic or fibric material in the subsurface and bottom tiers. The C horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 4 to 6, and chroma of 1 to 4, or it is neutral in hue and has value of 4 to 6. Some pedons have thin layers of loamy material or a sedimentary organic layer directly above the C1 horizon.

Minocqua Series

The Minocqua series consists of poorly drained and very poorly drained soils on outwash plains. These soils formed in silty and loamy deposits and in the underlying outwash of gravelly coarse sand. Permeability is moderate in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 2 percent.

Typical pedon of Minocqua silt loam, 0 to 2 percent slopes, 300 feet east and 900 feet north of the southwest corner of sec. 2, T. 36 N., R. 11 E.

Oa—0 to 1 inch; black (10YR 2/1) muck; moderate medium granular structure; friable; many roots; about 25 percent mineral material; strongly acid (pH by Truog method); abrupt smooth boundary.

Eg—1 to 8 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; few medium prominent olive brown (2.5Y 4/4) and few medium prominent yellowish red (5YR 4/6) mottles; weak very thick platy structure parting to moderate medium subangular blocky; friable; many roots; strongly acid; abrupt wavy boundary.

Bg1—8 to 16 inches; grayish brown (2.5Y 5/2) silt loam; many medium distinct light brownish gray (10YR 6/2), common medium prominent reddish brown (2.5YR 4/4), and common medium distinct olive brown (2.5Y 4/4) mottles; moderate medium and coarse subangular blocky structure; friable; common roots; strongly acid; clear wavy boundary.

Bg2—16 to 21 inches; light brownish gray (2.5Y 6/2) loam; common medium distinct gray (5Y 6/1) and many medium prominent yellowish red (5YR 5/8) mottles; moderate medium subangular blocky structure; friable; common roots; strongly acid; clear wavy boundary.

2BCg—21 to 24 inches; dark grayish brown (10YR 4/2) loamy coarse sand; common medium faint gray (10YR 5/1) and common medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; few roots; strongly acid; clear wavy boundary.

2Cg—24 to 60 inches; brown (7.5YR 5/2) gravelly coarse sand; few fine and medium prominent strong brown (7.5YR 5/6) mottles; single grain; loose; about 25 percent gravel; slightly acid.

The solum ranges from 20 to 40 inches in thickness. The Oa horizon is less than 6 inches thick. Some pedons have an A horizon. This horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. It is less than 6 inches thick. The Eg horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 1 or 2. The Bg horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 4 to 6, and chroma of 1 or 2. It is sandy loam, loam, or silt loam. The 2Cg horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4.

Monico Series

The Monico series consists of somewhat poorly drained, moderately permeable soils on drumlins and moraines. These soils formed mainly in silty material and in the underlying sandy loam or loamy sand glacial till. Slope ranges from 1 to 6 percent. Stones are in the surface layer in most areas.

Typical pedon of Monico loam, 1 to 6 percent slopes, stony, 1,100 feet north and 1,500 feet west of the southeast corner of sec. 12, T. 36 N., R. 11 E.

Oe—2 inches to 0; mat of partially decomposed forest litter.
A—0 to 1 inch; black (5YR 2/1) loam, dark reddish gray (5YR 4/2) dry; weak fine granular structure; very friable; many fine roots; strongly acid; abrupt wavy boundary.
E—1 to 3 inches; brown (7.5YR 5/2) loam, pinkish gray (7.5YR 6/2) dry; moderate medium subangular blocky structure; friable; many roots; strongly acid; abrupt wavy boundary.
Bs1—3 to 7 inches; dark reddish brown (5YR 3/4) silt loam; common fine distinct yellowish red (5YR 5/6) mottles; moderate medium subangular blocky structure; friable; many roots; very strongly acid; clear wavy boundary.
Bs2—7 to 14 inches; dark brown (7.5YR 4/4) silt loam; common medium distinct brown (7.5YR 5/2) and common fine prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; friable; common roots; very strongly acid; abrupt wavy boundary.
E′—14 to 23 inches; brown (7.5YR 5/3) silt loam, pink (7.5YR 7/3) dry; many medium prominent yellowish red (5YR 5/6 and 5/8) and many medium distinct pinkish gray (7.5YR 6/2) mottles; moderate medium and coarse subangular blocky structure; friable; few roots; very strongly acid; clear wavy boundary.
2Bw—23 to 26 inches; dark brown (7.5YR 4/4) sandy loam; many medium prominent pinkish gray (5YR 6/2) and many coarse prominent yellowish red (5YR 5/8) mottles; moderate medium and coarse subangular blocky structure; friable; about 5 percent gravel; strongly acid; clear wavy boundary.
2BC—26 to 29 inches; dark brown (7.5YR 4/4) sandy loam; many medium prominent yellowish red (5YR 5/8) and pinkish gray (5YR 6/2) mottles; moderate medium and thin platy structure; friable; about 8 percent gravel and cobbles; strongly acid; clear wavy boundary.
2C—29 to 60 inches; dark brown (7.5YR 4/4) sandy loam; many medium prominent yellowish red (5YR 5/8) and few medium prominent pinkish gray (5YR 6/2) mottles; massive; friable; about 10 percent gravel and cobbles; medium acid.

The solum ranges from 24 to 50 inches in thickness. Cobbles and stones are throughout the profile in most areas.

The A horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. It is less than 5 inches thick. The E horizon has hue of 10YR, 7.5YR, or 5YR and value of 5 or 6. The Bs horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 4 to 6. The E′ horizon has hue of 10YR, 7.5YR, or 5YR and chroma of 2 or 3. The 2Bw horizon has hue of 7.5YR or 5YR and chroma of 3 or 4. The 2C horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam, loamy sand, or the gravelly analogs of those textures.

Padus Series

The Padus series consists of well drained and moderately well drained soils on moraines and outwash plains and in areas of pitted outwash. These soils formed in loamy deposits and in the underlying outwash of stratified sand and gravel. Permeability is moderate or moderately rapid in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 45 percent.

Typical pedon of Padus sandy loam, in an area of Padus-Pence sandy loams, 1 to 6 percent slopes, 65 feet east and 20 feet north of the southwest corner of sec. 17, T. 39 N., R. 11 E.

A—0 to 1 inch; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; many roots; few charcoal fragments; very strongly acid; clear wavy boundary.
E—1 to 5 inches; brown (7.5YR 5/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine and medium subangular blocky structure; very friable; many roots; very strongly acid; clear wavy boundary.
Bs1—5 to 11 inches; dark reddish brown (5YR 3/4) sandy loam; weak fine and medium subangular blocky structure; very friable; common roots; medium acid; clear wavy boundary.
Bs2—11 to 16 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; common roots; medium acid; clear wavy boundary.
B/E—16 to 26 inches; about 80 percent dark brown (7.5YR 4/4) sandy loam (Bt); about 20 percent coatings of brown (7.5YR 5/3) sandy loam on faces of some peds, pink (7.5YR 7/3) dry (E′); weak coarse subangular blocky structure; friable; few firm peds; few roots; few thin discontinuous clay films on faces of peds; medium acid; clear wavy boundary.
Bt1—26 to 33 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; few firm peds; few roots; few thin discontinuous dark brown (7.5YR 3/4) clay films on faces of some peds; medium acid; clear wavy boundary.
2Bt2—33 to 35 inches; dark brown (7.5YR 4/4) gravelly loamy sand; weak medium subangular blocky

structure; very friable; clay bridges between some sand grains; about 15 percent gravel; medium acid; clear wavy boundary.
2C—35 to 60 inches; strong brown (7.5YR 5/6), stratified sand and gravel; single grain; loose; less than 5 percent fines in the layers of gravel; slightly acid.

The thickness of the solum ranges from 24 to 40 inches. The A horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2. It is sandy loam or loam. It is less than 5 inches thick. The E horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 2 or 3. The E′ part of the B/E horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. The Bt1 horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam or loam. In some pedons the 2Bt2 horizon is characterized by slight brittleness similar to that of a fragipan. The 2C horizon has hue of 7.5YR or 5YR and value and chroma of 4 to 6.

Pence Series

The Pence series consists of well drained soils on outwash plains and in areas of pitted outwash. These soils formed in loamy deposits and in the underlying outwash of gravelly coarse sand. Permeability is moderately rapid in the subsoil and rapid or very rapid in the substratum. Slope ranges from 1 to 45 percent.

Typical pedon of Pence sandy loam, in an area of Padus-Pence sandy loams, 6 to 15 percent slopes, 200 feet east and 380 feet north of the southwest corner of sec. 5, T. 38 N., R. 11 E.

A—0 to 3 inches; dark reddish brown (5YR 3/2) sandy loam, brown (7.5YR 5/2) dry; weak fine subangular blocky structure; very friable; many roots; common white (5YR 8/1) sand grains; about 10 percent gravel; medium acid; abrupt smooth boundary.
E—3 to 8 inches; brown (7.5YR 4/2) sandy loam, pinkish gray (7.5YR 7/2) dry; weak fine subangular blocky structure; very friable; many roots; about 10 percent gravel; slightly acid; clear wavy boundary.
Bs1—8 to 11 inches; dark reddish brown (5YR 3/4) sandy loam; weak medium subangular blocky structure; very friable; common roots; about 10 percent gravel; slightly acid; clear wavy boundary.
Bs2—11 to 15 inches; reddish brown (5YR 4/4) gravelly sandy loam; weak fine and medium subangular blocky structure; very friable; common roots; about 15 percent gravel; medium acid; clear wavy boundary.
2BC—15 to 21 inches; yellowish red (5YR 4/6 and 5/6) gravelly coarse sand; weak coarse subangular blocky structure; very friable; few roots; about 25 percent gravel; strongly acid; clear wavy boundary.
2C—21 to 60 inches; yellowish red (5YR 5/6) and reddish yellow (5YR 6/6) gravelly coarse sand; single grain; loose; thin strata of light reddish brown (5YR 6/4) coarse sand and sand; about 25 percent gravel; strongly acid.

The solum ranges from 12 to 36 inches in thickness. The thickness of the loamy mantle ranges from 12 to 20 inches.

The A horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 7.5YR or 5YR and value of 4 to 6. The Bs horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 4 to 6. It is sandy loam, loamy sand, or the gravelly analogs of those textures. In some pedons the B horizon is characterized by slight brittleness similar to that of a fragipan. The 2C horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 2 to 6.

Pequaming Series

The Pequaming series consists of somewhat poorly drained soils on drumlins and water-worked moraines. These soils formed primarily in sandy deposits underlain by sandy and loamy glacial drift. Permeability is moderately rapid or rapid. Slope ranges from 1 to 3 percent. Stones are in the surface layer in most areas.

Typical pedon of Pequaming loamy sand, 1 to 3 percent slopes, stony, 1,600 feet south and 10 feet west of the northeast corner of sec. 28, T. 36 N., R. 5 E.

Oe—2 inches to 0; mat of partially decomposed forest litter.
E—0 to 3 inches; brown (7.5YR 4/2) loamy sand, light gray (10YR 6/1) dry; weak medium subangular blocky structure; very friable; many roots; strongly acid; abrupt wavy boundary.
Bs1—3 to 7 inches; dark brown (7.5YR 3/4) loamy sand; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; many roots; medium acid; clear wavy boundary.
Bs2—7 to 12 inches; dark brown (7.5YR 4/4) loamy sand; common medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; common roots; medium acid; clear wavy boundary.
Bs3—12 to 24 inches; strong brown (7.5YR 4/6) loamy sand; many medium and coarse faint and distinct strong brown (7.5YR 5/6 and 5/8) mottles; weak

coarse subangular blocky structure; very friable; few roots; about 8 percent gravel; medium acid; abrupt wavy boundary.

E/B—24 to 32 inches; about 75 percent brown (7.5YR 5/3) loamy sand, pink (7.5YR 7/3) dry (E′); about 25 percent isolated remnants of dark brown (7.5YR 4/4) sandy loam (Bt); many medium distinct pinkish gray (7.5YR 6/2) and many medium prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; friable; about 8 percent gravel; strongly acid; clear wavy boundary.

C1—32 to 50 inches; dark brown (7.5YR 4/4) loamy sand; many fine and medium distinct and prominent strong brown (7.5YR 5/6 and 5/8) mottles; massive; friable; about 10 percent gravel and cobbles; slightly acid; clear wavy boundary.

C2—50 to 60 inches; reddish brown (5YR 4/3 and 5/3) sandy loam; massive; friable; about 12 percent gravel and cobbles; slightly acid.

The solum ranges from 24 to 46 inches in thickness. Cobbles and stones are throughout the profile in most areas.

Some pedons have an A horizon. This horizon has hue of 5YR, value of 2 or 3, and chroma of 1. It is less than 4 inches thick. The E horizon has hue of 7.5YR or 5YR and value of 4 or 5. The Bs horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 3 to 6. The E′ part of the E/B horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. The Bt part also has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam or loamy sand. The C horizon is dominantly loamy sand but has strata of sandy loam or sand.

Plover Series

The Plover series consists of somewhat poorly drained soils on glacial lake plains, outwash plains, and moraines. These soils formed in loamy and sandy deposits underlain by stratified loamy, silty, and sandy lacustrine deposits. Permeability is moderate. Slope ranges from 0 to 3 percent.

Typical pedon of Plover fine sandy loam, 0 to 3 percent slopes, 400 feet west and 1,800 feet north of the southeast corner of sec. 9, T. 37 N., R. 9 E.

Oe—2 inches to 0; mat of partially decomposed forest litter.

E—0 to 2 inches; brown (7.5YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; very friable; many roots; very strongly acid; abrupt wavy boundary.

Bs—2 to 5 inches; dark brown (7.5YR 3/4) fine sandy loam; weak medium subangular blocky structure; very friable; many roots; very strongly acid; clear wavy boundary.

E/B—5 to 23 inches; about 70 percent brown (10YR 5/3) loamy fine sand (E′); about 30 percent isolated remnants of dark brown (7.5YR 4/4) fine sandy loam (Bt); common medium faint grayish brown (10YR 5/2) and few coarse prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; common roots; strongly acid; gradual wavy boundary.

Bt—23 to 29 inches; dark brown (7.5YR 4/4) fine sandy loam; many medium distinct strong brown (7.5YR 5/6) and many medium prominent grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; few roots; few thin discontinuous dark brown (7.5YR 3/4) clay films on faces of some peds; brown (10YR 5/3) coatings of loamy fine sand on faces of some peds; medium acid; clear wavy boundary.

C—29 to 60 inches; brown (7.5YR 5/4), stratified fine sand, very fine sandy loam, and silt loam; many medium distinct strong brown (7.5YR 5/6) and many medium prominent grayish brown (10YR 5/2) mottles; massive; very friable; medium acid.

The solum ranges from 28 to 40 inches in thickness. Some pedons have an A horizon. This horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is less than 4 inches thick. The E horizon has hue of 10YR or 7.5YR and value of 4 to 6. The E′ part of the E/B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. The Bt part of the E/B horizon and all of the Bt horizon have hue of 10YR or 7.5YR and value of 4 or 5. They are fine sandy loam or sandy loam. The C horizon has hue of 10YR, 7.5YR, or 5YR and value and chroma of 4 to 6. It is typically stratified fine sand, very fine sandy loam, and silt loam, but it has strata of fine sandy loam, loamy sand, or sand in some pedons.

Rousseau Series

The Rousseau series consists of well drained soils on glacial lake plains, outwash plains, and moraines. These soils formed in sandy glacial outwash or lacustrine deposits. Permeability is rapid. Slope ranges from 0 to 15 percent.

Typical pedon of Rousseau loamy fine sand, 0 to 6 percent slopes, 900 feet east and 3,700 feet south of the northwest corner of sec. 29, T. 37 N., R. 10 E.

Oe—2 inches to 0; mat of partially decomposed forest litter.

E—0 to 2 inches; brown (7.5YR 4/2) loamy fine sand,

light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; many roots; very strongly acid; clear wavy boundary.
Bs1—2 to 6 inches; dark brown (7.5YR 3/4) loamy fine sand; weak medium subangular blocky structure; very friable; many roots; strongly acid; clear wavy boundary.
Bs2—6 to 15 inches; dark brown (7.5YR 4/4) fine sand; weak medium subangular blocky structure; very friable; common roots; slightly acid; clear wavy boundary.
BC—15 to 21 inches; strong brown (7.5YR 5/6) fine sand; weak medium subangular blocky structure; very friable; few roots; slightly acid; gradual wavy boundary.
C—21 to 60 inches; light yellowish brown (10YR 6/4) fine sand; single grain; loose; thin strata of brown (10YR 5/3 and 7.5YR 5/4) very fine sand; slightly acid.

The solum ranges from 20 to 32 inches in thickness. Some pedons have an A horizon. This horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 or 3. It is less than 3 inches thick. The E horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 1 or 2. The Bs horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 4 to 6. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 to 6. It typically is fine sand, but it has strata of very fine sand, sand, or loamy fine sand in some pedons.

Sayner Series

The Sayner series consists of excessively drained soils on moraines and outwash plains and in areas of pitted outwash. These soils formed in sandy deposits and in the underlying outwash of stratified sand and gravel. Permeability is moderately rapid in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 45 percent.

Typical pedon of Sayner loamy sand, 15 to 45 percent slopes, 450 feet south and 1,380 feet west of the northeast corner of sec. 27, T. 38 N., R. 6 E.

A—0 to 2 inches; black (N 2/0) loamy sand, dark brown (7.5YR 3/2) dry; weak medium granular structure; very friable; many roots; few charcoal fragments; many uncoated sand grains; about 3 percent gravel; strongly acid; abrupt wavy boundary.
E—2 to 4 inches; brown (7.5YR 4/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; many roots; about 3 percent gravel; medium acid; abrupt wavy boundary.
Bs1—4 to 7 inches; dark reddish brown (5YR 3/4) loamy sand; weak medium subangular blocky structure; very friable; many roots; about 5 percent gravel; medium acid; clear wavy boundary.
Bs2—7 to 14 inches; reddish brown (5YR 4/4) sand; weak medium subangular blocky structure; very friable; common roots; about 10 percent gravel; slightly acid; clear wavy boundary.
BC—14 to 22 inches; strong brown (7.5YR 4/6) gravelly sand; single grain; loose; few roots; about 25 percent gravel; slightly acid; clear wavy boundary.
C1—22 to 38 inches; strong brown (7.5YR 5/6), stratified sand and gravel; single grain; loose; less than 5 percent fines in the layers of gravel; slightly acid; gradual wavy boundary.
C2—38 to 60 inches; light yellowish brown (10YR 6/4) and brownish yellow (10YR 6/6), stratified sand and gravel; single grain; loose; less than 5 percent fines in the layers of gravel; slightly acid.

The solum ranges from 12 to 36 inches in thickness. The A horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. It is less than 4 inches thick. The E horizon has hue of 7.5YR or 5YR, value of 4 to 6, and chroma of 2 or 3. The Bs horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 4 to 6. It is loamy sand, sand, or the gravelly analogs of those textures. The C horizon has hue of 10YR, 7.5YR, or 5YR and value and chroma of 4 to 6. It is stratified sand and gravel or gravelly sand.

Vilas Series

The Vilas series consists of excessively drained soils on moraines and outwash plains and in areas of pitted outwash. These soils formed in sandy glacial outwash. Permeability is rapid. Slope ranges from 0 to 25 percent.

Typical pedon of Vilas loamy sand, 0 to 6 percent slopes, 2,400 feet east and 1,300 feet south of the northwest corner of sec. 24, T. 38 N., R. 5 E.

Oe—1 inch to 0; mat of partially decomposed forest litter.
A—0 to 1 inch; black (N 2/0) loamy sand, very dark gray (5YR 3/1) dry; weak fine granular structure; very friable; many roots; very strongly acid; clear wavy boundary.
E—1 to 3 inches; brown (7.5YR 5/2) loamy sand, pinkish gray (7.5YR 6/2) dry; weak medium subangular blocky structure; very friable; many roots; very strongly acid; clear wavy boundary.
Bs1—3 to 7 inches; dark reddish brown (5YR 3/4)

loamy sand; weak medium subangular blocky structure; very friable; many roots; strongly acid; clear wavy boundary.
Bs2—7 to 19 inches; dark brown (7.5YR 4/4) loamy sand; weak medium and coarse subangular blocky structure; very friable; common roots; medium acid; gradual wavy boundary.
BC—19 to 30 inches; strong brown (7.5YR 5/6) sand; weak coarse subangular blocky structure; very friable; few roots; slightly acid; clear wavy boundary.
C—30 to 60 inches; brown (7.5YR 5/4) sand; single grain; loose; slightly acid.

The solum ranges from 20 to 40 inches in thickness. The A horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. It is less than 3 inches thick. The E horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 1 or 2. The C horizon has hue of 10YR or 7.5YR and value and chroma of 4 to 6.

Worcester Series

The Worcester series consists of somewhat poorly drained soils on outwash plains. These soils formed in loamy deposits underlain by outwash of stratified sand and gravel. Permeability is moderate in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 3 percent.

Typical pedon of Worcester sandy loam, 0 to 3 percent slopes, 1,300 feet east and 2,000 feet north of the southwest corner of sec. 12, T. 36 N., R. 11 E.

Oe—2 inches to 0; mat of partially decomposed forest litter.
E—0 to 3 inches; reddish gray (5YR 5/2) sandy loam, light gray (5YR 7/1) dry; weak medium platy structure; friable; many roots; very strongly acid; abrupt wavy boundary.
Bs1—3 to 6 inches; dark reddish brown (5YR 3/4) sandy loam; weak medium subangular blocky structure; friable; many roots; very strongly acid; clear wavy boundary.
Bs2—6 to 9 inches; dark brown (7.5YR 4/4) sandy loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; many roots; very strongly acid; clear wavy boundary.
E′—9 to 14 inches; pinkish gray (7.5YR 6/2) sandy loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate thick platy structure; friable; common roots; very strongly acid; clear wavy boundary.
Bt1—14 to 21 inches; dark brown (7.5YR 4/4) loam; many medium prominent yellowish red (5YR 5/8) and common medium distinct brown (7.5YR 5/2) mottles; moderate medium subangular blocky structure; friable; few roots; few thin discontinuous dark brown (7.5YR 3/4) clay films on faces of some peds; very strongly acid; clear wavy boundary.
Bt2—21 to 26 inches; dark brown (7.5YR 4/4) sandy loam; many fine and medium prominent yellowish red (5YR 5/8) and few fine distinct brown (7.5YR 5/2) mottles; moderate medium subangular blocky structure; friable; few thin discontinuous dark brown (7.5YR 3/4) clay films on faces of some peds; about 5 percent gravel; very strongly acid; clear wavy boundary.
2C—26 to 60 inches; brown (7.5YR 4/4), stratified sand and gravel; single grain; loose; less than 5 percent fines in the layers of gravel; medium acid.

The thickness of the solum ranges from 24 to 45 inches. Some pedons have an A horizon. This horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2. It is less than 5 inches thick. The E horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 or 5, and chroma of 2 or 3. The E′ horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 or 3. The Bt horizon has hue of 7.5YR or 5YR. The 2C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6.

Formation of the Soils

This section describes the geology and underlying material in Oneida County, relates the factors of soil formation to the soils in the county, and explains the processes of soil formation.

Geology and Underlying Material

Robert N. Cheetham, Jr., geologist, Soil Conservation Service, helped prepare this section.

Oneida County is underlain by Precambrian igneous and metamorphic bedrock, which is a southerly extension of the Canadian Shield. A bedrock geology map published by the University of Wisconsin shows the distribution of rock types *(7)*. Most of the rock is obscured by surficial glacial deposits as much as 300 feet thick, but more than 100 rock outcrops have been noted in the county. The exposures of bedrock commonly are in the southeastern townships of Monico, Pelican, and Schoepke and in the extreme northeastern Three Lakes Township, but a few are in the western half of the county. Most of the outcrops are greenstone (fig. 14) or granite, but some are diorite, diabase, gneiss, or metamorphosed sandstone.

Glacial advances originated primarily from the Labrador ice sheet east of Hudson Bay. As is indicated by the orientation of drumlins, elongated swamps, and bedrock striations, the ice moved to the south and southwest. As it advanced over Wisconsin, it divided into several lobes. The path of these lobes was determined by the preglacial configuration of the land. The latest lobe movement is referred to as the Wisconsin Glaciation. The ice that advanced during the Cary substage of this glaciation is the most recent ice to cover the county. The glacial till in Oneida County is of Woodfordian or Cary age.

Most of Oneida County is a pitted outwash plain formed by glacial meltwater streams that sorted glacial deposits. Other deposits are lacustrine in origin and are representative of lakes present during interglacial periods. Generally, these deposits border the present lakes, rivers, and streams or are in scattered small areas within areas of glacial till.

Factors of Soil Formation

Soil forms through processes acting on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; the physical and mineralogical composition of the parent material; and the length of time that the forces of soil formation have acted on the soil material *(9)*.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons.

The five factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect on any one factor unless conditions are specified for the other four.

Climate

Climate directly affects soil formation through the weathering of rocks. It also alters the parent material through the actions of freezing and thawing. It indirectly affects the accumulation of organic matter by supplying energy and a suitable environment for plants and animals.

Precipitation and temperature are the main climatic factors responsible for the development of soil features. They determine the amount of water available for percolation and the formation and decomposition of organic matter, which are the major processes of soil formation.

Percolating water from rainfall and snowmelt affects both the solution and hydration of mineral material and the organic substances. The movement of this water also controls the distribution of substances throughout the soil.

Oneida County has a continental climate characterized by wide variations in temperature from

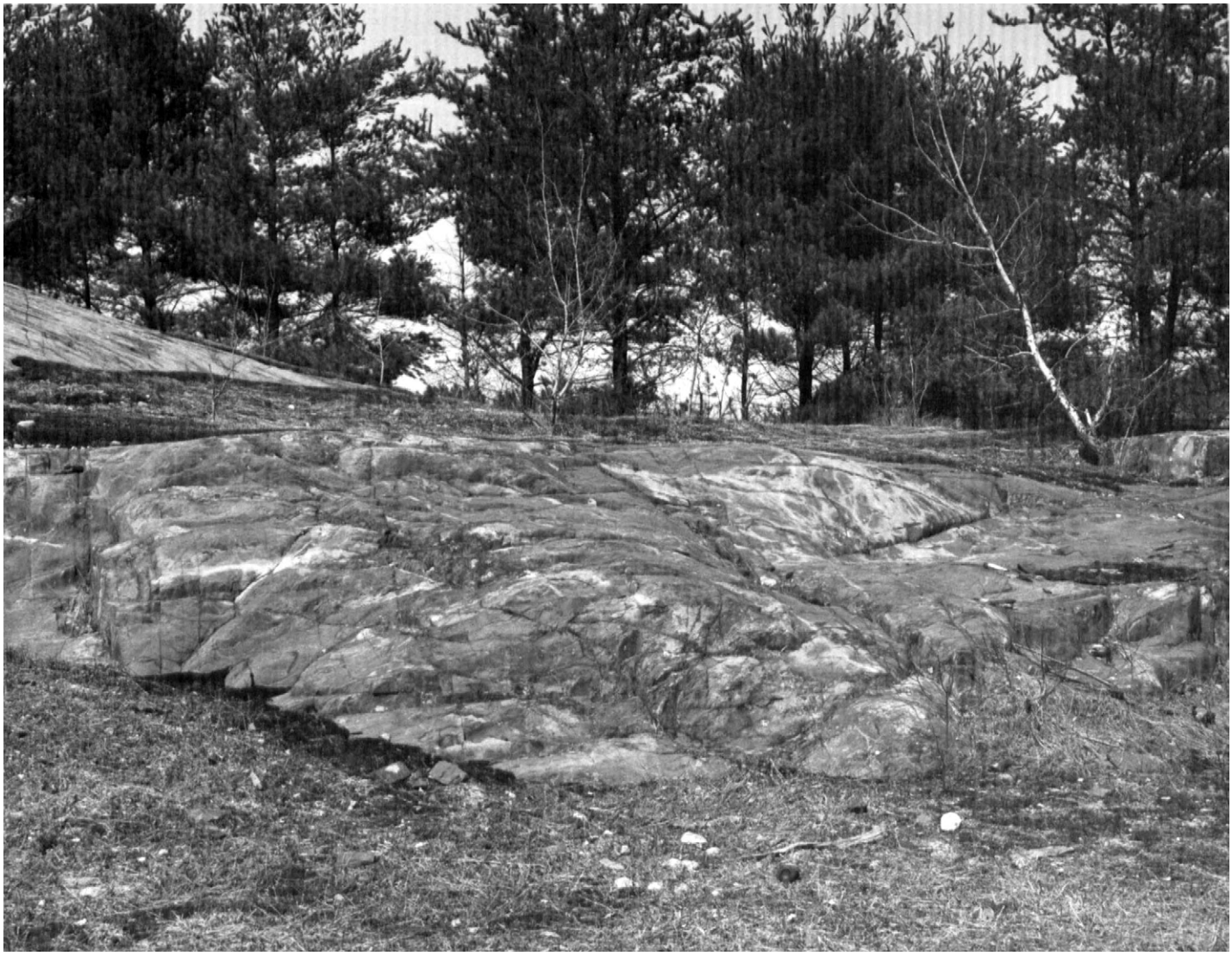

Figure 14.—Greenstone outcrop near Monico.

summer to winter. During winter the soil-forming processes are largely inactive, but some freezing and thawing occurs. Frost heave affects profile development.

High temperatures in summer increase the rates of evaporation and transpiration and thus limit the amount of percolating water available for soil formation. Temperature also affects the growth and decomposition of organic matter. Decomposition is much slower in cooler periods than in warmer ones.

Wind indirectly affects the moisture content of soils by influencing the rate of evaporation. Also, it often blows away soil particles and organic material, thereby eroding the surface layer and depositing sediment elsewhere as new parent material.

Climate is modified by variations in slope aspect. The soils on south- or west-facing slopes are warmed and dried by the sun and wind more thoroughly than those on north- and east-facing slopes. The soils on the cooler, more humid north- and east-facing slopes generally contain more moisture and remain frozen for longer periods.

Plant and Animal Life

Living organisms, such as plants, bacteria, fungi, insects, earthworms, and rodents, influence the

formation of soils. Plants generally have the greatest influence. Plant roots penetrate the soil and create channels for percolating water. The roots excrete a number of acid substances that act on rocks and minerals and result in the solution of nutrients or mineral substances, which are absorbed and translocated upward to stems and leaves. When the plants die, the translocated nutrients and minerals are released in the upper soil layers. The organic acids formed from the decaying plant residue accelerate soil formation by reacting with the rock and minerals.

Plants indirectly affect soil formation by modifying the effects of climate. For example, they reduce the force of winds, thereby influencing the evaporation rate of percolating water and the deposition of windblown parent material.

Animals burrow into the soil and mix the material in different layers. Roots and percolating water follow the channels created by the animals. Animal life affects soil structure, helps to decompose organic matter, and carries nutrients upward in the soil profile. When the animals die, they contribute to the supply of organic matter in the soil.

Human activities have had important effects on the soils in the county. Removing the native vegetation, planting crops that differ from the native vegetation, mixing the upper layers through cultivation, and other human activities have altered the original condition of some soils. Removing the native vegetation has accelerated erosion on the more sloping soils. Heavy tillage and harvesting equipment has compacted the soil. Applications of lime and fertilizer have altered pH values and the fertility of soils. Some cropping practices have reduced the content of organic matter. The content of soil moisture has been altered by irrigation and drainage systems. Some of the effects of human activities, such as those caused by additions of fertilizer, pesticide, herbicide, and fungicide, may not be known for many years.

Relief and Drainage

Relief influences soil formation through its effect on the amount of precipitation absorbed by the soil, erosion, and the movement of material in suspension or solution from one part of the soil profile to another. Generally, the steeper soils have a thinner solum and less well developed profiles than gently sloping soils, which have more water percolating through the profile.

Relief directly affects external and internal drainage in the soils. Goodman, Monico, and Cable soils form a drainage sequence in Oneida County. The well drained and moderately well drained Goodman soils are on the higher ridges and knolls. They are nearly level to moderately steep. The somewhat poorly drained Monico soils are on low ridges and foot slopes and in depressions. They are nearly level and gently sloping. The poorly drained and very poorly drained Cable soils are in depressions and drainageways. They are nearly level and gently sloping.

Parent Material

Parent material has an effect on the kind of soil that forms and in places determines the soil properties almost entirely. Most of the soils in Oneida County formed in material deposited by glaciers or by meltwater as the glaciers receded. Some formed in recent alluvium on flood plains. The organic soils formed in plant remains that accumulated in swamps or shallow lakes and were preserved under water. Some soils formed in more than one kind of parent material. The nature of the parent material influences the texture, mineral composition, and chemical properties of the soil.

Glacial outwash is stratified sand and gravel, gravelly sand, or sand that was carried, sorted, and deposited by glacial meltwater. Padus soils formed in loamy deposits and in the underlying stratified sand and gravel. Pence soils formed in loamy deposits and in the underlying outwash of gravelly coarse sand. Vilas soils formed in sandy outwash.

The glacial till in the county is unsorted, nonstratified drift consisting of clay, silt, sand, gravel, cobbles, stones, and boulders transported and deposited by glacial ice. Most of the till is loamy sand, sandy loam, or the gravelly analogs of those textures. Cable, Goodman, and Monico are examples of soils that formed in silty or loamy deposits and in the underlying till.

Glaciolacustrine material was deposited in still water in former glacial lake basins. These deposits are stratified silt loam, very fine sandy loam, fine sandy loam, loamy fine sand, very fine sand, or fine sand. Alcona, Plover, and Rousseau soils formed in this material. The Croswell soils that have a loamy substratum formed in sandy outwash over lacustrine deposits.

Six of the soils in the county formed primarily in organic material. Dawson and Markey soils formed in organic material 16 to 51 inches deep over sandy glacial outwash. Carbondale, Greenwood, Loxley, and Lupton soils formed in more than 51 inches of organic material.

Time

Time is needed for the transformation of the parent material into a soil. The length of time required for

horizon differentiation varies. Soils can have horizons that are well developed, poorly developed, or partially developed. The degree of development depends on the length of time that the soil-forming factors have been active. Padus soils, for example, have moderately distinct horizons and are considered to be fairly mature. Fordum and other soils that formed in recently deposited alluvium, however, show little or no evidence of horizon development.

Processes of Soil Formation

The result of the interaction of the five soil-forming factors is a soil profile that has several horizons. Most of the soils in Oneida County are Spodosols. The horizonation of these soils is exemplified by Vilas soils, which are Entic Haplorthods. The surface of these soils is covered by a mat of partially decomposed forest litter, or an Oe horizon. The A horizon consists of mineral particles that have coatings of organic material or of a soil mass that is darkened by organic particles. An albic, or E, horizon, is directly below the A horizon. The albic horizon is one from which organic material, clay, and free iron and aluminum oxides have been removed by leaching or the oxides have been segregated to the extent that the color of the horizon is determined by the color of the primary sand and silt particles rather than by the coatings of these particles.

Under the eluvial albic horizon is the illuvial spodic, or Bs, horizon. Active amorphous material made up of organic matter and aluminum with or without iron has precipitated in the spodic horizon. Almost all spodic horizons have a maximum content of organic matter, iron, or aluminum in the upper part, but some have no iron. In some spodic horizons, the maximum content of iron and aluminum is below the maximum content of organic matter or the maximum content of aluminum is below the maximum content of iron *(13)*. The upper part of the spodic horizon has the lowest value, the reddest hue, or the highest chroma. The hue commonly is redder than 10YR, and the moist value and chroma generally are 3/4 or 4/4.

Between the spodic horizon and the C horizon is a transitional BC horizon. This transitional horizon has properties characteristic of the overlying spodic horizon but also has clearly expressed properties characteristic of the underlying C horizon. The glacial outwash comprising the C horizon has changed little since it was deposited.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of glacial drift. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper

balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

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 overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cd horizon.—Dense, unconsolidated deposits that have high bulk density, such as basal till.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or

gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loamy. General term for the texture classes very fine sandy loam, fine sandy loam, sandy loam, coarse sandy loam, loam, clay loam, and sandy clay loam.

Low strength. The soil is not strong enough to support loads.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some 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. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper,

boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Organic soil. A soil in which the content of organic carbon is 12 to more than 18 percent, depending on the content of mineral material, and the organic material is more than 16 inches thick.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitted outwash. An area of outwash characterized by many irregular depressions, such as kettles, shallow pits, and potholes.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

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.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandy. General term for the texture classes loamy very fine sand, loamy fine sand, loamy sand, loamy coarse sand, very fine sand, fine sand, sand, and coarse sand.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has

the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

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.

Silty. General term for the texture classes silt, silt loam, and silty clay loam.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

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. The slope classes in Oneida County are:

Nearly level	0 to 2 percent
Gently sloping	2 to 6 percent
Sloping	6 to 15 percent
Moderately steep	15 to 25 percent
Steep	25 to 45 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the Earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil blowing. The detachment and movement of soil particles by wind.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Succession. The development of vegetation toward a stable, self-perpetuating climax plant community; replacement of one plant community by another.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tiers. Layers in the control section of organic soils. The organic material has been divided somewhat arbitrarily into three tiers. The surface tier is the upper 12 inches, the subsurface tier is the next 24 inches, and the bottom tier is the lower 16 inches.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the Earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-81 at Rhinelander, Wisconsin)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	20.6	0.1	10.4	42	-31	0	1.01	0.43	1.49	4	11.5
February---	26.3	3.1	14.7	48	-29	0	.85	.26	1.32	3	9.4
March------	37.0	14.9	26.0	61	-19	0	1.48	.57	2.23	4	9.6
April------	53.1	30.1	41.6	82	9	20	2.42	1.38	3.34	6	2.4
May--------	67.0	41.5	54.3	88	23	207	3.47	2.21	4.60	8	.6
June-------	75.3	51.4	63.4	92	34	402	4.17	2.54	5.64	9	.0
July-------	79.6	55.9	67.8	93	41	552	3.56	2.10	4.86	7	.0
August-----	77.0	53.9	65.5	91	37	481	4.61	2.25	6.65	8	.0
September--	67.3	45.4	56.4	87	28	206	3.82	1.85	5.51	8	.0
October----	56.1	36.2	46.2	80	18	86	2.26	.90	3.39	6	.1
November---	38.8	23.3	31.1	64	-4	0	1.78	.77	2.62	5	6.8
December---	25.4	8.2	16.8	48	-24	0	1.23	.60	1.77	5	12.6
Yearly:											
Average---	52.0	30.3	41.2	---	---	---	---	---	---	---	---
Extreme---	---	---	---	95	-32	---	---	---	---	---	---
Total-----	---	---	---	---	---	1,954	30.66	25.58	35.50	73	53.0

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-81 at Rhinelander, Wisconsin)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 7	May 17	May 28
2 years in 10 later than--	May 3	May 13	May 25
5 years in 10 later than--	Apr. 25	May 5	May 18
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 4	Sept. 23	Sept. 11
2 years in 10 earlier than--	Oct. 10	Sept. 28	Sept. 15
5 years in 10 earlier than--	Oct. 22	Oct. 7	Sept. 23

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-81 at Rhinelander, Wisconsin)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	157	136	109
8 years in 10	164	143	115
5 years in 10	179	155	127
2 years in 10	194	167	138
1 year in 10	202	174	144

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
AcB	Alcona fine sandy loam, 0 to 6 percent slopes	1,690	0.2
AcC	Alcona fine sandy loam, 6 to 15 percent slopes	370	*
Au	Au Gres loamy sand, 0 to 2 percent slopes	14,970	1.9
CaA	Cable muck, 0 to 3 percent slopes, stony	17,130	2.2
Cb	Carbondale, Lupton, and Markey mucks, 0 to 1 percent slopes	90,741	11.5
CrA	Croswell sand, 0 to 3 percent slopes	19,360	2.4
CsA	Croswell loamy sand, loamy substratum, 0 to 3 percent slopes	4,950	0.6
EmE	Emmert very gravelly sand, 20 to 45 percent slopes	600	0.1
Fh	Fordum mucky very fine sandy loam, 0 to 2 percent slopes	3,990	0.5
GoB	Goodman silt loam, 1 to 6 percent slopes, stony	11,075	1.4
GoC	Goodman silt loam, 6 to 15 percent slopes, stony	8,910	1.1
GoD	Goodman silt loam, 15 to 25 percent slopes, stony	2,030	0.3
Gr	Greenwood, Loxley, and Dawson peats, 0 to 1 percent slopes	81,485	10.3
KaB	Karlin loamy fine sand, 0 to 6 percent slopes	4,805	0.6
KeB	Keweenaw sandy loam, 1 to 6 percent slopes, stony	9,670	1.2
KeC	Keweenaw sandy loam, 6 to 15 percent slopes, stony	10,760	1.4
KeD	Keweenaw sandy loam, 15 to 25 percent slopes, stony	3,120	0.4
KnB	Keweenaw-Vilas complex, 1 to 6 percent slopes, stony	16,610	2.1
KnC	Keweenaw-Vilas complex, 6 to 15 percent slopes, stony	31,005	3.9
KrD	Keweenaw-Sayner complex, 15 to 30 percent slopes, stony	23,730	3.0
Ks	Kinross muck, 0 to 2 percent slopes	9,745	1.2
MaB	Magnor silt loam, 1 to 6 percent slopes, stony	10,930	1.4
Mc	Minocqua silt loam, 0 to 2 percent slopes	3,780	0.5
MoB	Monico loam, 1 to 6 percent slopes, stony	19,420	2.5
PaB	Padus loam, 0 to 6 percent slopes	13,635	1.7
PaC	Padus loam, 6 to 15 percent slopes	10,755	1.4
PaD	Padus loam, 15 to 25 percent slopes	4,640	0.6
PbB	Padus-Goodman complex, 1 to 6 percent slopes, stony	5,705	0.7
PbC	Padus-Goodman complex, 6 to 15 percent slopes, stony	12,565	1.6
PbD	Padus-Goodman complex, 15 to 25 percent slopes, stony	5,615	0.7
PeB	Padus-Pence sandy loams, 1 to 6 percent slopes	34,955	4.4
PeC	Padus-Pence sandy loams, 6 to 15 percent slopes	37,265	4.7
PeD	Padus-Pence sandy loams, 15 to 45 percent slopes	34,490	4.4
PrB	Pequaming loamy sand, 1 to 3 percent slopes, stony	9,085	1.1
Pt	Pits, gravel	325	*
PvA	Plover fine sandy loam, 0 to 3 percent slopes	2,640	0.3
RsB	Rousseau loamy fine sand, 0 to 6 percent slopes	2,145	0.3
RsC	Rousseau loamy fine sand, 6 to 15 percent slopes	880	0.1
SaB	Sayner loamy sand, 0 to 6 percent slopes	9,365	1.2
SaC	Sayner loamy sand, 6 to 15 percent slopes	35,650	4.5
SaD	Sayner loamy sand, 15 to 45 percent slopes	31,135	3.9
UdB	Udorthents, nearly level and gently sloping	340	*
VsB	Vilas loamy sand, 0 to 6 percent slopes	30,520	3.9
VsC	Vilas loamy sand, 6 to 15 percent slopes	19,085	2.4
VsD	Vilas loamy sand, 15 to 25 percent slopes	11,630	1.5
WoA	Worcester sandy loam, 0 to 3 percent slopes	9,950	1.3
	Water	68,096	8.6
	Total	791,347	100.0

* Less than 0.05 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
AcB	Alcona fine sandy loam, 0 to 6 percent slopes
PaB	Padus loam, 0 to 6 percent slopes
PvA	Plover fine sandy loam, 0 to 3 percent slopes (where drained)
WoA	Worcester sandy loam, 0 to 3 percent slopes (where drained)

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
AcB, AcC-------- Alcona	3L	Slight	Moderate	Slight	Slight	Sugar maple--------- Red maple---------- Yellow birch-------- American basswood--- American beech------ Northern red oak---- Eastern white pine-- White ash---------- Red pine----------	61 --- --- --- --- --- --- ---	38 --- --- --- --- --- --- ---	White spruce, red pine, eastern white pine.
Au-------------- Au Gres	6W	Slight	Severe	Moderate	Severe	Quaking aspen------- Bigtooth aspen------ Balsam fir---------- Paper birch--------- Yellow birch-------- Red maple---------- Eastern hemlock----- Eastern white pine-- Northern whitecedar-	70 --- --- --- --- --- --- --- ---	81 --- --- --- --- --- --- --- ---	White spruce, red pine, eastern white pine, Norway spruce.
CaA------------- Cable	2X	Slight	Severe	Severe	Severe	Red maple---------- Balsam fir---------- White ash---------- Black ash---------- Black spruce-------- Quaking aspen------- White spruce--------	56 --- --- 48 --- --- ---	36 --- --- 32 --- --- ---	White spruce, red maple, balsam fir, black spruce.
Cb**: Carbondale----- Lupton--------- Markey--------- 	5W 6W 7W 	Slight Slight Slight 	Severe Severe Severe 	Severe Severe Severe 	Severe Severe Severe 	Balsam fir---------- Black spruce-------- Northern whitecedar- Tamarack---------- Paper birch--------- Silver maple-------- Balsam fir---------- Black spruce-------- Black ash---------- Northern whitecedar- Paper birch--------- Tamarack---------- Red maple---------- Quaking aspen------- White spruce-------- Balsam fir---------- Quaking aspen------- Black spruce-------- Tamarack---------- Black ash---------- Northern whitecedar- Paper birch--------- Red maple---------- White spruce--------	40 15 --- --- --- 78 46 20 --- 30 --- --- --- --- --- 52 --- --- --- --- --- --- ---	71 23 --- --- --- 32 86 29 --- 42 --- --- --- --- --- 100 --- --- --- --- --- --- ---	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
CrA---------- Croswell	5S	Slight	Moderate	Moderate	Slight	Quaking aspen-------	68	78	Red pine, eastern white pine, white spruce.
						Red pine----------	55	88	
						Jack pine----------	53	73	
						Northern red oak----	---	---	
						Black cherry--------	---	---	
						Eastern white pine--	---	---	
						Bigtooth aspen------	---	---	
						Red maple----------	---	---	
CsA---------- Croswell	7A	Slight	Slight	Slight	Slight	Red pine----------	60	101	Red pine, eastern white pine, jack pine.
						Jack pine----------	---	---	
						Eastern white pine--	---	---	
						Northern pin oak----	---	---	
						Quaking aspen-------	---	---	
						Bigtooth aspen------	---	---	
						Northern red oak----	---	---	
						Red maple----------	---	---	
						American basswood---	---	---	
						Paper birch---------	---	---	
EmE---------- Emmert	6R	Moderate	Moderate	Severe	Slight	Red pine----------	52	80	Red pine, jack pine, eastern white pine.
						Eastern white pine--	50	90	
						Jack pine----------	60	85	
						White spruce--------	55	42	
Fh---------- Fordum	2W	Slight	Severe	Severe	Severe	Silver maple--------	80	34	Silver maple, red maple, white ash.
						Red maple----------	---	---	
						White ash----------	---	---	
						Northern whitecedar-	---	---	
						Tamarack----------	---	---	
						Black spruce--------	---	---	
						Balsam fir----------	---	---	
						White spruce--------	---	---	
GoB, GoC-------- Goodman	3X	Slight	Moderate	Slight	Moderate	Sugar maple---------	69	42	Eastern white pine, red pine, white spruce.
						Yellow birch--------	---	---	
						American basswood---	68	63	
						Bigtooth aspen------	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
GoD---------- Goodman	3R	Slight	Moderate	Slight	Slight	Sugar maple---------	69	42	Eastern white pine, red pine, white spruce.
						Yellow birch--------	---	---	
						American basswood---	68	63	
						Bigtooth aspen------	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
KaB---------- Karlin	3A	Slight	Slight	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine.
						Yellow birch--------	---	---	
						Bigtooth aspen------	---	---	
						Northern red oak----	---	---	
						American basswood---	---	---	
						Red pine----------	65	8	
						Eastern white pine--	---	---	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
KeB, KeC-------- Keweenaw	3X	Slight	Moderate	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine.
						Eastern hemlock-----	---	---	
						Yellow birch--------	---	---	
						Northern red oak----	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
						Black cherry--------	---	---	
						Eastern white pine--	---	---	
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Bigtooth aspen------	---	---	
						American basswood---	---	---	
						Red pine------------	---	---	
KeD------------- Keweenaw	3R	Slight	Moderate	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine.
						Eastern hemlock-----	---	---	
						Yellow birch--------	---	---	
						Northern red oak----	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
						Black cherry--------	---	---	
						Eastern white pine--	---	---	
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Bigtooth aspen------	---	---	
						American basswood---	---	---	
						Red pine------------	---	---	
KnB**, KnC**:									
Keweenaw-------	3X	Slight	Moderate	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine.
						Eastern hemlock-----	---	---	
						Yellow birch--------	---	---	
						Northern red oak----	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
						Black cherry--------	---	---	
						Eastern white pine--	---	---	
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Bigtooth aspen------	---	---	
						American basswood---	---	---	
						Red pine------------	---	---	
Vilas----------	6A	Slight	Slight	Slight	Slight	Red pine------------	57	93	Red pine, eastern white pine, jack pine.
						Jack pine-----------	65	94	
						Eastern white pine--	56	109	
						Northern pin oak----	---	---	
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Northern red oak----	---	---	
						Red maple-----------	---	---	
						Paper birch---------	---	---	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
KrD**:									
Keweenaw	3R	Slight	Moderate	Slight	Slight	Sugar maple	61	38	Red pine, eastern white pine.
						Eastern hemlock	---	---	
						Yellow birch	---	---	
						Northern red oak	---	---	
						Paper birch	---	---	
						Red maple	---	---	
						Black cherry	---	---	
						Eastern white pine	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Bigtooth aspen	---	---	
						American basswood	---	---	
						Red pine	---	---	
Sayner	7R	Moderate	Moderate	Moderate	Slight	Red pine	59	99	Red pine, eastern white pine, jack pine.
						Jack pine	---	---	
						Eastern white pine	57	112	
						Northern red oak	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Red maple	---	---	
Ks	2W	Slight	Severe	Severe	Severe	Quaking aspen	45	32	
Kinross						Black spruce	---	---	
						Tamarack	---	---	
						Northern whitecedar	---	---	
						Balsam fir	---	---	
						Red maple	---	---	
MaB	3X	Slight	Severe	Moderate	Severe	Sugar maple	61	38	Eastern white pine, white spruce, red pine.
Magnor						Northern red oak	67	61	
						Red maple	65	40	
						American basswood	67	61	
						Yellow birch	65	40	
						White ash	68	63	
						Quaking aspen	---	---	
						Bigtooth aspen	---	---	
Mc	7W	Slight	Severe	Severe	Severe	Balsam fir	54	105	Red maple, white ash, white spruce, black spruce.
Minocqua						Red maple	55	35	
						White ash	---	---	
						Black ash	---	---	
						Tamarack	55	50	
						Northern whitecedar	---	---	
						Quaking aspen	---	---	
MoB	3X	Slight	Severe	Slight	Moderate	Sugar maple	63	39	White spruce, black spruce, eastern white pine, red maple, white ash.
Monico						American basswood	---	---	
						Yellow birch	---	---	
						Red maple	---	---	
						White ash	---	---	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
PaB, PaC-------- Padus	3L	Slight	Moderate	Slight	Slight	Sugar maple--------- Northern red oak---- Bigtooth aspen------ American basswood--- White ash---------- Red pine----------	67 70 78 --- --- ---	41 66 91 --- --- ---	Red pine, eastern white pine, white spruce.
PaD------------- Padus	3R	Moderate	Moderate	Slight	Slight	Sugar maple--------- Northern red oak---- Bigtooth aspen------ White ash---------- American basswood--- Red pine----------	67 70 78 --- --- ---	41 66 91 --- --- ---	Red pine, eastern white pine, white spruce.
PbB**, PbC**: Padus---------- Goodman-------- PbD**: Padus----------	3L 3X 3R	Slight Slight Moderate	Moderate Moderate Moderate	Slight Slight Slight	Slight Moderate Slight	Sugar maple--------- Northern red oak---- Bigtooth aspen------ American basswood--- White ash---------- Red pine---------- Sugar maple--------- Yellow birch-------- American basswood--- Bigtooth aspen------ Quaking aspen------- Paper birch--------- Sugar maple--------- Northern red oak---- Bigtooth aspen------ White ash---------- American basswood--- Red pine----------	67 70 78 --- --- --- 69 --- 68 --- --- --- 67 70 78 --- --- ---	41 66 91 --- --- --- 42 --- 63 --- --- --- 41 66 91 --- --- ---	Red pine, eastern white pine, white spruce. Eastern white pine, red pine, white spruce. Red pine, eastern white pine, white spruce.
Goodman-------- PeB**, PeC**: Padus----------	3R 3L	Slight Slight	Moderate Moderate	Slight Slight	Slight Slight	Sugar maple--------- Yellow birch-------- American basswood--- Bigtooth aspen------ Quaking aspen------- Paper birch--------- Sugar maple--------- Northern red oak---- Bigtooth aspen------ White ash---------- American basswood--- Red pine----------	69 --- 68 --- --- --- 67 70 78 --- --- ---	42 --- 63 --- --- --- 41 66 91 --- --- ---	Eastern white pine, red pine, white spruce. Red pine, eastern white pine, white spruce.

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
PeB**, PeC**:									
Pence	3A	Slight	Slight	Slight	Slight	Sugar maple	59	37	Red pine, eastern white pine, jack pine.
						Red pine	59	99	
						Eastern white pine	57	112	
						American basswood	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Yellow birch	---	---	
PeD**:									
Padus	3R	Severe	Severe	Slight	Slight	Sugar maple	67	41	Red pine, eastern white pine, white spruce.
						Northern red oak	70	66	
						Bigtooth aspen	78	91	
						White ash	---	---	
						American basswood	---	---	
						Red pine	---	---	
Pence	3R	Severe	Severe	Slight	Slight	Sugar maple	59	37	Red pine, eastern white pine, jack pine.
						Red pine	59	99	
						Eastern white pine	57	112	
						American basswood	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Yellow birch	---	---	
PrB---------- Pequaming	4X	Slight	Severe	Moderate	Severe	Quaking aspen	60	64	White spruce, black spruce, eastern white pine, Norway spruce, northern whitecedar.
						Sugar maple	53	34	
						Balsam fir	53	107	
						White spruce	53	103	
						Northern whitecedar	33	48	
						Red maple	56	36	
PvA---------- Plover	3W	Slight	Severe	Slight	Moderate	Red maple	65	40	Eastern white pine, white spruce, black spruce.
						American basswood	---	---	
						American elm	---	---	
						Yellow birch	---	---	
RsB, RsC-------- Rousseau	5S	Slight	Slight	Moderate	Slight	Quaking aspen	65	73	Red pine, jack pine.
SaB, SaC-------- Sayner	7S	Slight	Slight	Moderate	Slight	Red pine	59	99	Red pine, eastern white pine, jack pine.
						Jack pine	---	---	
						Eastern white pine	57	112	
						Northern red oak	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Red maple	---	---	
SaD---------- Sayner	7R	Severe	Moderate	Severe	Slight	Red pine	59	99	Red pine, eastern white pine, jack pine.
						Jack pine	---	---	
						Eastern white pine	57	112	
						Northern red oak	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Red maple	---	---	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
VsB, VsC-------- Vilas	6A	Slight	Slight	Slight	Slight	Red pine---------- Jack pine---------- Eastern white pine-- Northern pin oak---- Balsam fir---------- Quaking aspen------- Northern red oak---- Red maple---------- Paper birch---------	57 65 56 --- --- --- --- --- ---	93 94 109 --- --- --- --- --- ---	Red pine, eastern white pine, jack pine.
VsD------------- Vilas	6R	Moderate	Moderate	Slight	Slight	Red pine---------- Jack pine---------- Eastern white pine-- Northern pin oak---- Balsam fir---------- Quaking aspen------- Northern red oak---- Red maple---------- Paper birch---------	57 65 56 --- --- --- --- --- ---	93 94 109 --- --- --- --- --- ---	Red pine, eastern white pine, jack pine.
WoA------------- Worcester	2W	Slight	Severe	Slight	Moderate	Red maple---------- Sugar maple--------- Yellow birch-------- Balsam fir---------- White spruce--------	55 --- --- --- ---	35 --- --- --- ---	Eastern white pine, red maple, white spruce.

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked, natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND EQUIPMENT USE

(Only the soils suitable for the production of commercial trees are listed)

Soil name and map symbol	Ratings for the most limiting seasons			Preferred operating seasons
	Logging areas and skid trails	Log landings	Haul roads	
AcB Alcona	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.
AcC Alcona	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.
Au Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.
CaA Cable	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.
Cb*:				
Carbondale	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter.
Lupton	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter.
Markey	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter.
CrA Croswell	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Year round.
CsA Croswell	Slight	Slight	Slight	Year round.
EmE Emmert	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
Fh Fordum	Severe: wetness, low strength.	Severe: wetness, flooding, low strength.	Severe: wetness, flooding, low strength.	Summer, winter.
GoB Goodman	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.
GoC Goodman	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.
GoD Goodman	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Summer, fall, winter.
KaB Karlin	Slight	Slight	Slight	Year round.

See footnote at end of table.

TABLE 7.--WOODLAND EQUIPMENT USE--Continued

Soil name and map symbol	Ratings for the most limiting seasons			Preferred operating seasons
	Logging areas and skid trails	Log landings	Haul roads	
KeB---- Keweenaw	Slight	Slight	Slight	Year round.
KeC---- Keweenaw	Slight	Moderate: slope.	Slight	Year round.
KeD---- Keweenaw	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
KnB*:				
Keweenaw----	Slight	Slight	Slight	Year round.
Vilas----	Slight	Slight	Slight	Year round.
KnC*:				
Keweenaw----	Slight	Moderate: slope.	Slight	Year round.
Vilas----	Slight	Moderate: slope.	Slight	Year round.
KrD*:				
Keweenaw----	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
Sayner----	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
Ks---- Kinross	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.
MaB---- Magnor	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.
Mc---- Minocqua	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.
MoB---- Monico	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.
PaB---- Padus	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.
PaC---- Padus	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.
PaD---- Padus	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Summer, fall, winter.
PbB*:				
Padus----	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.
Goodman----	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.

See footnote at end of table.

TABLE 7.--WOODLAND EQUIPMENT USE--Continued

Soil name and map symbol	Ratings for the most limiting seasons			Preferred operating seasons
	Logging areas and skid trails	Log landings	Haul roads	
PbC*:				
Padus	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.
Goodman	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.
PbD*:				
Padus	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Summer, fall, winter.
Goodman	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Summer, fall, winter.
PeB*:				
Padus	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.
Pence	Slight	Slight	Slight	Year round.
PeC*:				
Padus	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.
Pence	Slight	Moderate: slope.	Slight	Year round.
PeD*:				
Padus	Severe: slope.	Severe: slope.	Severe: slope.	Summer, fall, winter.
Pence	Severe: slope.	Severe: slope.	Severe: slope.	Year round.
PrB Pequaming	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.
PvA Plover	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.
RsB Rousseau	Slight	Slight	Slight	Year round.
RsC Rousseau	Slight	Moderate: slope.	Slight	Year round.
SaB Sayner	Slight	Slight	Slight	Year round.
SaC Sayner	Slight	Moderate: slope.	Slight	Year round.
SaD Sayner	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.

See footnote at end of table.

TABLE 7.--WOODLAND EQUIPMENT USE--Continued

Soil name and map symbol	Ratings for the most limiting seasons			Preferred operating seasons
	Logging areas and skid trails	Log landings	Haul roads	
VsB---- Vilas	Slight	Slight	Slight	Year round.
VsC---- Vilas	Slight	Moderate: slope.	Slight	Year round.
VsD---- Vilas	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
WoA---- Worcester	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields in the N column are for nonirrigated soils; those in the I column are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability (nonirrigated)	Oats (nonirrigated)	Bromegrass-alfalfa hay (nonirrigated)	Timothy-red clover hay (nonirrigated)	Kentucky bluegrass (nonirrigated)	Irish potatoes	
						N	I
		Bu	Tons	Tons	AUM*	Cwt	Cwt
AcB---- Alcona	IIe	75	4.2	3.3	3.5	325	450
AcC---- Alcona	IIIe	65	3.5	2.5	3.0	300	425
Au---- Au Gres	IVw	45	2.2	1.7	1.6	200	425
CaA---- Cable	VIw	---	---	---	---	---	---
Cb**---- Carbondale, Lupton, and Markey	VIw	---	---	---	---	---	---
CrA---- Croswell	IVs	40	2.5	2.0	1.5	200	425
CsA---- Croswell	IVs	50	2.5	2.0	1.6	225	425
EmE---- Emmert	VIIs	---	---	---	---	---	---
Fh---- Fordum	VIw	---	---	---	---	---	---
GoB, GoC---- Goodman	VIs	---	---	---	3.3	---	---
GoD---- Goodman	VIIs	---	---	---	2.6	---	---
Gr**---- Greenwood, Loxley, and Dawson	VIw	---	---	---	---	---	---
KaB---- Karlin	IIIs	55	3.0	2.3	1.6	225	425
KeB---- Keweenaw	VIs	---	---	---	2.5	---	---
KeC---- Keweenaw	VIs	---	---	---	2.0	---	---
KeD---- Keweenaw	VIIs	---	---	---	1.6	---	---

See footnotes at end of table.

TABLE 8.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability (nonirrigated)	Oats (nonirrigated)	Bromegrass-alfalfa hay (nonirrigated)	Timothy-red clover hay (nonirrigated)	Kentucky bluegrass (nonirrigated)	Irish potatoes	
						N	I
		Bu	Tons	Tons	AUM*	Cwt	Cwt
KnB**--- Keweenaw-Vilas	VIs	---	---	---	2.0	---	---
KnC**--- Keweenaw-Vilas	VIs	---	---	---	1.7	---	---
KrD**--- Keweenaw-Sayner	VIIs	---	---	---	1.4	---	---
Ks--- Kinross	VIw	---	---	---	---	---	---
MaB--- Magnor	VIs	---	---	---	3.5	---	---
Mc--- Minocqua	VIw	---	---	---	---	---	---
MoB--- Monico	VIs	---	---	---	3.3	---	---
PaB--- Padus	IIe	75	4.0	3.0	3.0	375	450
PaC--- Padus	IIIe	70	3.5	2.5	2.5	350	425
PaD--- Padus	VIe	---	---	---	2.0	---	---
PbB**, PbC**--- Padus-Goodman	VIs	---	---	---	3.0	---	---
PbD**--- Padus-Goodman	VIIs	---	---	---	2.2	---	---
PeB**--- Padus-Pence	IIIe	65	3.5	2.8	2.5	275	450
PeC**--- Padus-Pence	IVe	55	3.0	2.3	2.0	250	425
PeD**--- Padus-Pence	VIIe	---	---	---	1.5	---	---
PrB--- Pequaming	VIs	---	---	---	1.6	---	---
Pt**. Pits							
PvA--- Plover	IIw	70	3.5	3.0	2.0	300	450
RsB--- Rousseau	IIIs	55	2.5	2.0	1.6	225	425

See footnotes at end of table.

TABLE 8.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability (nonirrigated)	Oats (nonirrigated)	Bromegrass-alfalfa hay (nonirrigated)	Timothy-red clover hay (nonirrigated)	Kentucky bluegrass (nonirrigated)	Irish potatoes	
						N	I
		Bu	Tons	Tons	AUM*	Cwt	Cwt
RsC---------- Rousseau	IIIe	45	2.3	1.8	1.3	200	425
SaB---------- Sayner	IVs	40	2.3	1.8	1.4	200	425
SaC---------- Sayner	VIs	---	---	---	1.0	---	---
SaD---------- Sayner	VIIs	---	---	---	0.8	---	---
UdB**. Udorthents							
VsB---------- Vilas	IVs	45	2.3	1.8	1.5	200	425
VsC---------- Vilas	VIs	---	---	---	1.2	---	---
VsD---------- Vilas	VIIs	---	---	---	1.0	---	---
WoA---------- Worcester	IIw	75	4.0	3.0	3.3	350	450

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil. Only the soils suited to windbreaks and environmental plantings are listed)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
AcB, AcC---------- Alcona	Manyflower cotoneaster.	Arrowwood, nannyberry viburnum, Siberian crabapple, Amur privet, American cranberrybush, lilac, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	Imperial Carolina poplar.
Au---------- Au Gres	---	Silky dogwood, American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, Manchurian crabapple, Norway spruce.	Jack pine, green ash, eastern white pine.	Imperial Carolina poplar.
CrA---------- Croswell	Manyflower cotoneaster.	Lilac, silky dogwood, Amur maple, Amur privet.	Norway spruce, Siberian crabapple, white spruce.	Red pine, eastern white pine.	Imperial Carolina poplar.
CsA---------- Croswell	Manyflower cotoneaster.	Nannyberry viburnum, lilac, Siberian peashrub.	Manchurian crabapple, white spruce, Norway spruce.	Eastern white pine, red pine, jack pine, green ash.	Imperial Carolina poplar.
KaB---------- Karlin	Manyflower cotoneaster.	Siberian crabapple, arrowwood, lilac, Amur privet, Siberian peashrub, Amur maple.	Norway spruce, white spruce.	Red pine, eastern white pine.	Imperial Carolina poplar.
KnB*, KnC*: Keweenaw.					
Vilas---------- Manyflower cotoneaster.		Lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	Imperial Carolina poplar.
KrD*: Keweenaw.					
Sayner---------- Manyflower cotoneaster.		Siberian peashrub, lilac, Amur maple, American cranberrybush, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	Imperial Carolina poplar.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
PaB, PaC, PaD----- Padus	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac.	Norway spruce-----	Jack pine, red pine, eastern white pine.	Imperial Carolina poplar.
PbB*, PbC*, PbD*: Padus---------- Goodman.	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac.	Norway spruce-----	Jack pine, red pine, eastern white pine.	Imperial Carolina poplar.
PeB*, PeC*, PeD*: Padus----------	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac.	Norway spruce-----	Jack pine, red pine, eastern white pine.	Imperial Carolina poplar.
Pence----------	Manyflower cotoneaster.	Lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	Imperial Carolina poplar.
PvA---------- Plover	---	Northern whitecedar, nannyberry viburnum, silky dogwood, American cranberrybush, redosier dogwood, lilac.	White spruce------	Eastern white pine, red maple, white ash, red pine, silver maple.	Imperial Carolina poplar.
RsB, RsC---------- Rousseau	Vanhoutte spirea, manyflower cotoneaster.	Siberian crabapple, silky dogwood, Amur privet.	White spruce, Norway spruce.	Red pine, eastern white pine, jack pine.	Imperial Carolina poplar.
SaB, SaC, SaD----- Sayner	Manyflower cotoneaster.	Siberian peashrub, lilac, Amur maple, American cranberrybush, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	Imperial Carolina poplar.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
VsB, VsC, VsD----- Vilas	Manyflower cotoneaster.	Lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	Imperial Carolina poplar.
WoA---------- Worcester	---	Common ninebark, northern whitecedar, nannyberry viburnum, American cranberrybush, redosier dogwood, silky dogwood, lilac.	White spruce------	Eastern white pine, silver maple, red maple, white ash.	Imperial Carolina poplar.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
AcB Alcona	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
AcC Alcona	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
Au Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
CaA Cable	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding, excess humus.	Severe: large stones, ponding, excess humus.
Cb*: Carbondale	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Lupton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Markey	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
CrA Croswell	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.
CsA Croswell	Moderate: too sandy.	Moderate: too sandy.	Moderate: small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
EmE Emmert	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: too sandy.	Severe: small stones, droughty.
Fh Fordum	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
GoB Goodman	Moderate: wetness.	Moderate: wetness.	Moderate: large stones, slope, wetness.	Moderate: large stones, wetness.	Severe: large stones.
GoC Goodman	Moderate: slope, wetness.	Moderate: slope, wetness.	Severe: slope.	Moderate: large stones, wetness.	Severe: large stones.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
GoD Goodman	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: large stones, slope.	Severe: large stones, slope.
Gr*: Greenwood	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Loxley	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Dawson	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
KaB Karlin	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
KeB Keweenaw	Slight	Slight	Moderate: large stones, slope, small stones.	Moderate: large stones.	Severe: large stones.
KeC Keweenaw	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: large stones.	Severe: large stones.
KeD Keweenaw	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: large stones, slope.	Severe: large stones, slope.
KnB*: Keweenaw	Slight	Slight	Moderate: large stones, slope, small stones.	Moderate: large stones.	Severe: large stones.
Vilas	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
KnC*: Keweenaw	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: large stones.	Severe: large stones.
Vilas	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
KrD*: Keweenaw	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: large stones, slope.	Severe: large stones, slope.
Sayner	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.	Severe: droughty, slope.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ks Kinross	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
MaB Magnor	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Mc Minocqua	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
MoB Monico	Severe: wetness.	Moderate: wetness, small stones.	Severe: small stones, wetness.	Moderate: large stones, wetness.	Severe: large stones.
PaB Padus	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones, droughty.
PaC Padus	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.
PaD Padus	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
PbB*: Padus	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones, droughty.
Goodman	Moderate: wetness.	Moderate: wetness.	Moderate: large stones, slope, wetness.	Moderate: large stones, wetness.	Severe: large stones.
PbC*: Padus	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.
Goodman	Moderate: slope, wetness.	Moderate: slope, wetness.	Severe: slope.	Moderate: large stones, wetness.	Severe: large stones.
PbD*: Padus	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Goodman	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: large stones, slope.	Severe: large stones, slope.
PeB*: Padus	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones, droughty.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
PeB*: Pence	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones, droughty.
PeC*: Padus	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.
Pence	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.
PeD*: Padus	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pence	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
PrB Pequaming	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: large stones, wetness.
Pt*. Pits					
PvA Plover	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
RsB Rousseau	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
RsC Rousseau	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
SaB Sayner	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Severe: droughty.
SaC Sayner	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Severe: droughty.
SaD Sayner	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
UdB*. Udorthents					

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
VsB---------- Vilas	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
VsC---------- Vilas	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
VsD---------- Vilas	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.	Severe: slope.
WoA---------- Worcester	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
AcB---- Alcona	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
AcC---- Alcona	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Au---- Au Gres	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
CaA---- Cable	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
Cb*:										
Carbondale----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Lupton----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Markey----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
CrA---- Croswell	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
CsA---- Croswell	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
EmE---- Emmert	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.
Fh---- Fordum	Very poor.	Very poor.	Poor	Fair	Fair	Good	Good	Very poor.	Fair	Good.
GoB, GoC, GoD---- Goodman	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Gr*:										
Greenwood----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Loxley----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Dawson----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
KaB---- Karlin	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
KeB---- Keweenaw	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
KeC---- Keweenaw	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
KeD--Keweenaw	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
KnB*:										
Keweenaw	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Vilas	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
KnC*:										
Keweenaw	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Vilas	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
KrD*:										
Keweenaw	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Sayner	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Ks--Kinross	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
MaB--Magnor	Very poor.	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
Mc--Minocqua	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
MoB--Monico	Very poor.	Poor	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
PaB--Padus	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
PaC--Padus	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
PaD--Padus	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
PbB*:										
Padus	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Goodman	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
PbC*:										
Padus	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Goodman	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
PbD*:										
Padus	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Goodman	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
PeB*, PeC*:										
Padus	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Pence	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
PeD*:										
Padus	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Pence	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
PrB---- Pequaming	Poor	Fair	Good	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
Pt*. Pits										
PvA---- Plover	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
RsB---- Rousseau	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
RsC---- Rousseau	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
SaB, SaC---- Sayner	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
SaD---- Sayner	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
UdB*. Udorthents										
VsB, VsC---- Vilas	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
VsD---- Vilas	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
WoA---- Worcester	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AcB Alcona	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Moderate: droughty.
AcC Alcona	Severe: cutbanks cave.	Moderate: slope.	Moderate: wetness, slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
Au Au Gres	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
CaA Cable	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: large stones, ponding, excess humus.
Cb*: Carbondale	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Lupton	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
Markey	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
CrA Croswell	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.
CsA Croswell	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Moderate: droughty.
EmE Emmert	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, droughty.
Fh Fordum	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: ponding, flooding.
GoB Goodman	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Severe: large stones.
GoC Goodman	Severe: cutbanks cave, wetness.	Moderate: wetness, slope.	Severe: wetness.	Severe: slope.	Moderate: wetness, slope, frost action.	Severe: large stones.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
GoD---------- Goodman	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: large stones, slope.
Gr*:						
Greenwood--------	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
Loxley----------	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: excess humus, ponding.
Dawson----------	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
KaB---------- Karlin	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
KeB---------- Keweenaw	Severe: cutbanks cave.	Moderate: large stones.	Moderate: wetness, large stones.	Moderate: large stones.	Moderate: large stones.	Severe: large stones.
KeC---------- Keweenaw	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, large stones.	Severe: large stones.
KeD---------- Keweenaw	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: large stones, slope.
KnB*:						
Keweenaw---------	Severe: cutbanks cave.	Moderate: large stones.	Moderate: wetness, large stones.	Moderate: large stones.	Moderate: large stones.	Severe: large stones.
Vilas----------	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
KnC*:						
Keweenaw---------	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, large stones.	Severe: large stones.
Vilas----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
KrD*:						
Keweenaw---------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: large stones, slope.
Sayner----------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ks Kinross	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
MaB Magnor	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Mc Minocqua	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
MoB Monico	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Severe: large stones.
PaB Padus	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Moderate: large stones, droughty.
PaC Padus	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
PaD Padus	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
PbB*: Padus	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Moderate: large stones, droughty.
Goodman	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Severe: large stones.
PbC*: Padus	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
Goodman	Severe: cutbanks cave, wetness.	Moderate: wetness, slope.	Severe: wetness.	Severe: slope.	Moderate: wetness, slope, frost action.	Severe: large stones.
PbD*: Padus	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Goodman	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: large stones, slope.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
PeB*:						
Padus	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Moderate: large stones, droughty.
Pence	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: large stones, droughty.
PeC*:						
Padus	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
Pence	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
PeD*:						
Padus	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pence	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
PrB Pequaming	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: large stones, wetness.
Pt*. Pits						
PvA Plover	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
RsB Rousseau	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
RsC Rousseau	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
SaB Sayner	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
SaC Sayner	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
SaD Sayner	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
UdB* Udorthents						

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
VsB Vilas	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
VsC Vilas	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
VsD Vilas	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
WoA Worcester	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: large stones, wetness, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "severe," "poor," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AcB Alcona	Severe: wetness.	Severe: seepage, wetness.	Severe: too sandy.	Moderate: wetness.	Poor: too sandy.
AcC Alcona	Severe: wetness.	Severe: seepage, slope, wetness.	Severe: too sandy.	Moderate: wetness, slope.	Poor: too sandy.
Au Au Gres	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
CaA Cable	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: small stones, ponding.
Cb*: Carbondale	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Lupton	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Markey	Severe: subsides, ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
CrA Croswell	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
CsA Croswell	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
EmE Emmert	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Fh Fordum	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, ponding.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
GoB Goodman	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Fair: wetness.
GoC Goodman	Severe: wetness.	Severe: slope, wetness.	Severe: wetness.	Moderate: wetness, slope.	Fair: slope, wetness.
GoD Goodman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Gr*: Greenwood	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Loxley	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Dawson	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
KaB Karlin	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
KeB Keweenaw	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, small stones.
KeC Keweenaw	Moderate: slope, large stones.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.
KeD Keweenaw	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
KnB*: Keweenaw	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, small stones.
Vilas	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
KnC*: Keweenaw	Moderate: slope, large stones.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
KnC*:					
Vilas	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
KrD*:					
Keweenaw	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
Sayner	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Ks	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Kinross					
MaB	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Magnor					
Mc	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
Minocqua					
MoB	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: seepage, small stones, wetness.
Monico					
PaB	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Padus					
PaC	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Padus					
PaD	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Padus					
PbB*:					
Padus	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Goodman	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Fair: wetness.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
PbC*:					
Padus	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Goodman	Severe: wetness.	Severe: slope, wetness.	Severe: wetness.	Moderate: wetness, slope.	Fair: slope, wetness
PbD*:					
Padus	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Goodman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
PeB*:					
Padus	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Pence	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
PeC*:					
Padus	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Pence	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
PeD*:					
Padus	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Pence	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
PrB	Severe: wetness, poor filter.	Severe: seepage, wetness, large stones.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
Pt*. Pits					

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
PvA---------- Plover	Severe: wetness.	Severe: wetness.	Severe: wetness, too sandy.	Severe: wetness.	Poor: too sandy, wetness.
RsB---------- Rousseau	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
RsC---------- Rousseau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
SaB---------- Sayner	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
SaC---------- Sayner	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
SaD---------- Sayner	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
UdB*. Udorthents					
VsB---------- Vilas	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VsC---------- Vilas	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VsD---------- Vilas	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
WoA---------- Worcester	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AcB, AcC Alcona	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
Au Au Gres	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
CaA Cable	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, wetness.
Cb*:				
Carbondale	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Lupton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Markey	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
CrA Croswell	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
CsA Croswell	Fair: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy.
EmE Emmert	Poor: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Fh Fordum	Poor: wetness.	Probable	Improbable: too sandy.	Poor: small stones, wetness.
GoB, GoC Goodman	Fair: wetness.	Probable	Probable	Poor: large stones, area reclaim.
GoD Goodman	Fair: slope.	Probable	Probable	Poor: large stones, slope.
Gr*:				
Greenwood	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Gr*:				
Loxley	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Dawson	Poor: wetness.	Probable	Probable	Poor: excess humus, wetness.
KaB Karlin	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
KeB Keweenaw	Fair: large stones, wetness.	Probable	Improbable: too sandy.	Poor: small stones, area reclaim.
KeC Keweenaw	Fair: large stones.	Probable	Improbable: too sandy.	Poor: small stones, area reclaim.
KeD Keweenaw	Fair: large stones, slope.	Probable	Improbable: too sandy.	Poor: small stones, area reclaim, slope.
KnB*:				
Keweenaw	Fair: large stones, wetness.	Probable	Improbable: too sandy.	Poor: small stones, area reclaim.
Vilas	Good	Probable	Improbable: too sandy.	Poor: too sandy.
KnC*:				
Keweenaw	Fair: large stones.	Probable	Improbable: too sandy.	Poor: small stones, area reclaim.
Vilas	Good	Probable	Improbable: too sandy.	Poor: too sandy.
KrD*:				
Keweenaw	Fair: large stones, slope.	Probable	Improbable: too sandy.	Poor: small stones, area reclaim, slope.
Sayner	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Ks Kinross	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
MaB Magnor	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Mc Minocqua	Poor: wetness.	Probable	Probable	Poor: small stones, area reclaim.
MoB Monico	Fair: large stones, wetness.	Probable	Probable	Poor: small stones, area reclaim.
PaB Padus	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.
PaC Padus	Good	Probable	Probable	Poor: small stones, area reclaim.
PaD Padus	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
PbB*: Padus	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.
Goodman	Fair: wetness.	Probable	Probable	Poor: large stones, area reclaim.
PbC*: Padus	Good	Probable	Probable	Poor: small stones, area reclaim.
Goodman	Fair: wetness.	Probable	Probable	Poor: large stones, area reclaim.
PbD*: Padus	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
Goodman	Fair: slope.	Probable	Probable	Poor: large stones, slope.
PeB*, PeC*: Padus	Good	Probable	Probable	Poor: small stones, area reclaim.
Pence	Good	Probable	Probable	Poor: small stones, area reclaim.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
PeD*:				
Padus	Poor: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
Pence	Poor: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
PrB Pequaming	Poor: wetness.	Probable	Improbable: too sandy.	Poor: large stones, area reclaim, wetness.
Pt*. Pits				
PvA Plover	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
RsB, RsC Rousseau	Good	Probable	Improbable: too sandy.	Poor: too sandy.
SaB, SaC Sayner	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
SaD Sayner	Poor: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
UdB*. Udorthents				
VsB, VsC Vilas	Good	Probable	Improbable: too sandy.	Poor: too sandy.
VsD Vilas	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
WoA Worcester	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "moderate" and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
AcB---- Alcona	Moderate: seepage, slope.	Severe: piping.	Slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy.	Droughty.
AcC---- Alcona	Severe: slope.	Severe: piping.	Slope, cutbanks cave.	Slope, wetness, droughty.	Slope, wetness, too sandy.	Slope, droughty.
Au---- Au Gres	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
CaA---- Cable	Moderate: seepage.	Severe: piping, ponding.	Ponding, frost action.	Large stones, ponding.	Large stones, erodes easily, ponding.	Large stones, wetness, erodes easily.
Cb*:						
Carbondale----	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
Lupton----	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
Markey----	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
CrA---- Croswell	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy.	Droughty.
CsA---- Croswell	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
EmE---- Emmert	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, large stones, droughty.	Slope, large stones, too sandy.	Large stones, slope, droughty.
Fh---- Fordum	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, flooding, frost action.	Ponding, flooding.	Ponding, too sandy.	Wetness.
GoB---- Goodman	Moderate: seepage, slope.	Severe: piping.	Slope----	Slope, wetness.	Large stones, erodes easily, wetness.	Erodes easily, large stones.
GoC---- Goodman	Severe: slope.	Severe: piping.	Slope----	Slope, wetness.	Slope, large stones, erodes easily.	Slope, erodes easily, large stones.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
GoD---------- Goodman	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Gr*: Greenwood--------	Severe: seepage.	Severe: excess humus, ponding.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
Loxley----------	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding--------	Ponding--------	Wetness.
Dawson----------	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, rooting depth.	Ponding--------	Wetness, rooting depth.
KaB---------- Karlin	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
KeB---------- Keweenaw	Severe: seepage.	Severe: seepage, piping.	Slope, cutbanks cave.	Slope, large stones, wetness.	Large stones, wetness.	Large stones, droughty.
KeC, KeD---------- Keweenaw	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, large stones, droughty.	Slope, large stones, too sandy.	Large stones, slope, droughty.
KnB*: Keweenaw---------	Severe: seepage.	Severe: seepage, piping.	Slope, cutbanks cave.	Slope, large stones, wetness.	Large stones, wetness.	Large stones, droughty.
Vilas----------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
KnC*: Keweenaw---------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, large stones, droughty.	Slope, large stones, too sandy.	Large stones, slope, droughty.
Vilas----------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
KrD*: Keweenaw---------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, large stones, droughty.	Slope, large stones, too sandy.	Large stones, slope, droughty.
Sayner----------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
Ks---------- Kinross	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding--------	Ponding, too sandy, soil blowing.	Wetness.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
MaB---Magnor	Moderate: seepage, slope.	Severe: piping, wetness.	Percs slowly, frost action, slope.	Slope, wetness, droughty.	Large stones, erodes easily, wetness.	Large stones, wetness, erodes easily.
Mc---Minocqua	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, frost action, cutbanks cave.	Ponding, droughty.	Erodes easily, ponding, too sandy.	Wetness, erodes easily, droughty.
MoB---Monico	Moderate: seepage, slope.	Severe: seepage, piping.	Frost action, slope, cutbanks cave.	Slope, large stones, wetness.	Large stones, wetness, too sandy.	Large stones, wetness, droughty.
PaB---Padus	Severe: seepage.	Severe: seepage, piping.	Slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy.	Droughty, rooting depth.
PaC, PaD---Padus	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty, rooting depth.
PbB*:						
Padus	Severe: seepage.	Severe: seepage, piping.	Slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy.	Droughty, rooting depth.
Goodman	Moderate: seepage, slope.	Severe: piping.	Slope	Slope, wetness.	Large stones, erodes easily, wetness.	Erodes easily, large stones.
PbC*:						
Padus	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty, rooting depth.
Goodman	Severe: slope.	Severe: piping.	Slope	Slope, wetness.	Slope, large stones, erodes easily.	Slope, erodes easily, large stones.
PbD*:						
Padus	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty, rooting depth.
Goodman	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
PeB*:						
Padus	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty, rooting depth.
Pence	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
PeC*, PeD*:						
Padus	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
PeC*, PeD*: Pence	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
PrB--- Pequaming	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Large stones, wetness.	Large stones, wetness, too sandy.	Large stones, wetness, droughty.
Pt*. Pits						
PvA--- Plover	Moderate: seepage.	Severe: piping, wetness.	Frost action, cutbanks cave.	Wetness, soil blowing.	Wetness, too sandy.	Wetness.
RsB--- Rousseau	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
RsC--- Rousseau	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
SaB--- Sayner	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
SaC, SaD--- Sayner	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
UdB*. Udorthents						
VsB--- Vilas	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
VsC, VsD--- Vilas	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
WoA--- Worcester	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness, droughty, soil blowing.	Wetness, too sandy, soil blowing.	Wetness, droughty, rooting depth.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
AcB, AcC--------- Alcona	0-9	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-4, A-2-4	0-8	95-100	90-100	55-95	25-65	<25	NP-7
	9-16	Loamy fine sand, very fine sandy loam, gravelly sandy loam.	SM, ML, SC, CL	A-4, A-2-4	0-8	85-100	70-100	55-95	15-65	<30	NP-10
	16-29	Sandy loam, fine sandy loam, loam.	SC, SM-SC, CL, CL-ML	A-2-4, A-4	0-8	95-100	90-100	55-85	25-70	20-30	4-10
	29-60	Stratified fine sand to silt loam.	SM, ML	A-4, A-2-4	0-8	95-100	90-100	60-95	25-85	<30	NP-7
Au--------------- Au Gres	0-3	Loamy sand-------	SM, SP-SM, SM-SC	A-2-4, A-1-b	0	95-100	85-100	40-75	10-30	<25	NP-7
	3-25	Sand, loamy sand	SP-SM, SM, SM-SC	A-2-4, A-3, A-1-b	0	95-100	85-100	40-75	5-30	<25	NP-7
	25-60	Sand-------------	SP-SM, SM	A-3, A-2-4, A-1-b	0	95-100	85-100	40-60	5-15	---	NP
CaA-------------- Cable	0-3	Sapric material	PT	A-8	25-50	---	---	---	---	---	---
	3-31	Silt loam, loam, fine sandy loam.	SM, SC, ML, CL	A-2, A-4	0-25	75-100	75-100	50-100	30-90	<33	NP-10
	31-34	Loam, sandy loam, gravelly sandy loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-25	65-100	60-100	35-95	20-75	<27	NP-8
	34-60	Sandy loam, gravelly sandy loam, gravelly loamy sand.	SM, GM, ML, CL-ML	A-2, A-1, A-4	0-25	65-100	60-100	40-90	20-70	<23	NP-6
Cb*:											
Carbondale------	0-35	Sapric material	PT	A-8	0	---	---	---	---	---	---
	35-60	Hemic material---	PT	A-8	0	---	---	---	---	---	---
Lupton----------	0-12	Sapric material	PT	A-8	0	---	---	---	---	---	---
	12-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
Markey----------	0-26	Sapric material	PT	A-8	0	---	---	---	---	---	---
	26-60	Sand, loamy sand, fine sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	95-100	75-100	35-75	0-30	---	NP
CrA-------------- Croswell	0-4	Sand-------------	SP-SM, SM	A-3, A-2-4, A-1-b	0	90-100	85-100	40-70	5-15	---	NP
	4-38	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	85-100	40-75	3-30	---	NP
	38-60	Sand-------------	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	85-100	40-70	3-15	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
CsA---------- Croswell	0-8	Loamy sand-------	SM	A-2, A-1	0	90-100	85-100	40-75	15-30	<20	NP-4
	8-24	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0	90-100	85-100	40-75	0-30	<20	NP-4
	24-54	Sand----------	SP-SM, SM, SP	A-3, A-2, A-1	0	90-100	85-100	40-70	0-25	---	NP
	54-60	Stratified fine sand to silt loam.	CL, SC, SM-SC, CL-ML	A-6, A-4, A-2	0	100	90-100	65-95	20-90	20-35	4-15
EmE---------- Emmert	0-2	Very gravelly sand.	SM, SP, GW, GP	A-1	0-10	45-90	40-75	10-50	0-20	<25	NP
	2-60	Very gravelly coarse sand, very gravelly sand.	GW, GP, SP, SW	A-1	0-30	20-60	10-45	5-25	0-5	---	NP
Fh---------- Fordum	0-7	Mucky very fine sandy loam.	SM, SM-SC, ML, CL-ML	A-4, A-2, A-1	0-15	80-100	75-100	45-95	20-65	<25	3-7
	7-39	Silt loam, very fine sandy loam, loamy very fine sand.	SM, SC, ML, CL	A-2, A-4, A-1	0-15	80-100	75-100	45-100	20-90	<30	3-10
	39-60	Sand, fine sand, loamy fine sand.	SP, SM	A-3, A-2, A-1	0-15	80-100	75-100	35-80	2-35	---	NP
GoB, GoC, GoD---- Goodman	0-3	Silt loam	ML, CL-ML	A-4	25-50	90-100	90-100	80-100	55-90	<23	NP-6
	3-23	Silt loam--------	ML, CL-ML	A-4	0-15	95-100	90-100	85-100	55-90	<25	NP-7
	23-38	Fine sandy loam, gravelly sandy loam, gravelly loamy sand.	ML, CL-ML, SM, SM-SC	A-2, A-1, A-4, A-3	0-15	65-100	60-95	30-90	7-70	<23	NP-6
	38-60	Sandy loam, gravelly sandy loam, gravelly loamy sand.	SM, SM-SC, SP-SM	A-2, A-1, A-3	0-15	65-100	60-95	30-80	7-35	<23	NP-6
Gr*:											
Greenwood-------	0-9	Fibric material	PT	A-8	0	---	---	---	---	---	---
	9-60	Hemic material---	PT	A-8	0	---	---	---	---	---	---
Loxley----------	0-4	Fibric material	PT	A-8	0	---	---	---	---	---	---
	4-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
Dawson----------	0-4	Fibric material	PT	A-8	0	---	---	---	---	---	---
	4-35	Sapric material	PT	A-8	0	---	---	---	---	---	---
	35-60	Sand, gravelly sand, very fine sand.	SM-SC, SM, SC, SP-SM	A-2, A-3, A-1, A-4	0	45-100	35-100	15-90	0-45	<20	NP-10
KaB---------- Karlin	0-4	Loamy fine sand	SM, SP-SM	A-2, A-4	0	90-100	75-100	60-100	10-45	---	NP-4
	4-32	Loamy fine sand, loamy sand, sandy loam.	SP-SM, SM, ML	A-2, A-4	0	90-100	75-100	60-100	10-55	<20	NP-4
	32-60	Sand----------	SP, SP-SM, SM	A-2, A-3, A-1	0	80-100	75-100	35-70	0-15	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
KeB, KeC, KeD----- Keweenaw	0-5	Sandy loam-------	SM, SC, SM-SC	A-2, A-4, A-1-b	25-50	90-100	75-100	45-75	15-40	<20	NP-10
	5-23	Loamy fine sand, gravelly loamy sand, sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b, A-4, A-3	0-25	85-100	60-100	30-85	5-45	<20	NP-10
	23-55	Gravelly sandy loam, sand, gravelly loamy sand.	SM, SC, SP-SM, ML	A-2, A-3, A-1-b, A-4	0-25	85-100	60-100	30-85	5-55	<30	NP-10
	55-60	Loamy sand, gravelly loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b	0-25	85-100	60-100	30-75	10-30	<20	NP-10
KnB*, KnC*:											
Keweenaw--------	0-5	Sandy loam-------	SM, SC, SM-SC	A-2, A-4, A-1-b	25-50	90-100	75-100	45-75	15-40	<20	NP-10
	5-23	Loamy fine sand, gravelly loamy sand, sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b, A-4, A-3	0-25	85-100	60-100	30-85	5-45	<20	NP-10
	23-55	Gravelly sandy loam, sand, gravelly loamy sand.	SM, SC, SP-SM, ML	A-2, A-3, A-1-b, A-4	0-25	85-100	60-100	30-85	5-55	<30	NP-10
	55-60	Loamy sand, gravelly loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b	0-25	85-100	60-100	30-75	10-30	<20	NP-10
Vilas----------	0-3	Loamy sand-------	SM, SP-SM	A-1, A-2	0	80-100	75-100	35-90	12-30	---	NP
	3-19	Loamy sand-------	SP-SM, SM	A-1, A-2	0	80-100	75-100	35-90	12-30	---	NP
	19-30	Sand-------------	SM, SP-SM	A-1, A-2, A-3	0	80-100	75-100	35-90	5-20	---	NP
	30-60	Sand-------------	SP, SP-SM, SM	A-1, A-2, A-3	0	80-100	75-100	35-90	1-20	---	NP
KrD*:											
Keweenaw--------	0-5	Sandy loam-------	SM, SC, SM-SC	A-2, A-4, A-1-b	25-50	90-100	75-100	40-70	15-40	<20	NP-10
	5-23	Loamy fine sand, gravelly loamy sand, sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b, A-4, A-3	0-25	85-100	60-100	30-85	5-45	<20	NP-10
	23-55	Gravelly sandy loam, sand, gravelly loamy sand.	SM, SC, SP-SM, ML	A-2, A-3, A-1-b, A-4	0-25	85-100	60-100	30-85	5-55	<30	NP-10
	55-60	Loamy sand, gravelly loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b	0-25	85-100	60-100	30-75	10-30	<20	NP-10
Sayner----------	0-4	Loamy sand-------	SM, SP-SM	A-1, A-2	0-15	80-100	75-100	35-75	10-30	---	NP
	4-22	Loamy sand, sand, gravelly sand.	SP, SM, GP, GM	A-1, A-3, A-2	0-15	50-100	50-100	20-75	0-30	---	NP
	22-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-15	50-90	40-85	0-55	0-10	---	NP
Ks--------------- Kinross	0-5	Sapric material	PT	A-8	0	---	---	---	---	---	NP
	5-29	Sand, fine sand, loamy sand.	SP-SM, SM	A-3, A-2-4	0	100	100	50-80	5-30	---	NP
	29-60	Sand, fine sand.	SP-SM, SM	A-3, A-2-4	0	100	100	50-80	5-30	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
MaB--------- Magnor	0-4	Silt loam--------	CL, CL-ML, ML	A-4	15-25	95-100	90-100	85-100	65-100	<28	2-10
	4-29	Silt loam, silt	CL, CL-ML, ML	A-4	0-15	95-100	90-100	85-100	65-100	<35	NP-10
	29-35	Loam, sandy loam, gravelly sandy loam.	ML, CL-ML, SM, SM-SC	A-2, A-4, A-1	0-15	75-100	70-95	40-90	20-70	<25	NP-7
	35-60	Sandy loam, loam, gravelly sandy loam.	ML, CL-ML, SM, SM-SC	A-2, A-4, A-1	0-15	75-100	70-95	40-90	20-70	<25	NP-6
Mc--------- Minocqua	0-8	Silt loam--------	CL, ML, SC, SM	A-4	0-7	80-100	75-100	60-100	45-90	<30	NP-10
	8-21	Silt loam, loam, sandy loam.	SC, SM, CL, ML	A-2, A-4, A-6	0-7	80-100	75-100	45-100	25-90	<35	NP-13
	21-24	Loamy coarse sand, gravelly loamy sand, gravelly sandy loam.	SM, GM, GP, SP	A-2, A-1, A-3, A-4	0-7	50-100	45-100	5-70	2-40	<20	NP-4
	24-60	Gravelly coarse sand, sand, gravelly sand.	SP, SM, GP, GM	A-1, A-3, A-2	0-7	35-100	30-100	5-70	0-30	---	NP
MoB--------- Monico	0-3	Loam-------------	ML, CL-ML, SM, SM-SC	A-4	25-50	75-100	70-100	60-100	40-90	<35	NP-7
	3-23	Silt loam, gravelly loam, fine sandy loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-25	65-100	60-100	35-95	20-75	<35	NP-10
	23-29	Sandy loam, gravelly sandy loam, loamy sand.	SM, SP-SM, GM, GP-GM	A-2, A-1	0-25	60-100	60-100	30-85	10-35	<20	NP-4
	29-60	Gravelly loamy sand, loamy sand, sandy loam.	SM, SP-SM, GM, GP-GM	A-2, A-1	0-25	60-100	60-100	30-85	10-35	<20	NP-4
PaB, PaC, PaD---- Padus	0-3	Loam-------------	ML, CL-ML, CL	A-4	0-7	80-100	75-100	65-100	50-90	<30	NP-10
	3-28	Fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1-b	0-7	80-100	75-100	45-95	20-90	<30	NP-10
	28-33	Gravelly loamy sand, sandy loam, loamy sand.	SM, SP, GP, GM	A-2, A-4, A-1, A-3	0-7	50-100	45-100	25-75	2-40	<25	NP-4
	33-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-7	30-100	25-100	10-70	1-12	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
PbB*, PbC*, PbD*:											
Padus	0-3	Loam	ML, CL-ML, CL	A-4	0-7	80-100	75-100	65-100	50-90	<30	NP-10
	3-28	Fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1-b	0-7	80-100	75-100	45-95	20-90	<30	NP-10
	28-33	Gravelly loamy sand, sandy loam, loamy sand.	SM, SP, GP, GM	A-2, A-4, A-1, A-3	0-7	50-100	45-100	25-75	2-40	<25	NP-4
	33-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-7	30-100	25-100	10-70	1-12	---	NP
Goodman	0-3	Silt loam	ML, CL-ML	A-4	25-50	90-100	90-100	80-100	55-90	<23	NP-6
	3-23	Silt loam	ML, CL-ML	A-4	0-15	95-100	90-100	85-100	55-90	<25	NP-7
	23-38	Fine sandy loam, gravelly sandy loam, gravelly loamy sand.	ML, CL-ML, SM, SM-SC	A-2, A-1, A-4, A-3	0-15	65-100	60-95	30-90	7-70	<23	NP-6
	38-60	Sandy loam, gravelly sandy loam, gravelly loamy sand.	SM, SM-SC, SP-SM	A-2, A-1, A-3	0-15	65-100	60-95	30-80	7-35	<23	NP-6
PeB*, PeC*, PeD*:											
Padus	0-5	Sandy loam	SM	A-2, A-4, A-1-b	0-7	80-100	75-100	45-85	20-50	<25	NP-4
	5-33	Fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1-b	0-7	80-100	75-100	45-95	20-90	<30	NP-10
	33-35	Gravelly loamy sand, sand, gravelly sandy loam.	SM, SP, GP, GM	A-2, A-4, A-1, A-3	0-7	50-100	45-100	25-75	2-40	<25	NP-4
	35-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-7	30-100	25-100	10-70	1-12	---	NP
Pence	0-8	Sandy loam	SM, ML	A-4, A-2, A-1	0-7	85-100	75-100	45-85	20-55	<21	NP-4
	8-15	Sandy loam, loam, gravelly sandy loam.	SM, ML, CL-ML, SM-SC	A-4, A-2, A-1	0-7	55-100	50-100	30-95	15-75	<25	NP-7
	15-21	Gravelly coarse sand, loamy sand, sand.	SM, SP-SM, GM, GP-GM	A-2, A-1, A-3	0-8	55-100	50-100	25-75	2-30	---	NP
	21-60	Gravelly coarse sand, sand, sand and gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-15	30-100	25-100	10-70	1-12	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
PrB--------- Pequaming	0-3	Loamy sand-------	SM, SC, SM-SC, SP-SM	A-2-4, A-1-b	25-50	95-100	90-100	40-70	10-30	<20	NP-10
	3-24	Loamy sand, sand	SM, SM-SC, SC, SP-SM	A-2-4, A-3, A-1-b	0-25	95-100	90-100	40-75	5-30	<20	NP-10
	24-32	Loamy sand, sandy loam.	SM, SC, SM-SC	A-2, A-1, A-4, A-6	0-25	95-100	90-100	45-75	15-40	<40	NP-25
	32-60	Loamy sand, sand, sandy loam.	SM, SM-SC, SC, SP-SM	A-1-b, A-3, A-2	0-25	80-100	60-100	30-75	5-30	<25	NP-10
Pt*. Pits											
PvA--------- Plover	0-5	Fine sandy loam	ML, SM	A-2, A-4	0	100	100	60-95	30-55	<20	NP-4
	5-23	Fine sandy loam, very fine sandy loam, loamy fine sand.	SM, ML, SM-SC, CL-ML	A-4	0	100	100	70-100	40-75	<20	NP-5
	23-29	Fine sandy loam, sandy loam.	SM, ML, CL-ML, SM-SC	A-4	0	100	100	70-100	40-70	<25	NP-7
	29-60	Stratified silt to fine sand.	SM, ML, CL-ML, SM-SC	A-4	0	100	100	65-100	40-75	<25	NP-7
RsB, RsC--------- Rousseau	0-6	Loamy fine sand	SM	A-2-4, A-4	0	100	100	75-95	25-45	---	NP
	6-21	Fine sand--------	SM	A-2-4	0	100	100	65-100	20-35	---	NP
	21-60	Fine sand, sand	SP-SM, SM	A-2-4, A-3	0	100	100	50-100	5-35	---	NP
SaB, SaC, SaD---- Sayner	0-4	Loamy sand-------	SM, SP-SM	A-1, A-2	0-15	80-100	75-100	35-75	10-30	---	NP
	4-22	Loamy sand, sand, gravelly sand.	SP, SM, GP, GM	A-1, A-3, A-2	0-15	50-100	50-100	20-75	0-30	---	NP
	22-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-15	50-90	40-85	0-55	0-10	---	NP
UdB*. Udorthents											
VsB, VsC, VsD---- Vilas	0-3	Loamy sand-------	SM, SP-SM	A-1, A-2	0	80-100	75-100	35-90	12-30	---	NP
	3-19	Loamy sand-------	SP-SM, SM	A-1, A-2	0	80-100	75-100	35-90	12-30	---	NP
	19-30	Sand-------------	SM, SP-SM	A-1, A-2, A-3	0	80-100	75-100	35-90	5-20	---	NP
	30-60	Sand-------------	SP, SP-SM, SM	A-1, A-2, A-3	0	80-100	75-100	35-90	1-20	---	NP
WoA--------- Worcester	0-3	Sandy loam-------	SM, SM-SC	A-2, A-4	0-7	80-100	75-100	45-85	25-50	<20	2-7
	3-14	Loam, sandy loam, silt loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0-7	80-100	75-100	35-95	12-80	<20	2-7
	14-26	Loam, sandy loam, gravelly sandy loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-7	50-100	45-100	25-95	10-80	15-25	3-10
	26-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-7	30-100	25-100	10-70	1-12	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
AcB, AcC----------	0-9	5-15	1.10-1.60	0.6-6.0	0.12-0.18	4.5-7.3	Low----------	0.24	5	3	1-3
Alcona	9-16	5-18	1.25-1.70	0.6-6.0	0.10-0.17	4.5-7.3	Low----------	0.17			
	16-29	10-18	1.35-1.70	0.6-2.0	0.13-0.20	5.1-7.8	Low----------	0.24			
	29-60	5-18	1.50-1.70	0.6-2.0	0.08-0.20	5.1-7.8	Low----------	0.24			
Au----------	0-3	10-15	1.30-1.55	6.0-20	0.07-0.09	3.6-7.3	Low----------	0.17	5	2	2-4
Au Gres	3-25	1-15	1.50-1.70	6.0-20	0.06-0.09	4.5-7.3	Low----------	0.15			
	25-60	0-8	1.50-1.70	6.0-20	0.05-0.07	5.1-7.3	Low----------	0.15			
CaA----------	0-3	---	0.10-0.35	2.0-6.0	0.35-0.45	4.5-7.3	Low----------	----	5	8	>50
Cable	3-31	8-18	1.35-1.45	0.2-2.0	0.10-0.22	4.5-7.3	Low----------	0.37			
	31-34	8-16	1.40-1.90	0.2-2.0	0.03-0.18	4.5-7.3	Low----------	0.37			
	34-60	5-10	1.70-1.90	0.2-0.6	0.03-0.13	5.1-7.8	Low----------	0.28			
Cb*:											
Carbondale------	0-35	---	0.30-0.40	0.2-6.0	0.35-0.45	5.6-7.8	----------	----	5	2	40-65
	35-60	---	0.10-0.17	0.6-6.0	0.45-0.55	5.6-7.8	----------	----			
Lupton----------	0-12	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8	----------	----	5	2	70-90
	12-60	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8	----------	----			
Markey----------	0-26	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	----------	----	4	2	55-85
	26-60	0-10	1.40-1.65	6.0-20	0.03-0.08	5.6-8.4	Low----------	0.15			
CrA----------	0-4	0-10	1.30-1.55	6.0-20	0.06-0.09	3.6-6.5	Low----------	0.15	5	1	.5-1
Croswell	4-38	0-10	1.40-1.60	6.0-20	0.06-0.10	4.5-7.3	Low----------	0.15			
	38-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.1-8.4	Low----------	0.15			
CsA----------	0-8	0-10	1.20-1.65	6.0-20	0.09-0.12	4.5-6.0	Low----------	0.17	5	2	.5-1
Croswell	8-24	0-10	1.35-1.75	6.0-20	0.06-0.10	5.1-6.5	Low----------	0.15			
	24-54	0-5	1.45-1.70	6.0-20	0.04-0.06	5.1-6.5	Low----------	0.15			
	54-60	10-25	1.30-1.90	0.2-0.6	0.05-0.21	5.1-7.8	Low----------	0.24			
EmE----------	0-2	1-5	1.45-1.60	>20	0.06-0.10	5.1-6.5	Low----------	0.10	2	8	.5-1
Emmert	2-60	1-3	1.55-1.65	>20	0.02-0.04	5.1-7.3	Low----------	0.10			
Fh----------	0-7	8-15	1.35-1.50	0.6-6.0	0.11-0.18	5.6-8.4	Low----------	0.28	4	8	3-12
Fordum	7-39	8-18	1.40-1.50	0.6-6.0	0.10-0.22	5.6-8.4	Low----------	0.43			
	39-60	2-5	1.55-1.70	>6.0	0.04-0.10	5.6-8.4	Low----------	0.15			
GoB, GoC, GoD----	0-3	5-12	1.35-1.45	0.6-2.0	0.11-0.20	3.6-6.5	Low----------	0.28	5	8	3-7
Goodman	3-23	8-14	1.45-1.60	0.6-2.0	0.17-0.22	3.6-6.5	Low----------	0.37			
	23-38	2-12	1.50-1.65	0.6-2.0	0.04-0.16	3.6-6.5	Low----------	0.24			
	38-60	2-12	1.55-1.75	0.6-2.0	0.04-0.12	5.1-6.5	Low----------	0.24			
Gr*:											
Greenwood-------	0-9	---	0.30-0.40	>6.0	0.55-0.65	3.6-4.4	----------	----	5	7	55-75
	9-60	---	0.10-0.25	0.6-6.0	0.45-0.55	3.6-4.4	----------	----			
Loxley----------	0-4	---	0.30-0.40	>6.0	0.55-0.65	3.6-5.0	----------	----	5	7	70-90
	4-60	---	0.10-0.35	0.2-6.0	0.35-0.45	3.6-5.0	----------	----			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
Gr*:											
Dawson	0-4	---	0.15-0.30	>6.0	0.55-0.65	3.6-4.4	----------	----	4	7	65-85
	4-35	---	0.15-0.40	0.2-6.0	0.35-0.45	3.6-4.4	----------	----			
	35-60	0-10	1.55-1.75	6.0-20	0.03-0.10	4.5-6.5	Low----------	0.15			
KaB	0-4	0-12	1.35-1.60	2.0-6.0	0.08-0.12	3.6-6.5	Low----------	0.17	4	2	.5-2
Karlin	4-32	2-15	1.35-1.60	2.0-6.0	0.08-0.16	3.6-6.5	Low----------	0.17			
	32-60	0-10	1.40-1.70	6.0-20	0.03-0.04	5.6-7.3	Low----------	0.15			
KeB, KeC, KeD	0-5	2-15	1.35-1.70	0.6-2.0	0.13-0.15	4.5-6.5	Low----------	0.17	5	8	1-2
Keweenaw	5-23	2-15	1.45-1.80	2.0-6.0	0.08-0.11	4.5-6.5	Low----------	0.17			
	23-55	0-15	1.55-1.80	0.6-6.0	0.06-0.14	4.5-6.5	Low----------	0.17			
	55-60	2-15	1.50-1.70	2.0-6.0	0.04-0.10	5.1-6.5	Low----------	0.17			
KnB*, KnC*:											
Keweenaw	0-5	2-15	1.35-1.70	0.6-2.0	0.13-0.15	4.5-6.5	Low----------	0.17	5	8	1-2
	5-23	2-15	1.45-1.80	2.0-6.0	0.08-0.11	4.5-6.5	Low----------	0.17			
	23-55	0-15	1.55-1.80	0.6-6.0	0.06-0.14	4.5-6.5	Low----------	0.17			
	55-60	2-15	1.50-1.70	2.0-6.0	0.04-0.10	5.1-6.5	Low----------	0.17			
Vilas	0-3	2-6	1.35-1.65	6.0-20	0.09-0.12	4.5-6.5	Low----------	0.17	5	2	<1
	3-19	2-6	1.50-1.65	6.0-20	0.07-0.12	4.5-6.5	Low----------	0.17			
	19-30	1-3	1.50-1.70	6.0-20	0.05-0.08	4.5-6.5	Low----------	0.17			
	30-60	0-3	1.50-1.70	6.0-20	0.04-0.07	5.1-6.5	Low----------	0.17			
KrD*:											
Keweenaw	0-5	2-15	1.35-1.70	0.6-2.0	0.13-0.15	4.5-6.5	Low----------	0.17	5	8	1-2
	5-23	2-15	1.45-1.80	2.0-6.0	0.08-0.11	4.5-6.5	Low----------	0.17			
	23-55	0-15	1.55-1.80	0.6-6.0	0.06-0.14	4.5-6.5	Low----------	0.17			
	55-60	2-15	1.50-1.70	2.0-6.0	0.04-0.10	5.1-6.5	Low----------	0.17			
Sayner	0-4	1-5	1.30-1.40	2.0-6.0	0.08-0.12	4.5-6.5	Low----------	0.17	4	2	.5-1
	4-22	1-5	1.35-1.45	2.0-6.0	0.03-0.12	4.5-6.5	Low----------	0.17			
	22-60	0-3	1.55-1.80	>6.0	0.02-0.04	5.1-6.5	Low----------	0.10			
Ks	0-5	---	0.10-0.35	2.0-6.0	0.35-0.45	3.6-5.0	----------	----	5	2	>50
Kinross	5-29	0-10	1.40-1.70	6.0-20	0.04-0.09	3.6-6.0	Low----------	0.15			
	29-60	0-10	1.40-1.70	6.0-20	0.04-0.06	4.5-6.5	Low----------	0.15			
MaB	0-4	5-18	1.35-1.55	0.6-2.0	0.12-0.21	4.5-6.0	Low----------	0.28	4	8	3-7
Magnor	4-29	5-18	1.60-1.70	0.6-2.0	0.17-0.22	4.5-6.0	Low----------	0.37			
	29-35	3-12	1.40-1.70	0.2-2.0	0.08-0.18	4.5-6.0	Low----------	0.37			
	35-60	3-12	1.80-1.95	<0.06	0.00-0.00	4.5-6.5	Low----------	0.24			
Mc	0-8	8-12	1.20-1.55	0.6-2.0	0.19-0.24	4.5-7.8	Low----------	0.37	4	5	4-10
Minocqua	8-21	10-18	1.50-1.60	0.6-2.0	0.11-0.19	4.5-7.8	Low----------	0.37			
	21-24	3-10	1.65-1.75	2.0-6.0	0.06-0.13	4.5-7.8	Low----------	0.10			
	24-60	0-3	1.75-1.85	>6.0	0.02-0.04	4.5-7.8	Low----------	0.10			
MoB	0-3	8-15	1.10-1.40	0.6-2.0	0.09-0.20	4.5-6.5	Low----------	0.28	5	8	3-7
Monico	3-23	3-18	1.65-1.75	0.6-2.0	0.06-0.19	4.5-6.5	Low----------	0.24			
	23-29	2-8	1.70-1.80	0.6-2.0	0.04-0.12	5.1-7.3	Low----------	0.17			
	29-60	2-8	1.70-1.80	0.6-2.0	0.04-0.12	5.1-7.3	Low----------	0.10			
PaB, PaC, PaD	0-3	6-15	1.35-1.55	0.6-6.0	0.17-0.24	4.5-6.5	Low----------	0.32	4	5	2-4
Padus	3-28	5-18	1.40-1.65	0.6-6.0	0.09-0.22	4.5-6.5	Low----------	0.24			
	28-33	2-10	1.40-1.65	0.6-6.0	0.05-0.14	4.5-6.5	Low----------	0.10			
	33-60	0-3	1.50-1.80	>6.0	0.02-0.06	5.1-6.5	Low----------	0.10			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
PbB*, PbC*, PbD*:											
Padus	0-3	6-15	1.35-1.55	0.6-6.0	0.17-0.24	4.5-6.5	Low	0.32	4	5	2-4
	3-28	5-18	1.40-1.65	0.6-6.0	0.09-0.22	4.5-6.5	Low	0.24			
	28-33	2-10	1.40-1.65	0.6-6.0	0.05-0.14	4.5-6.5	Low	0.10			
	33-60	0-3	1.50-1.80	>6.0	0.02-0.06	5.1-6.5	Low	0.10			
Goodman	0-3	5-12	1.35-1.45	0.6-2.0	0.11-0.20	3.6-6.5	Low	0.28	5	8	3-7
	3-23	8-14	1.45-1.60	0.6-2.0	0.17-0.22	3.6-6.5	Low	0.37			
	23-38	2-12	1.50-1.65	0.6-2.0	0.04-0.16	3.6-6.5	Low	0.24			
	38-60	2-12	1.55-1.75	0.6-2.0	0.04-0.12	5.1-6.5	Low	0.24			
PeB*, PeC*, PeD*:											
Padus	0-5	3-10	1.35-1.70	0.6-6.0	0.10-0.15	4.5-6.5	Low	0.24	4	3	.5-2
	5-33	5-18	1.40-1.65	0.6-6.0	0.09-0.22	4.5-6.5	Low	0.24			
	33-35	2-10	1.40-1.65	0.6-6.0	0.05-0.14	4.5-6.5	Low	0.10			
	35-60	0-3	1.55-1.80	>6.0	0.02-0.06	5.1-6.5	Low	0.10			
Pence	0-8	3-11	1.20-1.65	2.0-6.0	0.10-0.18	4.5-6.5	Low	0.24	3	3	1-3
	8-15	2-12	1.35-1.45	2.0-6.0	0.10-0.15	4.5-6.5	Low	0.24			
	15-21	2-10	1.65-1.75	2.0-20	0.05-0.08	4.5-6.5	Low	0.10			
	21-60	0-4	1.35-1.80	>6.0	0.02-0.05	5.1-6.5	Low	0.10			
PrB	0-3	0-12	1.25-1.50	2.0-20	0.09-0.12	4.5-6.0	Low	0.10	5	8	1-4
Pequaming	3-24	0-15	1.35-1.70	2.0-20	0.05-0.11	4.5-6.0	Low	0.17			
	24-32	2-18	1.50-1.80	2.0-20	0.08-0.14	4.5-6.0	Low	0.17			
	32-60	0-12	1.45-1.80	2.0-20	0.04-0.12	5.1-6.5	Low	0.17			
Pt*.											
Pits											
PvA	0-5	3-8	1.35-1.65	0.6-2.0	0.13-0.18	4.5-7.3	Low	0.24	5	3	2-3
Plover	5-23	5-18	1.40-1.70	0.6-2.0	0.15-0.19	4.5-7.3	Low	0.24			
	23-29	10-18	1.50-1.70	0.6-2.0	0.12-0.17	4.5-7.3	Low	0.24			
	29-60	1-12	1.50-1.70	0.6-2.0	0.11-0.22	5.6-7.3	Low	0.24			
RsB, RsC	0-6	2-12	1.30-1.55	2.0-6.0	0.10-0.12	4.5-6.0	Low	0.17	5	2	.5-2
Rousseau	6-21	0-10	1.30-1.60	6.0-20	0.06-0.08	4.5-6.5	Low	0.15			
	21-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.1-6.5	Low	0.15			
SaB, SaC, SaD	0-4	1-5	1.30-1.40	2.0-6.0	0.08-0.12	4.5-6.5	Low	0.17	4	2	.5-1
Sayner	4-22	1-5	1.35-1.45	2.0-6.0	0.03-0.12	4.5-6.5	Low	0.17			
	22-60	0-3	1.55-1.80	>6.0	0.02-0.04	5.1-6.5	Low	0.10			
UdB*.											
Udorthents											
VsB, VsC, VsD	0-3	2-6	1.35-1.65	6.0-20	0.09-0.12	4.5-6.5	Low	0.17	5	2	<1
Vilas	3-19	2-6	1.50-1.65	6.0-20	0.07-0.12	4.5-6.5	Low	0.17			
	19-30	1-3	1.50-1.70	6.0-20	0.05-0.08	4.5-6.5	Low	0.17			
	30-60	0-3	1.50-1.70	6.0-20	0.04-0.07	5.1-6.5	Low	0.17			
WoA	0-3	5-15	1.35-1.55	0.6-2.0	0.10-0.18	4.5-6.5	Low	0.24	4	3	1-3
Worcester	3-14	8-18	1.40-1.70	0.6-2.0	0.09-0.22	4.5-6.5	Low	0.32			
	14-26	8-18	1.40-1.70	0.6-2.0	0.06-0.19	4.5-6.5	Low	0.32			
	26-60	0-3	1.30-2.00	>6.0	0.02-0.07	5.1-6.5	Low	0.15			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "long," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
AcB, AcC---------- Alcona	B	None--------	---	---	2.5-6.0	Perched	Sep-May	---	Moderate	Moderate	Low.
Au---------- Au Gres	B	None--------	---	---	0.5-1.5	Apparent	Nov-May	---	Moderate	Low------	Moderate.
CaA---------- Cable	B/D	None--------	---	---	+1-1.0	Perched	Nov-May	---	High-----	High-----	High.
Cb*:											
Carbondale-------	A/D	None--------	---	---	+1-1.0	Apparent	Sep-May	43-54	High-----	High-----	Moderate.
Lupton----------	A/D	None--------	---	---	+1-1.0	Apparent	Sep-May	50-55	High-----	High-----	Low.
Markey----------	A/D	None--------	---	---	+1-1.0	Apparent	Sep-May	25-30	High-----	High-----	Low.
CrA---------- Croswell	A	None--------	---	---	2.0-4.0	Apparent	Nov-May	---	Low------	Low------	Moderate.
CsA---------- Croswell	A	None--------	---	---	2.5-5.0	Perched	Nov-May	---	Low------	Low------	Moderate.
EmE---------- Emmert	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
Fh---------- Fordum	D	Frequent----	Long------	Mar-Jun	+1-1.0	Apparent	Jan-Dec	---	High-----	High-----	High.
GoB, GoC---------- Goodman	B	None--------	---	---	1.5-3.0	Perched	Nov-May	---	Moderate	Low------	High.
GoD---------- Goodman	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	High.
Gr*:											
Greenwood--------	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	50-55	High-----	High-----	High.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
Gr*:											
Loxley	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun	50-55	High	High	High.
Dawson	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun	30-36	High	High	High.
KaB Karlin	A	None	---	---	>6.0	---	---	---	Low	Low	High.
KeB Keweenaw	A	None	---	---	2.5-6.0	Perched	Nov-May	---	Low	Low	Moderate.
KeC, KeD Keweenaw	A	None	---	---	>6.0	---	---	---	Low	Low	Moderate.
KnB*:											
Keweenaw	A	None	---	---	2.5-6.0	Perched	Nov-May	---	Low	Low	Moderate.
Vilas	A	None	---	---	>6.0	---	---	---	Low	Low	High.
KnC*:											
Keweenaw	A	None	---	---	>6.0	---	---	---	Low	Low	Moderate.
Vilas	A	None	---	---	>6.0	---	---	---	Low	Low	High.
KrD*:											
Keweenaw	A	None	---	---	>6.0	---	---	---	Low	Low	Moderate.
Sayner	A	None	---	---	>6.0	---	---	---	Low	Low	Moderate.
Ks Kinross	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun	---	Moderate	High	Moderate.
MaB Magnor	C	None	---	---	0.5-3.0	Perched	Nov-Jun	---	High	Low	Moderate.
Mc Minocqua	B/D	None	---	---	+1-1.0	Apparent	Nov-May	---	High	High	High.
MoB Monico	C	None	---	---	1.0-3.0	Perched	Nov-May	---	High	Moderate	High.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
PaB---------- Padus	B	None---------	---	---	2.5-4.0	Perched	Nov-May	---	Moderate	Low------	High.
PaC, PaD---------- Padus	B	None---------	---	---	>6.0	---	---	---	Moderate	Low------	High.
PbB*: Padus----------	B	None---------	---	---	2.5-4.0	Perched	Nov-May	---	Moderate	Low------	High.
Goodman----------	B	None---------	---	---	1.5-3.0	Perched	Nov-May	---	Moderate	Low------	High.
PbC*: Padus----------	B	None---------	---	---	>6.0	---	---	---	Moderate	Low------	High.
Goodman----------	B	None---------	---	---	1.5-3.0	Perched	Nov-May	---	Moderate	Low------	High.
PbD*: Padus----------	B	None---------	---	---	>6.0	---	---	---	Moderate	Low------	High.
Goodman----------	B	None---------	---	---	>6.0	---	---	---	Moderate	Low------	High.
PeB*, PeC*, PeD*: Padus----------	B	None---------	---	---	>6.0	---	---	---	Moderate	Low------	High.
Pence----------	B	None---------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
PrB---------- Pequaming	A	None---------	---	---	0.5-1.5	Perched	Nov-May	---	Moderate	Low------	High.
Pt*. Pits											
PvA---------- Plover	C	Rare---------	---	---	1.0-3.0	Perched	Nov-May	---	High-----	Moderate	High.
RsB, RsC---------- Rousseau	A	None---------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
SaB, SaC, SaD----- Sayner	A	None---------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
UdB*. Udorthents											
VsB, VsC, VsD----- Vilas	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	High.
WoA---------- Worcester	C	Rare--------	---	---	1.0-3.0	Apparent	Nov-May	---	High-----	High-----	High.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--ENGINEERING INDEX TEST DATA

(Dashes indicate that data were not available. MAX means maximum dry density; OPT, optimum moisture; LL, liquid limit; PI, plasticity index; UN, Unified; and NP, nonplastic)

Soil name and location	Parent material	Report number	Depth	Moisture density		Percentage passing sieve number*--				Fragments smaller than*--				LL	PI	Classification	
				MAX	OPT	4	10	40	200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	UN
			In	Lb/cu ft	Pct					Pct	Pct	Pct	Pct	Pct			
Emmert very gravelly sand: SW1/4NW1/4 sec. 19, T. 38 N., R. 10 E.	Outwash of very gravelly sand.	S81WI-085-1-3	22-60	---	---	53	45	25	1	1	1	1	1	---	NP	A-1-a(0)	SP
Goodman silt loam: NW1/4NE1/4 sec. 10, T. 36 N., R. 11 E.	Silty deposits and the underlying gravelly and loamy or sandy till.	S81WI-085-3-2	3-8	---	---	100	100	90	63	57	38	10	5	---	NP	A-4(6)	ML
		3-5	23-38	---	---	87	83	67	27	23	15	6	4	---	NP	A-2-4(0)	SM
		3-6	38-60	129.9	8.1	86	79	62	20	17	11	5	3	---	NP	A-2-4(0)	SM
Goodman silt loam: SW1/4SW1/4 sec. 18, T. 36 N., R. 4 E.	Silty deposits and the underlying gravelly and loamy or sandy till.	S80WI-085-1-3	5-10	---	---	94	91	82	64	53	19	4	2	---	NP	A-4(6)	ML
		1-5	20-27	---	---	82	76	60	28	22	14	6	3	---	NP	A-2-4(0)	SM
		1-6	27-60	---	---	80	73	55	23	20	13	6	4	---	NP	A-2-4(0)	SM
Keweenaw sandy loam: SE1/4SW1/4 sec. 18, T. 36 N., R. 7 E.	Sandy and loamy deposits and the underlying gravelly loamy sand drift.	S79WI-085-1-1	2-5	---	---	86	79	59	18	14	8	4	3	---	NP	A-2-4(0)	SM
		1-2	35-55	---	---	91	86	71	26	22	14	6	3	---	NP	A-2-4(0)	SM
		1-3	55-60	128.1	8.1	85	79	62	15	11	5	2	1	12.4	NP	A-2-4(0)	SM
Magnor silt loam: NE1/4NE1/4 sec. 7, T. 36 N., R. 4 E.	Silty deposits and the underlying sandy loam till.	S82WI-085-1-4	9-13	---	---	100	100	96	85	79	48	17	10	---	NP	A-4(8)	ML
		1-7	25-30	---	---	95	92	77	44	34	22	11	8	16.4	2.6	A-4(1)	SM
		1-8	30-60	---	---	84	78	71	29	25	17	9	6	14.6	2.4	A-2-4(0)	SM

See footnote at end of table.

TABLE 19.--ENGINEERING INDEX TEST DATA--Continued

Soil name and location	Parent material	Report number	Depth	Moisture density		Percentage passing sieve number*--				Fragments smaller than*--				LL	PI	Classification	
				MAX	OPT	4	10	40	200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	UN
			In	Lb/cu ft	Pct					Pct	Pct	Pct	Pct	Pct			
Minocqua silt loam: SW1/4SW1/4 sec. 2, T. 36 N., R. 11 E.	Silty and loamy deposits and the underlying outwash of gravelly coarse sand.	S83WI-085-2-3	8-16	---	---	97	96	89	75	67	42	13	7	19.2	NP	A-4(8)	ML
		2-6	24-60	---	---	79	68	38	3	2	2	1	1	---	NP	A-1-6(0)	SP
Padus sandy loam: SW1/4SW1/4 sec. 17, T. 39 N., R. 11 E.	Loamy deposits and the underlying outwash of stratified sand and gravel.	S77WI-085-1-1	5-11	---	---	93	93	79	30	27	18	7	4	16.3	NP	A-2-4(0)	SM
		1-2	26-33	---	---	92	89	77	33	30	20	10	7	15.6	NP	A-2-4(0)	SM
		1-3	35-60	115.4	9.1	82	75	48	2	2	2	1	1	---	NP	A-1-b(0)	SP
Pence sandy loam: SW1/4SW1/4 sec. 5, T. 38 N., R. 11 E.	Loamy deposits and the underlying outwash of gravelly coarse sand.	S75WI-085-1-1	4-9	---	---	82	77	59	33	30	18	7	4	---	NP	A-2-4(0)	SM
		1-2	19-60	---	---	60	60	25	3	3	2	1	1	---	NP	A-1(0)	SP
Plover fine sandy loam: NE1/4SE1/4 sec. 9, T. 37 N., R. 9 E.	Loamy, sandy, and silty lacustrine deposits.	S83WI-085-1-3	5-23	---	---	100	100	97	57	42	14	4	3	---	NP	A-4(4)	ML
		1-5	23-29	---	---	100	100	98	65	52	19	6	4	---	NP	A-4(6)	ML
		1-6	29-60	---	---	100	100	99	72	55	20	6	3	---	NP	A-4(7)	ML
Rousseau loamy fine sand: NE1/4NW1/4 sec. 15, T. 37 N., R. 9 E.	Sandy glacial outwash and lacustrine deposits.	S79WI-085-10-1	4-7	---	---	100	100	98	22	14	4	1	1	---	NP	A-2-4(0)	SM
		10-2	24-60	---	---	100	100	99	16	5	1	1	1	---	NP	A-2-4(0)	SM

See footnote at end of table.

TABLE 19.--ENGINEERING INDEX TEST DATA--Continued

Soil name and location	Parent material	Report number	Depth	Moisture density		Percentage passing sieve number*--				Fragments smaller than*--				LL	PI	Classification	
				MAX	OPT	4	10	40	200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	UN
			In	Lb/cu ft	Pct					Pct	Pct	Pct	Pct	Pct			
Sayner loamy sand: NW1/4NE1/4 sec. 27, T. 38 N., R. 6 E.	Sandy deposits and the underlying outwash of stratified sand and gravel.	S77WI-085-2-1	4-7	---	---	100	96	65	14	14	11	6	4	---	NP	A-2-4(0)	SM
		2-2	38-60	---	---	89	82	49	1	1	1	1	1	---	NP	A-1-b(0)	SP
Vilas loamy sand: NE1/4NW1/4 sec. 24, T. 38 N., R. 5 E.	Sandy outwash	S80WI-085-2-3	3-7	---	---	100	100	82	12	8	5	2	1	---	NP	A-2-4(0)	SP-SM
		2-6	30-60	---	---	100	100	78	2	2	1	1	1	---	NP	A-3(0)	SP
Vilas loamy sand: NW1/4SW1/4 sec. 6, T. 39 N., R. 7 E.	Sandy outwash	S76WI-085-4-1	2-8	---	---	100	100	80	28	26	16	6	4	---	NP	A-2-4(0)	SM
		4-2	27-60	---	---	100	100	89	1	1	1	1	1	---	NP	A-3(0)	SP

* Mechanical analysis according to AASHTO Designation T88-57 (1). Results from this procedure can differ somewhat from the results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all material as much as 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from the calculation of grain-size fraction. The mechanical analysis data used in this table are not suitable for use in naming textural classes of soils.

TABLE 20.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Alcona	Coarse-loamy, mixed, frigid Alfic Haplorthods
Au Gres	Sandy, mixed, frigid Entic Haplaquods
Cable	Coarse-loamy, mixed, nonacid, frigid Typic Haplaquepts
Carbondale	Euic Hemic Borosaprists
Croswell	Sandy, mixed, frigid Entic Haplorthods
Dawson	Sandy or sandy-skeletal, mixed, dysic Terric Borosaprists
Emmert	Sandy-skeletal, mixed, frigid Typic Udorthents
Fordum	Coarse-loamy, mixed, nonacid, frigid Mollic Fluvaquents
Goodman	Coarse-loamy, mixed, frigid Alfic Haplorthods
Greenwood	Dysic Typic Borohemists
Karlin	Sandy, mixed, frigid Entic Haplorthods
Keweenaw	Sandy, mixed, frigid Alfic Haplorthods
Kinross	Sandy, mixed, frigid Typic Haplaquods
Loxley	Dysic Typic Borosaprists
Lupton	Euic Typic Borosaprists
Magnor	Coarse-loamy, mixed Aquic Glossoboralfs
Markey	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Minocqua	Coarse-loamy over sandy or sandy-skeletal, mixed, nonacid, frigid Typic Haplaquepts
Monico	Coarse-loamy, mixed, frigid Entic Haplaquods
Padus	Coarse-loamy, mixed, frigid Alfic Haplorthods
Pence	Sandy, mixed, frigid Entic Haplorthods
Pequaming	Sandy, mixed, frigid Alfic Haplaquods
Plover	Coarse-loamy, mixed Aquic Glossoboralfs
Rousseau	Sandy, mixed, frigid Entic Haplorthods
Sayner	Sandy, mixed, frigid Entic Haplorthods
Udorthents	Mixed, nonacid, frigid Typic Udorthents
Vilas	Sandy, mixed, frigid Entic Haplorthods
Worcester	Coarse-loamy, mixed, frigid Aqualfic Haplorthods

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