United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin

Soil Survey of Lincoln County, Wisconsin

How To Use This Soil Survey

General Soil Map

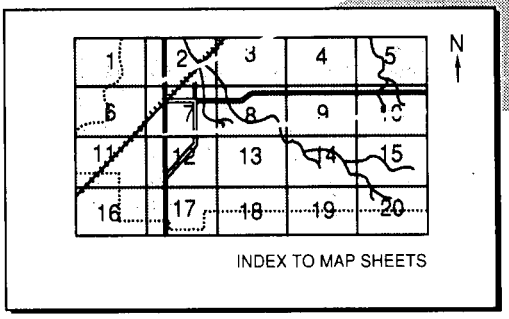
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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.

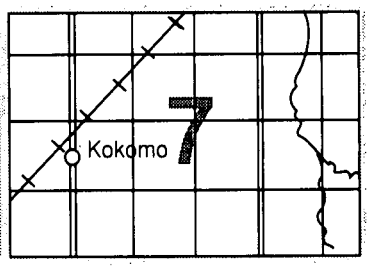
Detailed Soil Maps

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.



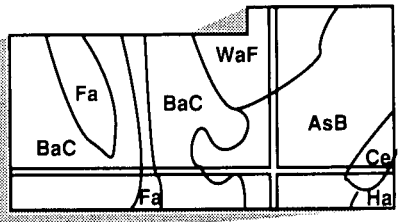
INDEX TO MAP SHEETS



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 Natural Resources Conservation Service (formerly 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 1991. Soil names and descriptions were approved in 1993. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1993. This survey was made cooperatively by the Natural Resources Conservation Service and the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the Lincoln County Land Conservation Committee, which helped finance the fieldwork.

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 Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Tahoe Lake in the Harrison Hills area. Lincoln County has many scenic lakes.

Contents

Issued November 1996

Index to Map Units

Summary of Tables

Foreword

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

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to 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 too unstable to be used as a foundation for buildings or roads. Wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

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

Patricia S. Leavenworth
State Conservationist
Natural Resources Conservation Service

Soil Survey of Lincoln County, Wisconsin

By Michael J. Mitchell, Natural Resources Conservation Service

Fieldwork by John E. Campbell, Roger A. Dahl, Ulf B. Gafvert, Kim C. Goerg, Sam D. Hagedorn, David J. Hvizdak, James A. Martzke, Michael J. Mitchell, and Fred J. Simeth, Natural Resources Conservation Service

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

LINCOLN COUNTY is in the north-central part of Wisconsin (fig. 1). It has a total area of 581,261 acres, of which 14,125 acres is water. In 1987, the county had a population of 26,803. The population increased by 14 percent from 1970 to 1987. The major cities are Merrill, the county seat, and Tomahawk. In 1987, the population was 10,008 in Merrill and 3,505 in Tomahawk.

Manufacturing, agriculture, lumbering, tourism, and recreational enterprises provide Lincoln County with a diversified economic base. Manufacturing employs the most people, largely in wood-using industries. Dairying is the major farming activity. It is based mostly in the south-central area, around Merrill, and along State Highway 17 in the eastern part of the county. Lumbering enterprises are based on the large area of timber resources. The western part of the county consists mostly of forest land. In 1983, about 70 percent of the county was classified as forest land, including many areas that are publicly owned. The wooded areas and the many wetlands, lakes, and streams provide opportunities for tourism and recreational enterprises. The strong retail trade reflects purchases by tourists and other vacationers.

A reconnaissance soil survey of Lincoln County was made prior to 1918 by the Soil Survey Division, Wisconsin Geological and Natural History Survey, State of Wisconsin, in cooperation with the United States Department of Agriculture, Bureau of Soils. This reconnaissance soil survey is part of a report published in 1918 (Whitson and others, 1918). The present survey updates the 1918 survey, provides more interpretive information, and has larger maps, which show the soils in greater detail.

General Nature of the County

This section provides general information about the county. It describes climate; physiography, relief, and drainage; water supply; history and settlement; forestry and lumbering; farming; and transportation facilities and industry.

Climate

Winters in Lincoln County are very cold, and summers are short and fairly warm. The short frost-free period in summer limits the production of crops to forage, small grain, and adapted vegetables. Precipitation is fairly well distributed throughout the year. It reaches a peak in summer. Snow covers the ground during much of the period from late fall through early spring.

The soils occasionally freeze to a depth of several feet when very cold temperatures occur before the ground is appreciably covered with snow. Unless the

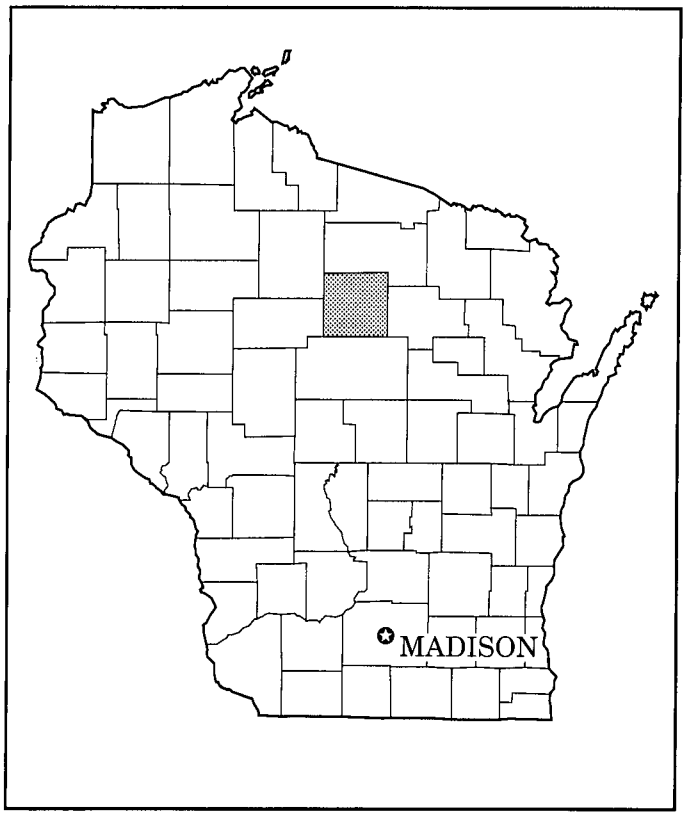


Figure 1.—Location of Lincoln County in Wisconsin.

snow cover is removed, the soils usually freeze to a depth that ranges from the top few inches to about 1 foot.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Merrill, Wisconsin, 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 15 degrees F and the average daily minimum temperature is 4 degrees. The lowest temperature on record, which occurred at Merrill on January 9, 1977, is -39 degrees. In summer, the average temperature is 66 degrees and the average daily maximum temperature is 79 degrees. The highest recorded temperature, which occurred on July 26, 1955, 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 31.41 inches. Of this, 22 inches, or 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 19 inches. The heaviest 1-day rainfall during the period of record was 3.74 inches at Merrill on August 24, 1962. Thunderstorms occur on about 34 days each year.

The average seasonal snowfall is 42 inches. The greatest snow depth at any one time during the period of record was 30 inches. On the average, 68 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

Lincoln County is in the Northern Highland physiographic region of Wisconsin. This region has some of the highest elevations in the state. Elevations range from about 1,910 feet above sea level, on a hill bordering the east side of Ament Lake in the northeastern part of the county, to about 1,220 feet at the point where the Wisconsin River leaves the county. Merrill is about 1,300 feet above sea level, and Tomahawk is about 1,450 feet.

The physiography, relief, and drainage of Lincoln County are primarily the result of glaciation. They are modified by ridges of hard bedrock in the southern part of the county. The landscape is very diverse. Moraines, eskers, kames, ice-contact lake basins, and drift-mantled ridges and hills of bedrock are generally in the highest positions on the landscape. These landforms are interspersed with lower areas of outwash plains, drumlins, lake plains, and bogs and other depressional areas where organic soils have formed.

The most prominent physiographic feature is the broad belt of dominantly end moraine that extends across the county from the northeastern part to the south-central part and then through the west-central area. This end moraine area has the highest elevations and the roughest terrain in the county.

The end moraine area has a complex physiography, especially in the central and northeastern parts of the

county. Some parts of the landscape, such as the Harrison Hills and the Underdown Hills, are typical morainic hills and ridges interspersed with many bogs, swamps, ponds, and lakes in kettles that resulted from the melting of buried ice blocks. Most of the kettles have no outlet. Slopes are short and complex in these areas. Other parts of the landscape, such as the Nine Mile, Irma, and Chase Hills, are distinct ridges or hills of bedrock that are covered by glacial drift. These bedrock areas commonly do not have wet depressions. The hills and ridges of end moraine in the central and western parts of the county are intermingled with small, relatively flat ice-contact glacial lake basins of lacustrine deposits. The sediments forming these basins were deposited in water-filled holes in the surface of glacial ice and now occupy some of the highest positions on the landscape. They are bordered by prominent ridges of glacial drift. In the central and northeastern parts of the end moraine landscape, the melting and readvances of glacial ice created recessional moraines and some initial landscape formations were subsequently destroyed or buried by outwash deposits from the melting ice. As a result, the terrain is characterized by small, rather flat outwash plains interspersed with swells, hills, and ridges of outwash and glacial till. On this landscape, slopes vary from nearly level and smooth to very steep and complex within short horizontal distances.

The landscape in the southern part of the county has only a few lakes and undrained depressions. It is an area of older glaciation where relatively flat outwash plains are in the major river valleys, such as the Prairie River valley. The valleys meander through broad swells of morainic upland where bedrock is close to the surface. In this area, slopes are generally long and smooth. Local relief commonly is about 100 feet.

A large outwash plain with low relief dominates the north-central part of the county. The topography is mostly flat, except for a few morainic mounds that protrude slightly higher than the level of the plain. Depressional areas, such as drainageways and basins, are common throughout the outwash plain. Streams, lakes, swamps, bogs, and marshes are in these lower areas.

An area of elongated drumlins and low recessional moraines segmented by drainage valleys of bogs and swamps is in the northwestern part of the county. The drumlins were shaped in grooves at the base of ice lobes and are oriented parallel to the movement of the ice sheets. In this area, the melting glacial ice retreated to the northwest and the landscape features are oriented southeast to northwest. The area has little local relief because glacial meltwater filled the low areas with outwash. Many of the drumlins and moraines also are veneered with outwash. Slopes are mostly long and smooth.

Lincoln County is entirely within the drainage basin of the Wisconsin River, which enters the northeastern part of the county, flows southwest to Tomahawk, and then flows south to generally bisect the county from north to south. The 285-foot drop of the Wisconsin River in the county is moderated by six water-control structures (fig. 2). Four principal tributaries of this river drain the eastern part of the county. They are the Pine River, the Prairie River, Little Pine Creek, and Big Pine Creek. The Tomahawk, Somo, Spirit, New Wood, and Copper Rivers are the main tributaries on the west side of the Wisconsin River.

Generally, the surface-water drainage system is well developed only in the area of older glaciation in the southern part of the county. In this area, runoff moves rapidly to flowing streams. Bogs, swamps, and marshes abound in other areas of the county where natural drainage systems are not well established. In those areas, the many kettles, basins, and other depressional areas tend to accumulate and hold runoff. They are an important part of the natural reservoir system, which helps to regulate the flow of rivers and to minimize flooding.

Water Supply

Lincoln County has an abundant supply of water to meet present and anticipated needs for domestic, agricultural, municipal, and industrial uses. Sources are the 14,125 acres of surface water and the ground water, which is primarily from glacial deposits.

More than 700 lakes and impoundments in the county make up most of the acreage of surface water. The construction of six water-control structures across the Wisconsin River has significantly increased the amount of surface water in the county. These structures also help to control flooding.

Most of the lakes are seepage lakes. The others are spring lakes, drainage lakes, or drained lakes (Carlson and Andrews, 1982). The majority of the lakes, including most of the spring lakes, also known as spring ponds, are small. Only 23 lakes are 100 acres or larger, but these make up 73 percent of the surface area of lakes. Deer Lake is the largest spring lake. Pesabic Lake and the other seepage lakes are landlocked (fig. 3). Lake Mohawksin, an impoundment and a drainage lake, is the largest body of water in the county. The deepest lake is Hilts Lake, which is as much as 70 feet deep.

Lincoln County is drained by more than 230 streams with a total surface area of about 2,600 acres and a total length of about 670 miles. The largest of these

Figure 2.—Grandfather Dam, in an area of Magroc soils. The flow of the Wisconsin River is moderated by six such water-control structures in Lincoln County.

streams is the Wisconsin River, which has a surface area of about 1,380 acres.

The surface water in the county is used mostly for recreational activities and watering stock. Four impoundments on the Wisconsin River, however, are used primarily for generating electricity. Industrial and municipal wastewater is discharged into this river at Merrill and Tomahawk.

The quality of the surface water is generally good, except for the Wisconsin River and associated impoundments, where industrial wastes have impaired the water quality. The northern and western parts of Lincoln County have good-quality surface water because the watersheds are mostly in areas of woodland (fig. 4). Eutrophication is a problem in the agricultural area in the southern part of the county, where excessive runoff carries nutrients to the lakes and streams. During the summer, the shallow water areas contain algae and weeds.

The surface water is mostly clear or light brown and has good light penetration for biological productivity. The landlocked or seepage lakes bordered by bogs are more acid than the other water areas. The spring lakes have the highest pH value. The water is predominantly soft in the seepage lakes, drained lakes, and drainage lakes, but it is generally hard in the spring lakes. Biological productivity is highest in the streams and spring lakes.

The ground water in the county meets municipal, industrial, and rural needs. Well water is available at various depths, depending on the general topography, the distance above permanent stream levels, and the character of the underlying aquifer. The well water is stored in porous strata called aquifers. At certain depths below the surface, all pores and fissures in unconsolidated material, such as sand and gravel, are filled with water. Wells drilled into these layers yield an adequate water supply. The level of ground water rises or falls from season to season and year to year, depending on the amount of rainfall. Seasonally, the

level generally rises in spring, declines in summer, rises slightly in fall, and declines in winter.

Most ground water in Lincoln County is obtained from sand and gravel aquifers. These aquifers occur as surficial sand and gravel deposits or as isolated buried deposits in the moraine areas.

The surficial sand and gravel deposits are mainly on extensive outwash plains. They are highly permeable and yield large quantities of water to wells. Most high-capacity wells are 40 to 140 feet deep. They usually yield 15 to 60 gallons per minute per foot of drawdown. Generally, the glacial till in moraine areas yields less than the outwash deposits. Yields also are lower in areas where till is intermixed with the sand and gravel. The underlying crystalline bedrock, which is close to the surface in the southern part of the county, yields little or no water. Shallow wells in the areas of surficial outwash are subject to pollution.

The quality of the ground water in Lincoln County is good. Local differences in quality are the result of the composition, solubility, and surface area of the soil and rock through which the water moves and the length of time that the water is in contact with these materials. Generally, the content of dissolved solids in the ground water is relatively low throughout the county. In many areas of the county, the soils have very porous layers

Figure 3.—A seepage lake in an area of Keweenaw soils. Most of the lakes in the county are seepage lakes that have no inlet or outlet.

Figure 4.—The Prairie River, in an area of Mequithy soils. The quality of surface water is generally good in areas where the watershed is wooded.

that are poor filters for domestic waste and agricultural chemicals. The impact of development and agriculture may cause deterioration of the ground-water quality in these areas.

History and Settlement

The original inhabitants of the survey area were Woodland Indians, dominantly the Chippewa Tribe after

about 1680. Father Rene Menard, a French Jesuit priest, entered the area in 1661 (Jones and others, 1924). He was later followed by other missionaries, explorers, fur traders, and trappers. They followed the Wisconsin River south from the Lake Superior area. Trading posts were established in areas where major tributaries, such as the Tomahawk, New Wood, and Prairie Rivers, flowed into the Wisconsin River.

The first white man to settle in the county was Francis Bollier. In 1818, he built a cabin in the area near Merrill. More permanent settlements were established during the mid 1800's, when the fur trade declined and the Indians ceded lands. Timber estimators, lumbermen, and homesteaders moved into the area at that time. In 1844, Oliver Barr Smith and his crew of lumberjacks came from Big Bull Falls, now Wausau, to a logging camp that was built at Jenny Bull Falls near the mouth of the Prairie River. Active settlement began at this camp after the development of water power by Andrew Warren in 1847. Warren constructed a dam across the Wisconsin River and built a sawmill. The settlement of Jenny became established near the mill. It grew rapidly after a railroad was built in 1880 that opened southern markets for all kinds of forest and farm products. Jenny was later named Merrill in honor of Sherburn Sanborn Merrill, the general manager of the railroad.

Settlement in the northern part of Lincoln County began in 1886, when the Tomahawk Land and Boom Company, formed by William H. Bradley, established a logging camp several miles south of the present city of Tomahawk. A dam across the Wisconsin River was built at this site to create a lake that was needed to store and sort logs. In 1887, more permanent settlement started at Tomahawk when the railroad was extended to the area from Merrill. The first sawmill, established in 1888, provided employment for the settlers.

Lincoln County was established in 1874 from territory that was formerly part of Marathon County. It was named in honor of Abraham Lincoln, the 16th President of the United States. Several changes were made in the original boundaries that reduced the size of the county. The present boundaries were established in 1885. The county was organized as one township that was later subdivided into 16 townships.

Forestry and Lumbering

Most of Lincoln County was forested prior to settlement. The forests were a mixture of pine, northern hardwoods, hemlock, lowland hardwoods, and swamp conifers. Lumbering began soon after the Chippewa Indians relinquished the land in the Treaty of 1842.

Lumbermen from Wausau, which was then called Big Bull Falls, acquired parcels of land in the county from the Federal government for the harvesting of timber resources. Lumbering began along the Pine, Prairie, and Wisconsin Rivers in the southern part of the county as early as 1844. The pine was cut first, and the other timber was cut later. Many logs were floated downstream to sawmills in Wausau, but some were sent farther downstream. Later, the logs were also hauled by horses and railroads to local sawmills.

The arrival of the railroad to Merrill and Tomahawk opened up the entire region to logging throughout the year. Logs were transported by many railroad routes run by lumber companies.

The first local sawmills were established in the late 1840's. At the peak of the lumbering era, in 1892, eight sawmills were operating along the Wisconsin River. That year, the mills produced 150,000,000 board feet of lumber and 86,000,000 wood shingles. The volume declined rapidly after 1896. The hardwood and hemlock timber came into prominence when the supply of pine diminished. By 1898, 20 sawmills in Lincoln County and the adjoining areas were engaged in the production of hardwood lumber.

Lumbering has remained a major enterprise in the county. In 1985, 108 harvesters and 13 sawmills were harvesting timber (Wisconsin Department of Natural Resources, 1985). About 111,430 cords of growing stock, including 23,061,000 board feet of sawtimber, was removed from the forests in 1982 (USDA, 1984). This harvest was about 71 percent of the net annual growth of growing stock. Hardwoods, mostly aspen and maple, made up about 87 percent of the harvest.

Growing Christmas trees is an important enterprise for about 30 landowners in Lincoln County. Several thousand acres of land is used for the trees, mostly balsam fir, white spruce, Scotch pine, and eastern white pine (fig. 5). Conifer boughs, mostly balsam fir, are harvested by private individuals from plantations and native stands for use as Christmas trimmings. Most of the trees and boughs are transported to southern markets, but many are sold locally.

The collection of sugar maple sap and the production of maple syrup also are important forestry enterprises (fig. 6). The sap is refined into maple syrup or sold to major refineries in the area. The potential for increased production is tremendous because the county has large acreages of sugar maple. Tapping these trees for sap, however, lowers the quality of veneer sawlogs because of staining near the boreholes.

Timber harvesters cut hardwood poletimber for firewood when the pulpwood market is slow. The firewood market fluctuates, however, depending on the

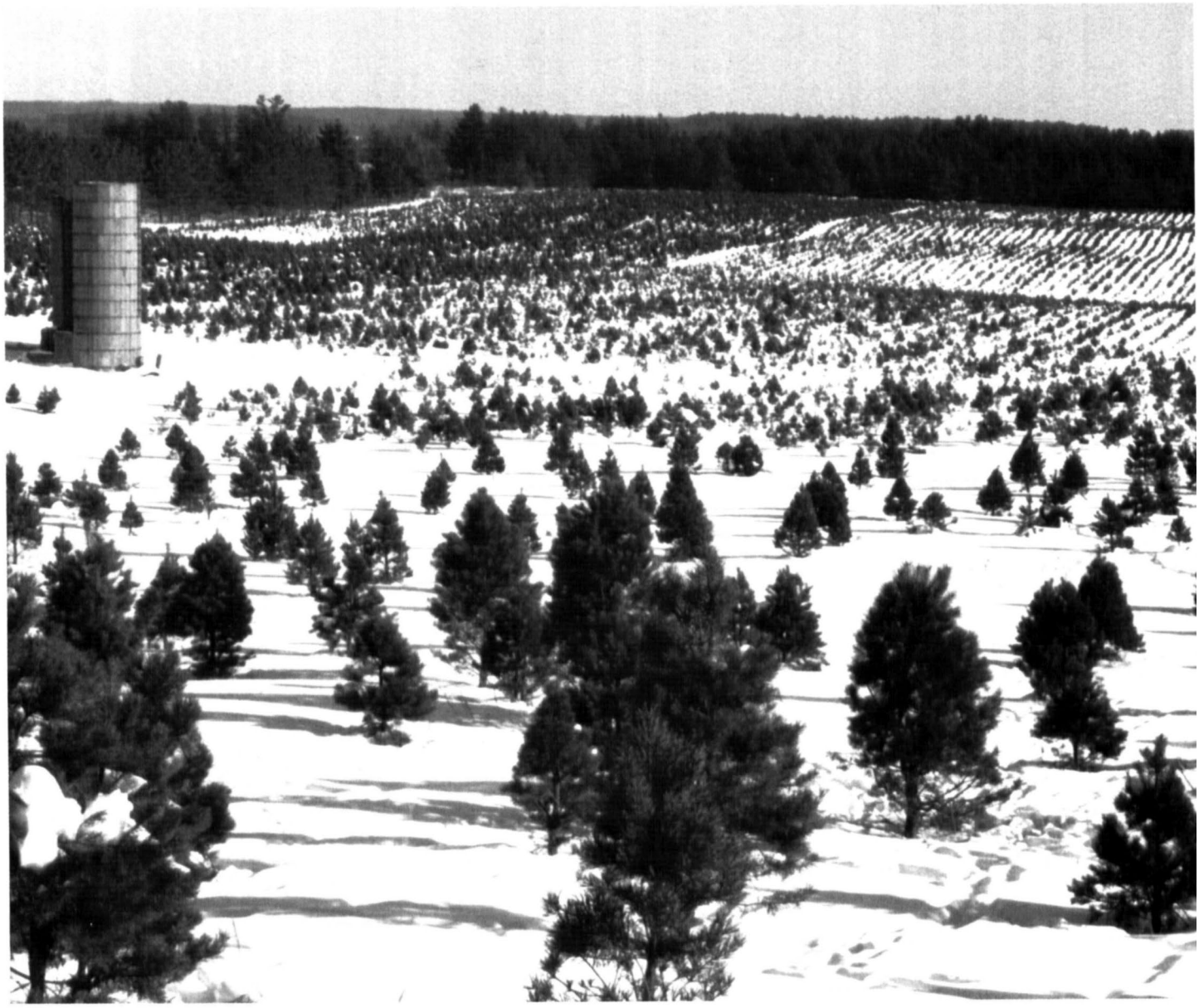


Figure 5.—A young plantation of pruned conifers in an area of Vilas soils.

cost of other types of fuel. It has generally increased in recent years because more homeowners have installed wood-burning furnaces.

Farming

Farming began in Lincoln County in conjunction with lumbering. Clearings were established in areas close to the logging camps where oxen could graze and wild hay could be cut. The oxen were used as draft animals in lumbering. The early farmers later used the clearings to grow other kinds of feed and produce for the lumbermen and oxen. Most farmers worked in the logging camps or sawmills in the winter and enlarged and cultivated their cropland in summer. They used their winter earnings to improve their farms.

Farming progressed slowly until the arrival of the railroad in 1880. The railroad opened southern markets for farm products and provided easy access for more settlers. There were only 153 small farms in 1880. The major crops were hay and oats, but wheat, potatoes, corn, barley, and rye were also grown. The livestock

included cattle, hogs, sheep, horses, and mules.

Most early farmers kept small herds of cows for milk, which was also converted to butter. Dairying started with the sale of surplus milk, cream, and butter. It increased rapidly after the cheese industry was developed about 1905. Over time, dairying became the most important type of agriculture in the county.

The number of farms increased to a high of 2,106 in 1935 (Wisconsin Department of Agriculture, 1957). It has declined since 1935. There were only 507 farms in 1987, but the average farm size had increased to 215 acres. The acreage of farmland reached a high of 256,403 acres in 1950, but only 29 percent was cropland. The rest was mostly woodland. By 1987, farmland had declined to 109,031 acres, but 51 percent was cropland. Between 1950 and 1987, the average cropland per farm increased from 45 to 111 acres.

Dairying is still the main farming enterprise. The trend is toward fewer dairy farms, larger herds, and more efficient husbandry. In recent years, the number of milk cows has remained fairly constant but milk production has increased. The milk is marketed mostly as cheese. The major crops grown to support the dairy agriculture are described under the heading "Crops and Pasture."

Some farming enterprises produce cattle and hogs for meat, sheep for wool, or chickens for eggs. The number of cattle, hogs, and sheep has been relatively stable in recent years. The number of chickens and the production of eggs have greatly decreased since about 1980.

Specialty products produced by some enterprises

Figure 6.—Collection of sugar maple sap in an area of Magnor soils.

include fruits, cranberries, ginseng, honey from bees, maple syrup, Christmas trees, and fur from mink. Some farmers also grow small acreages of vegetable crops for additional income.

Transportation Facilities and Industry

The major north-south access to Lincoln County is provided by U.S. Highway 51 in the central part of the county. The main east-west roads are U.S. Highway 8 in the northern part of the county and State Highway 64 in the southern part. State Highways 17, 86, 91, and 107 also provide access to the county. About 58 percent of the county roads are paved, but many remote areas, such as those in the west-central part of the county, have few good motor roads. Many of these remote areas have old logging roads that permit access by specialized vehicles.

The county also is served by two railroads, two airports, seven motor freight carriers, and one bus line. One railroad provides access to Merrill and Tomahawk from the north and south. It joins the other railroad that provides access to the northern part of the county from the east and west. Major commercial air transportation is available at the airports near Wausau and Rhinelander, in adjoining counties. Smaller aircraft can use the Merrill Municipal Airport or the Tomahawk Regional Airport.

Industry is the most important economic activity in Lincoln County. Based on population, the county has more industrial jobs than the average for the state.

Most industry is related to processing forest products. Many logging companies operate in the county, and lumber is produced by many sawmills. Other forest products produced locally include paperboard containers, paper, pulp for paper, wood chips for pulp, doors, and windows. Small industries produce pallets and specialty wood products, including window grids, architectural wall partitions, moldings, tool handles, cabinets, and furniture.

Some local industries produce wire forms and other metal products, lead products, fiberglass products, plastic material for packaging, sportswear, and shoes. Other industries include construction and printing.

Few agriculture-related industries are in the county, but milk is transported to dairies in adjacent counties. The county has one dairy plant that produces cheese, butter, ice cream, and milk for marketing. One company produces canned vegetables, mainly snap beans.

Mineral production is of minor extent. Sand and gravel are the only mineral resources that are mined. Several industries produce concrete and asphalt from these materials.

The many lakes and streams and the surrounding forested areas provide year-round opportunities for recreation and tourism. A wide variety of outdoor activities, such as fishing, hunting, boating, waterskiing, swimming, camping, hiking, snowmobiling, and cross-country skiing, are enjoyed by visitors and 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

Figure 7.—A small pond in an area of the somewhat poorly drained Magnor soils. Generally, such highly contrasting inclusions are indicated by a special symbol on the soil maps.

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.

Some of the soil names on the maps of this soil survey do not agree with those on the maps of surveys in adjacent counties. The differences result from variations in the extent or pattern of the soils in the survey areas. Also, the map units in Lincoln County were designed primarily for woodland use and those in some adjacent counties were designed for other land uses, such as farming.

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 (fig. 7). 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.

Soil Descriptions

1. Magnor-Freeon-Capitola Association

Somewhat poorly drained, moderately well drained, and very poorly drained, nearly level to sloping, silty and mucky soils on moraines

This association consists mostly of soils on ground moraines that have little local relief and few prominent features, such as lakes, undrained depressions, or areas of hilly topography. Bedrock is close to the surface on slopes that are adjacent to major river valleys. The topography is characterized by broad swells with long smooth side slopes interspersed with long drainageways that broaden into basins in places. The drainageways are frequently ponded during wet periods.

This association makes up about 20 percent of the land area in the county. It is about 67 percent Magnor and similar soils, 14 percent Freeon and similar soils, 9 percent Capitola and similar soils, and 10 percent soils of minor extent.

Magnor soils are somewhat poorly drained and are nearly level and gently sloping. They are on swells and knolls. Typically, the surface layer is very dark gray silt loam about 5 inches thick. The subsurface layer is dark grayish brown, mottled silt loam about 5 inches thick. The next layer is grayish brown and yellowish brown, mottled silt loam about 15 inches thick. The subsoil is reddish brown, mottled, firm sandy loam about 14 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, firm sandy loam.

Freeon soils are moderately well drained and are gently sloping and sloping. They are on the highest knolls and swells and on the sides of valleys. Typically, the surface layer is very dark gray silt loam about 1 inch thick. The subsurface layer is brown silt loam about 3 inches thick. The next layer is brown and dark yellowish brown silt loam and dark brown and brown, mottled sandy loam about 27 inches thick. The subsoil is reddish brown, mottled, firm sandy loam about 11 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, firm sandy loam.

Capitola soils are very poorly drained and are nearly level. They are in drainageways, basins, and upland swales. Typically, the surface layer is black muck about 5 inches thick. The subsurface layer is very dark gray, mottled silt loam about 2 inches thick. The subsoil is about 26 inches thick. It is gray and dark grayish brown, mottled silt 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.

Of minor extent are the very poorly drained, organic Cathro soils in drainageways and basins; the well drained Mequithy soils on summits, shoulders, and sides of bedrock ridges; and the moderately well drained Newood soils, mostly on the sides of valleys.

Many small woodlots and some larger areas of woodland, including many wooded swamps, are in areas of this association. The mature upland woods are mostly red maple and sugar maple in areas of the Magnor soils and sugar maple, American basswood, and white ash in areas of the Freeon soils. The main management concerns are the restricted use of machinery, seedling survival on the Capitola soils, windthrow on the Magnor and Capitola soils, and competing plants that interfere with tree regeneration.

Many of the logging trails are rutted because of low soil strength and wetness.

Many areas are used for farming and are some of the most intensively farmed areas in the county. Dairying is the main farm enterprise. The major crops are corn and oats and a mixture of timothy and red clover or bromegrass and alfalfa for hay and pasture. The crops are grown mostly on the higher soils that have good surface drainage. Some small areas are used as ginseng gardens. Many areas are used as permanent pasture. The main management concerns are wetness on the Magnor soils, water erosion in areas where the slope is more than 2 percent, and crusting of the surface layer.

Many farmsteads and rural homes, part of a city, and a few cottages and landfills are in areas of this association. Sanitary facilities, building sites, and roadways are generally limited in most areas by wetness or ponding and by the slope in some areas of the Freeon soils. Also, restricted permeability limits the use of the soils for sanitary facilities, and frost heave may damage local roads.

2. Ossmer-Minocqua-Sconsin Association

Somewhat poorly drained, very poorly drained, and moderately well drained, nearly level and gently sloping, silty and mucky soils on outwash plains

This association is on outwash plains where most of the soils have a seasonal high water table. The outwash plains are in major river valleys that meander through morainic uplands. The landscape is characterized by low flats interspersed with depressional areas, such as drainageways and basins. The low flats are not much higher than the depressional areas. The drainageways are frequently ponded during wet periods. Many streams are in areas of this unit. Slopes are mostly long and smooth.

This association makes up about 16 percent of the land area in the county. It is about 28 percent Ossmer and similar soils, 24 percent Minocqua and similar soils, 24 percent Sconsin and similar soils, and 24 percent soils of minor extent.

Ossmer soils are somewhat poorly drained and are nearly level and gently sloping. They are on low flats and in swales and drainageways on the higher parts of the landscape. Typically, the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is grayish brown, mottled silt loam about 2 inches thick. The next layer is brown and yellowish brown, mottled silt loam about 20 inches thick. The subsoil is dark brown, mottled loam and sandy loam about 12 inches thick. The substratum to a depth of about 60 inches is brown, mottled, stratified sand and gravelly sand.

Minocqua soils are very poorly drained and are nearly level. They are in drainageways and basins and in swales on the higher parts of the landscape. Typically, the surface layer is black muck about 4 inches thick. The subsurface layer is very dark gray silt loam about 1 inch thick. The subsoil is about 32 inches thick. It is gray, greenish gray, and dark greenish gray, mottled silt loam in the upper part; greenish gray, mottled loam in the next part; and dark gray, mottled gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is dark grayish brown very gravelly sand.

Sconsin soils are moderately well drained and are nearly level and gently sloping. They are on low flats and in swales and drainageways on the higher parts of the landscape. Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 1 inch thick. The next layer is dark brown, dark yellowish brown, and brown silt loam and loam about 29 inches thick. It is mottled in the lower part. The subsoil is dark yellowish brown, mottled sandy loam about 4 inches thick. The substratum to a depth of about 60 inches is yellowish brown, stratified very gravelly sand and sand.

Of minor extent are the loamy, well drained Padus and Pence soils on upland flats and on the sides of drainageways, basins, and ridges and the very poorly drained, organic Cathro, Loxley, and Lupton soils in drainageways and basins.

Many small woodlots and some larger areas of woodland, including many wooded swamps, are in areas of this association. The upland woods are mostly red maple, balsam fir, and quaking aspen in areas of the Ossmer soils and sugar maple, American basswood, and white ash in areas of the Sconsin soils. The main management concerns are the restricted use of machinery, seedling survival on the Minocqua soils, windthrow on the Ossmer and Minocqua soils, and competing plants that interfere with tree regeneration. Many of the logging trails are rutted because of low soil strength and wetness.

Many areas are used for farming. Dairying is the main farm enterprise. The major crops are corn and oats and a mixture of timothy and red clover or bromegrass and alfalfa for hay and pasture. The crops are grown mostly in the higher areas. Many areas are used as permanent pasture. The main management concerns are wetness on the Ossmer soils, water erosion in areas where the slope is more than about 2 percent, and crusting of the surface layer.

Many farmsteads and rural homes, part of a city, and a few villages and cottages are in areas of this

association. Sanitary facilities, building sites, and roadways are generally limited in most areas by wetness or ponding. Also, the effluent from waste disposal facilities can pollute ground water because of the poor filtering capacity of the substratum, and local roads may be damaged by frost heave.

3. Magnor-Lupton-Capitola Association

Somewhat poorly drained and very poorly drained, nearly level and gently sloping, silty and mucky soils on moraines and drumlins

This association is on uplands segmented by long, shallow valleys that are oriented from northwest to southeast. The terrain has little local relief and few areas of surface water, except for small streams in the valleys. Swamps and bogs are in the elongated drainageways and basins. The upland moraines and drumlins commonly have broad crests and gentle slopes. In many places the uplands are mantled by a thin deposit of glacial outwash. Slopes are mostly long and smooth.

This association makes up about 13 percent of the land area in the county. It is about 49 percent Magnor and similar soils, 15 percent Lupton and similar soils, 11 percent Capitola and similar soils, and 25 percent soils of minor extent.

Magnor soils are somewhat poorly drained and are nearly level and gently sloping. They are on knolls and swells of ground moraines, on the broad crests and foot slopes of drumlins, and in upland swales and drainageways. Typically, the surface layer is very dark gray silt loam about 5 inches thick. The subsurface layer is dark grayish brown, mottled silt loam about 5 inches thick. The next layer is grayish brown and yellowish brown, mottled silt loam about 15 inches thick. The subsoil is reddish brown, mottled, firm sandy loam about 14 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, firm sandy loam.

Lupton soils are very poorly drained and are nearly level. They are in drainageways and basins. Typically, they are dark reddish brown and black muck to a depth of about 60 inches.

Capitola soils are very poorly drained and are nearly level. They are in drainageways, basins, and upland swales. Typically, the surface layer is black muck about 5 inches thick. The subsurface layer is very dark gray, mottled silt loam about 2 inches thick. The subsoil is about 26 inches thick. It is gray and dark grayish brown, mottled silt 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.

Of minor extent are the loamy, somewhat poorly drained Pesabic soils in positions on the landscape similar to those of the Magnor soils; the moderately well drained Freeon and Newood soils on the higher parts of the landscape and on the sides of valleys, basins, and drainageways; and the well drained Padus and Pence soils, which formed in outwash deposits on valley slopes.

Most of the acreage is woodland, including many wooded swamps. The mature upland woods are mostly red maple and sugar maple. The main management concerns are the restricted use of machinery, seedling survival on the Capitola and Lupton soils, windthrow, and competing plants that interfere with tree regeneration. Many of the logging trails are rutted because of low soil strength and wetness.

A few small areas of the Magnor soils are used for farming. Dairying is the main farm enterprise. The major crops are corn and oats. Grasses and legumes are grown for hay and pasture. Some small areas are used as permanent pasture. The main management concerns are wetness, water erosion in areas where the slope is more than 2 percent, and crusting of the surface layer.

A few farmsteads, rural homes, cottages, and villages are in areas of this association. Sanitary facilities, building sites, and roadways are generally limited in most areas by wetness or ponding and by potential subsidence in the Lupton soils. Also, restricted permeability limits the use of Capitola and Magnor soils for sanitary facilities, and frost heave may damage local roads. Because of low strength, the organic Lupton soils are not suitable for dwellings.

4. Sarona-Keweenaw-Goodman Association

Well drained, rolling to very steep, loamy and silty soils on moraines

This association consists mostly of soils on terminal and recessional end moraines. The end moraines have the highest elevations and some of the roughest terrain in the county. In most areas the swells, hills, and ridges are interspersed with many small kettles and lake basins and a few narrow drainage valleys. Many of the kettles and lake basins contain lakes, ponds, bogs, or swamps. Slopes are mostly short and complex.

This association makes up about 12 percent of the land area in the county. It is about 35 percent Sarona and similar soils, 34 percent Keweenaw and similar soils, 9 percent Goodman and similar soils, and 22 percent soils of minor extent.

Sarona soils are rolling to very steep. They are on swells, hills, and ridges. Typically, the surface layer is very dark gray sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 2 inches

thick. The subsoil is dark reddish brown, reddish brown, and dark brown sandy loam about 13 inches thick. Below this to a depth of about 60 inches is reddish brown and brown sandy loam and brown loamy sand.

Keweenaw soils are rolling to very steep. They are on swells, hills, and ridges. Typically, the surface layer is very dark gray sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is dark reddish brown and reddish brown sandy loam and dark brown loamy sand about 16 inches thick. Below this to a depth of about 60 inches is brown sand, brown and reddish brown loamy sand, and reddish brown and dark reddish brown sandy loam.

Goodman soils are rolling. They are on swells, hills, and ridges. Typically, the surface layer is very dark gray silt loam about 5 inches thick. The subsurface layer is brown silt loam about 1 inch thick. The next layer is about 28 inches thick. It is dark brown and brown silt loam in the upper part and reddish brown and brown sandy loam in the lower part. The subsoil is reddish brown sandy loam about 16 inches thick. The substratum to a depth of about 60 inches also is reddish brown sandy loam.

Of minor extent are the very poorly drained Capitola soils and the very poorly drained, organic Cathro, Loxley, and Lupton soils in drainageways, kettles, and basins; the moderately well drained Crystal Lake and somewhat poorly drained Comstock soils in lake basins; and the somewhat poorly drained Hatley and Moodig soils in upland swales and drainageways and on small swells and knolls in low areas.

Most of the acreage is woodland, including many very small, wooded swamps (fig. 8). The mature upland woods are mostly sugar maple in areas of the Sarona soils; red maple, sugar maple, paper birch, and northern red oak in areas of the Keweenaw soils; and sugar maple, American basswood, and white ash in areas of the Goodman soils. The main management concerns are erosion and seedling survival on the steeper slopes, the restricted use of machinery on the steeper slopes and on the Goodman and Sarona soils during wet periods, and competing plants that interfere with tree regeneration.

Some areas are used for farming. Dairying is the main farm enterprise. The major crops are corn and oats and a mixture of bromegrass and alfalfa for hay and pasture. The crops are grown mostly on the less sloping soils. Some areas are used as permanent pasture. The main management concerns are water erosion, soil blowing on the Sarona and Keweenaw soils, crusting of the surface layer on the Goodman soils, and the low fertility and low available water capacity of the Keweenaw soils.

Many rural homes and cottages, some farmsteads, and a few villages and landfills are in areas of this association. Generally, the soils have few limitations affecting sanitary facilities or building site development, except for the slope. Local roads on the Goodman and Sarona soils may be damaged by frost heave. This association has more potential sites for landfills than the other associations in the county.

5. Newood-Magnor-Freeon Association

Moderately well drained and somewhat poorly drained, nearly level to rolling, loamy and silty soils on moraines

This association encompasses an end moraine where the terrain is rough, except within the small ice-contact lake basins that occupy the highest elevations. The lower landscape between the lake basins consists of knolls, swells, hills, and ridges intermingled with depressional areas, such as small kettles, basins, and narrow drainageways that contain bogs and swamps. Slopes are mostly short and complex, except in the lake basins.

This association makes up about 11 percent of the land area in the county. It is about 29 percent Newood and similar soils, 28 percent Magnor and similar soils, 19 percent Freeon and similar soils, and 24 percent soils of minor extent.

Newood soils are moderately well drained and are undulating and rolling. They are on knolls, swells, hills, and ridges. Typically, the surface layer is very dark gray sandy loam about 4 inches thick. The subsurface layer is brown gravelly sandy loam about 1 inch thick. The next layer is dark brown, brown, and reddish brown gravelly sandy loam about 32 inches thick. The subsoil is reddish brown, mottled, firm gravelly sandy loam and sandy loam about 21 inches thick. The substratum to a depth of about 60 inches is reddish brown, firm sandy loam.

Magnor soils are somewhat poorly drained and are nearly level and undulating. They are on knolls and swells, on the lower parts of glacial lake basins, and in upland swales and drainageways. Typically, the surface layer is very dark gray silt loam about 5 inches thick. The subsurface layer is dark grayish brown, mottled silt loam about 5 inches thick. The next layer is grayish brown and yellowish brown, mottled silt loam about 15 inches thick. The subsoil is reddish brown, mottled, firm sandy loam about 14 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, firm sandy loam.

Freeon soils are moderately well drained and are undulating and rolling. They are on knolls, swells, hills, and ridges. Typically, the surface layer is very dark gray silt loam about 1 inch thick. The subsurface layer is brown silt loam about 3 inches thick. The next layer is

Figure 8.—A typical area of the Sarona-Keweenaw-Goodman association. Most of the acreage is woodland dominated by northern hardwoods.

brown and dark yellowish brown silt loam and dark brown and brown, mottled sandy loam about 27 inches thick. The subsoil is reddish brown, mottled, firm sandy loam about 11 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, firm sandy loam.

Of minor extent are the very poorly drained Capitola soils and the very poorly drained, organic Cathro, Loxley, and Lupton soils in drainageways, kettles, and basins; the moderately well drained Crystal Lake and somewhat poorly drained Comstock soils in lake basins; and the somewhat poorly drained Pesabic soils in upland swales and drainageways and on small swells and knolls in low areas.

Most of the acreage is woodland, including many very small, wooded swamps. The mature upland woods are mostly red maple, sugar maple, eastern hemlock, paper birch, and northern red oak in areas of the Newood soils; sugar maple, American basswood, and white ash in areas of the Freeon soils; and red maple

and sugar maple in areas of the Magnor soils. The main management concerns are the restricted use of machinery during wet periods, windthrow on the Magnor soils, and competing plants that interfere with tree regeneration.

A few small areas are used for farming. Dairying is the main farm enterprise. The major crops are corn and oats. Grasses and legumes are grown for hay and pasture. Some small areas are used as permanent pasture. The main management concerns are wetness on the Magnor soils, water erosion in areas where the slope is more than 2 percent, soil blowing on the Newood soils, and crusting of the surface layer on the Freeon and Magnor soils.

Many rural homes and a few farmsteads are in areas of this association. Sanitary facilities, building sites, and roadways are generally limited in many areas by wetness and by the slope in the rolling areas of Freeon and Newood soils. Also, restricted permeability limits the use of the soils for sanitary facilities, and frost heave may damage local roads.

6. Sarwet-Moodig-Lupton Association

Moderately well drained, somewhat poorly drained, and very poorly drained, nearly level and gently sloping, loamy and mucky soils on moraines and drumlins

This association has a terrain of low recessional moraines and drumlins intermingled with swamps and bogs. The landscape has few areas of surface water and little local relief. The swamps and bogs are only slightly lower in elevation than the crests of the moraines and drumlins. The landscape features are linear in the drumlin areas. They are oriented from northwest to southeast. The drumlins have broad crests and gentle slopes. Many of the upland areas have a thin surface veneer of outwash deposits. These glacial meltwater deposits are thicker on the foot slopes that border the swamps and bogs. Slopes are mostly long and smooth.

This association makes up about 7 percent of the land area in the county. It is about 40 percent Sarwet and similar soils, 29 percent Moodig and similar soils, 20 percent Lupton and similar soils, and 11 percent soils of minor extent.

Sarwet soils are moderately well drained and are gently sloping. They are on knolls and swells of ground moraines and on the crests and sides of drumlins. Typically, the surface layer is very dark gray sandy loam about 5 inches thick. The subsurface layer is brown sandy loam about 1 inch thick. The upper part of the subsoil is dark brown sandy loam about 16 inches thick. Below this is about 49 inches of mostly pale brown and brown, mottled gravelly sandy loam. The lower part of the subsoil is brown, mottled gravelly sandy loam about 13 inches thick. The substratum to a depth of about 90 inches is brown very gravelly sandy loam.

Moodig soils are somewhat poorly drained and are nearly level and gently sloping. They are on small swells and knolls in low areas, on the broad crests and foot slopes of drumlins, and in upland swales and drainageways. Typically, the surface layer is very dark gray sandy loam about 3 inches thick. The subsurface layer is brown gravelly sandy loam about 2 inches thick. The upper part of the subsoil is dark brown, mostly mottled sandy loam and gravelly sandy loam about 17 inches thick. Below this is about 31 inches of mostly brown, mottled sandy loam and gravelly sandy loam and some brown, mottled loamy sand and gravelly loamy sand. The lower part of the subsoil is brown, mottled gravelly sandy loam about 20 inches thick. The substratum to a depth of about 95 inches is brown gravelly sandy loam.

Lupton soils are very poorly drained and are nearly level. They are in drainageways and basins. Typically, they are dark reddish brown and black muck to a depth of about 60 inches.

Of minor extent are the very poorly drained Capitola and similar soils in drainageways, basins, and upland swales and the moderately well drained Croswood and excessively drained Vilas soils on sandy knolls and flats that occupy valley foot slopes.

Most of the acreage is woodland, including many wooded swamps. The mature upland woods are mostly sugar maple in areas of the Sarwet soils and red maple and sugar maple in areas of the Moodig soils. The main management concerns are the restricted use of machinery, seedling survival on the Lupton soils, windthrow on the Moodig and Lupton soils, and competing plants that interfere with tree regeneration.

A few upland areas are used for farming. Dairying is the main farm enterprise. The major crops are corn and oats. Grasses and legumes are grown for hay and pasture. Some small areas are used as permanent pasture. The main management concerns are wetness on the Moodig soils, water erosion in areas where the slope is more than 2 percent, and soil blowing.

Many rural homes and a few farmsteads, cottages, villages, and landfills are in areas of this association. Sanitary facilities, building sites, and roadways are generally limited in most areas by wetness or ponding and by potential subsidence in the Lupton soils. Also, local roads may be damaged by frost heave. Because of low strength, the organic Lupton soils are not suitable for dwellings.

7. Vilas-Croswell-Markey Association

Excessively drained, moderately well drained, and very poorly drained, nearly level to sloping, sandy and mucky soils on outwash plains

This association consists of soils on outwash plains that have little local relief. The topography is relatively flat, except for a few morainic mounds that protrude upward slightly higher than the level of the plain and a long, prominent esker that extends from northwest to southeast along the Somo River. Depressional areas, such as drainageways and basins, are common throughout the outwash plain. Streams, lakes, swamps, bogs, and marshes are in these lower areas. This association contains much of the surface-water area in the county. Slopes are mostly long and smooth, except for the short slopes adjacent to depressional areas.

This association makes up about 6 percent of the land area in the county. It is about 48 percent Vilas and similar soils, 19 percent Croswell and similar soils, 19 percent Markey and similar soils, and 14 percent soils of minor extent.

Vilas soils are excessively drained and are mostly nearly level to sloping. They are on upland flats; on knolls, swells, hills, and ridges; and on side slopes that border drainageways, kettles, and basins. Typically, the surface layer is very dark gray loamy sand about 2 inches thick. The subsurface layer is brown loamy sand about 1 inch 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 and yellowish brown sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown sand.

Croswell soils are moderately well drained and are nearly level and gently sloping. They are on low flats and in swales and drainageways on the higher parts of the landscape. Typically, the surface layer is very dark gray loamy sand about 3 inches thick. The subsurface layer is brown sand about 2 inches thick. The subsoil is about 26 inches thick. It is dark reddish brown loamy sand in the upper part and dark brown and yellowish brown sand in the lower part. It is mottled in the lower 7 inches. The substratum to a depth of about 60 inches is yellowish red and brown, mottled sand.

Markey soils are very poorly drained and are nearly level. They are in drainageways, basins, and kettles. Typically, they have an upper layer of black and dark brown muck about 36 inches thick. The substratum to a depth of about 60 inches is dark grayish brown sand.

Of minor extent are the poorly drained and very poorly drained, alluvial Fordum soils in drainageways adjacent to streams; the somewhat poorly drained Au Gres soils on low flats and in upland swales and drainageways; the moderately well drained Sarwet soils on the higher morainic mounds; and the loamy, well drained Pence and Padus soils on and near the Somo River esker.

Most of the acreage is woodland, including many wooded swamps. Many pine plantations also are in areas of this association (fig. 9). The mature upland woods are mostly red maple, northern red oak, paper birch, eastern white pine, and red pine. On the Markey soils, the main management concerns are the restricted use of machinery, seedling survival, windthrow, and competing plants that interfere with tree regeneration. Competing plants also are a concern on the Croswell soils. During dry periods, loose sand can interfere with the traction of wheeled equipment on the Vilas and Croswell soils. Seedling survival during dry periods also is a management concern on the droughty Vilas and Croswell soils.

Some upland areas are used for farming. Many areas formerly used as cropland are now idle or have been planted to pine trees. Dairying is the main farm enterprise. The major crop is oats, and grasses and legumes are grown for hay and pasture. Crops are grown mostly in the less sloping areas. A few areas are used as permanent pasture. The main management concerns are soil blowing and the low fertility and available water capacity of the upland soils.

Many rural homes and cottages, a city, and a few farmsteads, villages, and landfills are in areas of this association. Sanitary facilities, building sites, and roadways are generally limited on the Markey soils by ponding and by potential subsidence in the upper part. Except for roadways, the Croswell soils are generally limited by wetness. The Vilas soils have few limitations affecting urban uses, except for the slope in some areas. Also, the effluent from waste disposal facilities can pollute ground water because of the poor filtering capacity of the soils, and local roads on the Markey soils may be damaged by frost heave. Because of low strength in the upper, organic part, the Markey soils are not suitable for dwellings.

8. Lupton-Padwet-Minocqua Association

Very poorly drained and moderately well drained, nearly level and gently sloping, mucky and loamy soils on outwash plains

This association consists mostly of soils in flow channels created by glacial meltwater. It encompasses some of the lowest positions on the landscape and includes small swells, hills, ridges, and flat remnants of outwash plains. Many of the flats border the valley slopes of adjacent uplands. The association also includes some isolated morainic knolls and swells and many streams. The channel floors of the streams are

Figure 9.—Red pine planted in an area of the Vilas-Croswell-Markey association.

frequently ponded during wet periods. Slopes generally are long and smooth.

This association makes up about 5 percent of the land area in the county. It is about 34 percent Lupton and similar soils, 30 percent Padwet and similar soils, 8 percent Minocqua and similar soils, and 28 percent soils of minor extent.

Lupton soils are very poorly drained and are nearly level. They are in drainageways and basins. Typically, they are dark reddish brown and black muck to a depth of about 60 inches.

Padwet soils are moderately well drained and are nearly level and gently sloping. They are on knolls and low flats and in swales and drainageways on the higher parts of the landscape. Typically, the surface layer is black sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 3 inches thick. The next layer is brown and dark brown sandy loam about 29 inches thick. It is mottled in the lower part. The subsoil is dark brown, mottled sandy loam about 5 inches thick. The substratum to a depth of about 60 inches is yellowish brown sand.

Minocqua soils are very poorly drained and are nearly level. They are in drainageways and basins and in swales on the higher parts of the landscape. Typically, the surface layer is black muck about 4 inches thick. The subsurface layer is very dark gray silt loam about 2 inches thick. The subsoil is about 32 inches thick. It is gray, greenish gray, and dark greenish gray, mottled silt loam in the upper part; greenish gray, mottled loam in the next part; and dark gray, mottled gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is dark grayish brown very gravelly sand.

Of minor extent are the somewhat poorly drained Worcester soils on low flats and in upland swales and drainageways; the somewhat poorly drained Augwood and moderately well drained Croswell soils on low, sandy flats; the excessively drained Vilas soils on swells, hills, and ridges of sandy outwash and on sandy flats; and the moderately well drained Sarwet soils on isolated knolls and swells of moraines.

Most of the acreage is woodland, including many wooded swamps. The mature upland woods are mostly sugar maple. The main management concerns are the restricted use of machinery, seedling survival and windthrow on the Minocqua and Lupton soils, and competing plants that interfere with tree regeneration.

A few areas of the Padwet soils are used for farming. Dairying is the main farm enterprise. The major crops are corn and oats, and grasses and legumes are grown for hay and pasture. Some small areas are used as permanent pasture. The main management concerns are water erosion in areas where the slope is more than 2 percent and soil blowing.

Many rural homes and cottages and a few farmsteads are in areas of this association. Sanitary facilities, building sites, and roadways are generally limited in most areas by wetness or ponding and by potential subsidence in the Lupton soils. Also, the effluent from waste disposal facilities in areas of the Padwet and Minocqua soils can pollute ground water because of the poor filtering capacity of the substratum, and local roads may be damaged by frost heave. Because of low strength, the organic Lupton soils are not suitable for dwellings.

9. Pence-Padus-Antigo Association

Well drained, nearly level to very steep, loamy and silty soils on outwash plains

This association consists mostly of soils in outwash areas that are made up of knolls, swells, hills, and ridges and are characterized by undulating to hilly topography. The landscape includes some small, nearly level, rather flat outwash plains that are pitted with kettles. The terrain also contains basins and drainageways. Many of the depressional areas contain lakes, streams, ponds, bogs, or swamps. Slopes range from nearly level and smooth to very steep and complex.

This association makes up about 5 percent of the land area in the county. It is about 32 percent Pence and similar soils, 19 percent Padus and similar soils, 18 percent Antigo and similar soils, and 31 percent soils of minor extent.

Pence soils are nearly level to very steep. They are on upland flats; on knolls, swells, hills, and ridges; and on the sides of drainageways, valleys, kettles, and basins. Typically, the surface layer is very dark gray sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is about 22 inches thick. It is dark brown sandy loam in the upper part and strong brown very gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified gravelly sand and very gravelly sand.

Padus soils are nearly level to very steep. They are on upland flats; on knolls, swells, hills, and ridges; and on the sides of drainageways, valleys, kettles, and basins. Typically, the surface layer is very dark gray sandy loam about 4 inches thick. The subsurface layer is brown sandy loam about 6 inches thick. The next layer is dark reddish brown, brown, and dark brown sandy loam about 13 inches thick. The subsoil is about 16 inches thick. It is dark brown sandy loam in the upper part and dark brown very gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is brown, stratified gravelly sand and sand.

Antigo soils are nearly level to sloping or rolling. They are on upland flats; on knolls, swells, hills, and ridges; and on the sides of drainageways, valleys, kettles, and basins. Typically, the surface layer is very dark grayish brown silt loam about 1 inch thick. The subsurface layer is grayish brown silt loam about 3 inches thick. The next layer is dark yellowish brown and brown silt loam about 24 inches thick. The subsoil is about 9 inches thick. It is dark yellowish brown silt loam in the upper part and dark brown sandy loam in the lower part. The substratum to a depth of about 60 inches is brown gravelly sand.

Of minor extent are the very poorly drained Minocqua soils and the very poorly drained, organic Loxley and Lupton soils in depressions; the somewhat poorly drained Ossmer and Worcester soils on low flats and in upland swales and drainageways; and the sandy Sayner and Vilas soils in positions on the landscape similar to those of the major soils.

Most of the acreage is woodland, including a few wooded swamps. The mature upland woods are mostly

sugar maple, paper birch, and red maple in areas of the Pence soils; sugar maple in areas of the Padus soils; and sugar maple, American basswood, and white ash in areas of the Antigo soils. The main management concerns are erosion and seedling survival on the steeper slopes, the restricted use of machinery on the steeper slopes and on the Antigo and Padus soils during wet periods, and competing plants that interfere with tree regeneration on the Antigo and Padus soils.

Some areas are used for farming. Dairying is the main farm enterprise. The major crops are corn and oats, and a mixture of bromegrass and alfalfa is grown for hay and pasture. Crops are grown mostly on the less sloping soils. Some areas are used as permanent pasture. The main management concerns are water erosion in areas where the slope is more than 2 percent, soil blowing on the Padus and Pence soils, crusting of the surface layer on the Antigo soils, and the low fertility and low available water capacity of the Pence soils.

Many rural homes and a few farmsteads, cottages, villages, and landfills are in areas of this association. Generally, the soils have few limitations affecting sanitary facilities or building site development. The slope, however, is a limitation in the sloping or rolling to very steep areas. Also, the effluent from waste disposal facilities can pollute ground water because of the poor filtering capacity of the substratum. Local roads on the Antigo and Padus soils may be damaged by frost heave. The substratum of these soils is a probable source of sand and gravel.

10. Vilas-Sayner-Keweenaw Association

Excessively drained and well drained, rolling to very steep, sandy and loamy soils on outwash plains and moraines

This association consists mostly of soils that formed in ridges of glacial drift deposited along the edge of a glacier that was retreating downslope to the northwest. The ridges of drift are fronted by areas of outwash and contain knolls, hills, and ridges of glacial outwash interspersed with morainic uplands. The outwash was most likely deposited by meltwater flowing southwest along the margin of the glacial ice. Areas of this association have a rough, complex topography and contain many small kettles, basins, and narrow drainageways. Many of the depressional areas have no drainage outlet. Slopes are short and complex.

This association makes up about 3 percent of the land area in the county. It is about 30 percent Vilas and similar soils, 22 percent Sayner and similar soils, 17 percent Keweenaw and similar soils, and 31 percent soils of minor extent.

Vilas soils are excessively drained and are on the glacial outwash parts of the landscape. They are on swells, hills, and ridges and on the sides of valleys, kettles, and basins. Typically, the surface layer is black loamy sand about 3 inches thick. The subsurface layer is brown loamy sand about 1 inch thick. The subsoil is about 23 inches thick. It is 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 yellowish brown sand.

Sayner soils are excessively drained and are on the glacial outwash parts of the landscape. They are on swells, hills, and ridges and on the sides of valleys, kettles, and basins. Typically, the surface layer is very dark grayish brown loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 3 inches thick. The subsoil is about 22 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 light yellowish brown, stratified gravelly sand and sand.

Keweenaw soils are well drained and are on the morainic parts of the landscape. They are on swells, hills, and ridges. Typically, the surface layer is very dark gray sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is dark reddish brown and reddish brown sandy loam and dark brown loamy sand about 16 inches thick. Below this to a depth of about 60 inches is brown sand, brown and reddish brown loamy sand, and reddish brown and dark reddish brown sandy loam.

Of minor extent are the very poorly drained, organic Dawson, Loxley, Markey, and Lupton soils in kettles, basins, and drainageways and the loamy, well drained Padus and Pence soils on swells, hills, and ridges of glacial outwash.

Most of the acreage is woodland, including a few small wooded swamps. The mature upland woods are mostly red maple, northern red oak, paper birch, eastern white pine, and red pine. Areas of the Keweenaw soils also support sugar maple. On the steeper slopes, the restricted use of machinery and erosion are management concerns. On the Keweenaw soils, competing plants can interfere with tree regeneration. During dry periods, loose sand can interfere with the traction of wheeled equipment on the Vilas soils. Seedling survival during dry periods is a management concern on these droughty soils, especially on the steeper, southern exposures.

A few small areas are used for farming. Dairying is the main farm enterprise. The major crop is oats, and grasses and legumes are grown for hay and pasture.

Crops are grown mostly on the less sloping soils. A few areas are used as permanent pasture. The main management concerns are soil blowing and the low fertility and low available water capacity of the soils.

A few farmsteads, rural homes, cottages, and landfills are in areas of this association. Generally, the soils have few limitations affecting sanitary facilities, building site development, or roadways, except for the slope. Because of a poor filtering capacity in areas of the Sayner and Vilas soils, however, the effluent from waste disposal facilities can pollute ground water.

11. Croswood-Lupton-Augwood Association

Moderately well drained, very poorly drained, and somewhat poorly drained, nearly level and gently sloping, sandy and mucky soils on outwash-veneered moraines and drumlins

This association has a landscape characterized by little local relief and few areas of surface water, except for several small streams. The terrain features are generally linear and oriented from northwest to southeast. The elongated or oval drumlins and the moraines are separated by long, shallow drainage valleys that contain swamps. The upland ridges have broad crests and gentle slopes. They are mostly glacial till that is veneered with sandy outwash deposits. The surficial sandy deposits commonly are thicker on the foot slopes that border the swamps and thinner on the highest crests. Slopes are mostly long and smooth.

This association makes up about 2 percent of the land area in the county. It is about 44 percent Croswood and similar soils, 28 percent Lupton and similar soils, 19 percent Augwood and similar soils, and 9 percent soils of minor extent.

Croswood soils are moderately well drained and are nearly level and gently sloping. They are on knolls and swells of ground moraines and on the broad crests and sides of drumlins. Typically, the surface layer is very dark gray loamy sand about 4 inches thick. The subsurface layer is dark grayish brown and grayish brown sand about 2 inches thick. The subsoil is about 25 inches thick. It is dark reddish brown loamy sand in the upper part and dark brown and strong brown sand in the lower part. It is mottled in the lower 9 inches. The upper 24 inches of the substratum is brown, mottled sand. Below this to a depth of about 60 inches is mostly brown, mottled gravelly loamy sand.

Lupton soils are very poorly drained and are nearly level. They are in drainageways and basins. Typically, they are dark reddish brown and black muck to a depth of about 60 inches.

Augwood soils are somewhat poorly drained and are nearly level and gently sloping. They are on small swells and knolls in low areas, on foot slopes of moraines and drumlins, and in upland swales and drainageways. Typically, the surface layer is very dark gray loamy sand about 1 inch thick. The subsurface layer is grayish brown sand about 2 inches thick. The subsoil is about 33 inches thick. It is dark reddish brown, mottled loamy sand in the upper part and dark brown and strong brown, mottled sand in the lower part. The upper 19 inches of the substratum is brown, mottled sand. Below this to a depth of about 60 inches is brown, mottled sandy loam.

Of minor extent are the moderately well drained Sarwet soils on the crests of drumlins and moraines and the excessively drained Vilas soils on sandy knolls and flats that occupy valley foot slopes.

Most of the acreage is woodland, including some wooded swamps. Many pine plantations also are in areas of this association. The mature upland woods are mostly red maple, northern red oak, paper birch, eastern white pine, and red pine in areas of the Croswood soils and red maple, red pine, paper birch, quaking aspen, and balsam fir in areas of the Augwood soils. On the Lupton and Augwood soils, the main management concerns are the restricted use of equipment, seedling survival, and windthrow. Competing plants that interfere with tree regeneration are a concern on all of the major soils. During dry periods, loose sand can interfere with the traction of wheeled equipment on the Croswood soils. Seedling survival during dry periods is a management concern on the seasonally droughty Croswood soils.

A few small areas of the Croswood soils are used for farming. Dairying is the main farm enterprise. The major crop is oats, and grasses and legumes are grown for hay and pasture. A few areas are used as permanent pasture. The main management concerns are soil blowing and the low fertility and low available water capacity of the soils.

A few farmsteads, rural homes, and landfills are in areas of this association. Sanitary facilities, building sites, and roadways are generally limited in most areas by wetness or ponding and by potential subsidence in the Lupton soils. Also, restricted permeability in the loamy part of the Augwood and Croswood soils limits their use for sanitary facilities. Effluent from waste disposal facilities on these soils can pollute ground water because of the poor filtering capacity of the upper sandy deposits. Local roads on the Augwood and Lupton soils may be damaged by frost heave. Because of low strength, the organic Lupton soils are not suitable for dwellings.

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 the heading "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, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Antigo silt loam, 1 to 6 percent slopes, is a phase of the Antigo 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 three soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Pence-Antigo complex, 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. Lupton, Cathro, and Markey mucks, 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.

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

AoB—Antigo silt loam, 1 to 6 percent slopes. This nearly level and gently sloping or undulating, well drained soil is on knolls and upland flats, in the higher parts of glacial lake basins, and on the sides of drainageways, kettles, and basins. The landscape is pitted in places. Areas are elongated or irregularly shaped and range from about 10 to 200 acres in size.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The next layer is dark yellowish brown and brown silt loam about 17 inches thick. The subsoil is dark brown loam and gravelly sandy loam about 10 inches thick. The substratum to a depth of about 60 inches is brown, stratified very gravelly sand and sand. In some areas the upper layers are loam. In

places the substratum is at a depth of more than 40 inches, and in a few places it has thin layers of loamy deposits. It is cobbly in some areas. In places the slope is 6 to 15 percent. In a few places the upper silty deposits are more than 30 inches thick.

Included with this soil in mapping are small areas of Ossmer, Padus, Pence, and Sconsin soils. The somewhat poorly drained Ossmer and moderately well drained Sconsin soils are in swales and other lower parts of the landscape. The well drained Padus and Pence soils are on the crests of knolls and on the sides of drainageways. They have a surface layer of sandy loam. Pence soils are shallower to sand and gravel than the Antigo soil. Also included are areas where loamy till is within a depth of 60 inches; areas where a perched seasonal high water table is in the subsoil; narrow areas that have steep slopes; and small ponds, wet spots, very stony areas, gravel pits, and depressions. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Antigo soil and rapid or very rapid in the lower part. Runoff is slow or medium. The available water capacity is moderate. The content of organic matter in the surface layer is moderate or moderately low. The potential for frost action is high. The surface layer can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after rainfall. In places, the rooting depth of some plants is limited by the sand and gravel substratum.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but yellow birch and black cherry are in most stands. The ground flora includes blue cohosh, sweet cicely, four-lined honeysuckle, smooth yellow violet, ladyfern, Virginia waterleaf, largeflowered bellwort, snow trillium, and bloodroot.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Landings that are stabilized with gravel 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas where the slope is more than 2 percent. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. The substratum is droughty and may be difficult to vegetate if exposed during the construction of diversions, grassed waterways, or terraces. Land smoothing in nearly level areas can prevent the crop damage caused by ponding. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the soil, improve fertility, help to prevent crusting and puddling of the surface layer, and conserve the water available for plant growth. They also help to prevent excessive water erosion in areas where the slope is more than 2 percent.

This soil is suited to pasture. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity of the substratum may result in the pollution of ground water. The soil is suited to dwellings, but the substratum may cave in if it is excavated. The soil is poorly suited to local roads because of the risk of frost damage. Frost action can be controlled by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts. The substratum is a probable source of sand and gravel.

The land capability classification is IIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is AViO or ATM. The secondary habitat type commonly is AH.

AoC—Antigo silt loam, 6 to 15 percent slopes. This sloping or rolling, well drained soil is on swells, hills, and ridges and on the sides of valleys, kettles, and glacial lake basins. Areas are elongated or irregularly shaped and range from about 10 to 200 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 1 inch thick. The subsurface layer is grayish brown silt loam about 3 inches thick. The next layer is dark yellowish brown and brown silt loam about 24 inches thick. The subsoil is about 9 inches thick. It is dark yellowish brown silt loam in the upper part and dark brown sandy loam in the lower part. The substratum to a depth of about 60 inches is brown gravelly sand. In some areas the upper layers are loam. In places the substratum is at a depth of more than 40 inches, and in a few places it has thin layers of loamy deposits. It is cobbly in some areas. In places the slope is less than 6 percent.

Included with this soil in mapping are small areas of Ossmer, Padus, Pence, and Sconsin soils. The somewhat poorly drained Ossmer and moderately well drained Sconsin soils are in the lower positions on the landscape. The well drained Padus and Pence soils are in landscape positions similar to those of the Antigo soil. They have a surface layer of sandy loam. Pence soils are shallower to sand and gravel than the Antigo soil. Also included are areas where loamy till is within a depth of 60 inches; small areas where the slope is more than 15 percent; and small ponds, wet spots, very stony areas, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Antigo soil and rapid or very rapid in the lower part. Runoff is medium. The available water capacity is moderate. The content of organic matter in the surface layer is moderate or moderately low. The potential for frost action is high. The surface layer can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after rainfall. In places, the rooting depth of some plants is limited by the sand and gravel substratum.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but yellow birch and black cherry are in most stands. The ground flora includes blue cohosh, sweet cicely, four-lined honeysuckle, smooth yellow violet, ladyfern, Virginia waterleaf, largeflowered bellwort, snow trillium, and bloodroot.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. The slope limits the selection of landing sites. Landings can be established on better suited included or adjacent soils that are nearly level or gently sloping.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish. The substratum is droughty and may be difficult to vegetate if exposed during the construction of diversions or grassed waterways. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the soil, improve fertility, help to prevent crusting and puddling of the surface layer, conserve the water available for plant growth, and help to prevent excessive water erosion.

This soil is suited to pasture. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of high-quality forage.

This soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity of the substratum may result in the pollution of ground water. The soil is only moderately suited to dwellings because of the slope. It is poorly suited to local roads because of the risk of frost damage. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. The substratum may cave in if it is excavated.

It is droughty and is difficult to vegetate if it is exposed by land shaping. Frost damage to local roads can be controlled by replacing the upper part of the soil with coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts. The substratum is a probable source of sand and gravel.

The land capability classification is IIIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is AViO or ATM. The secondary habitat type commonly is AH.

AuA—Au Gres loamy sand, 0 to 3 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on low flats and in swales and drainageways in the uplands. The surface of the land commonly is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are elongated or irregularly shaped and range from about 10 to several hundred acres in size.

Typically, the surface layer is black loamy sand about 2 inches thick. The subsurface layer is grayish brown and dark grayish brown sand about 3 inches thick. The subsoil is about 27 inches thick. It is dark reddish brown, mottled loamy sand in the upper part and dark brown and brown, mottled sand in the lower part. The substratum to a depth of about 60 inches is brown, mottled sand. In some areas the surface layer is sand. In places the substratum is loamy sand. In a few places the soil has thin layers of gravelly sand or very gravelly sand.

Included with this soil in mapping are small areas of very poorly drained soils in depressions, the somewhat poorly drained Augwood soils in areas where loamy till is at a depth of 40 to 60 inches, and the moderately well drained Croswell and excessively drained Vilas soils on the higher parts of the landscape. Also included are areas where the soil has thin layers of loamy deposits, areas where the sand fraction is fine or very fine, areas where the surface soil is sandy loam or fine sandy loam, and small ponds. Included areas make up less than 15 percent of the map unit.

Permeability is rapid in the Au Gres soil. Runoff is very slow. The available water capacity and natural fertility are low. The content of organic matter in the surface layer is moderate. The potential for frost action also is moderate. A seasonal high water table is at a depth of 0.5 foot to 1.5 feet. It limits the rooting depth of some plants.

Most areas are used as woodland. The timber stands are mostly red maple, red pine, paper birch, quaking aspen, and balsam fir, but yellow birch, eastern hemlock, eastern white pine, jack pine, and northern red oak are in most stands. The ground flora includes blueberry, bunchberry dogwood, goldthread, brackenfern, Canada mayflower, American starflower, wild sarsaparilla, beaked hazelnut, yellow beadlily, wintergreen, bigleaf aster, blackberry, and wild strawberry.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation, seedling mortality, and the windthrow hazard. The use of equipment is restricted in the spring and in other excessively wet periods because of the seasonal high water table. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. Logging roads and landings that have a gravel base can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited. Adequate culverts are needed on graveled roads to maintain the natural drainage system.

The seedling mortality resulting from soil wetness can be reduced by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If drained, this soil is suited to cultivated crops, but only a few small areas are used as cropland. The soil is suited to pasture. Forage stands are difficult to establish and maintain because of the high water table and the low natural fertility. A cover of pasture plants is effective in controlling soil blowing. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates and rotation grazing help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is generally unsuited to septic tank absorption fields and dwellings mainly because of the seasonal high water table. This limitation is difficult to overcome. A better site should be selected.

This soil is poorly suited to local roads because of the seasonal high water table. The roadbed can be

raised above the level of wetness by adding a coarse base material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IVw. Based on red pine productivity, the woodland ordination symbol is 6W. The habitat type commonly is a vaccinium phase of TMC (TMC-V).

AxA—Augwood loamy sand, 0 to 3 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on foot slopes of outwash-veneered moraines and drumlins. The surface of the land commonly is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are long and narrow or irregularly shaped and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark gray loamy sand about 1 inch thick. The subsurface layer is grayish brown sand about 2 inches thick. The subsoil is about 33 inches thick. It is dark reddish brown, mottled loamy sand in the upper part and dark brown and strong brown, mottled sand in the lower part. The upper part of the substratum is brown, mottled sand about 19 inches thick. The lower part to a depth of about 80 inches is brown, mottled gravelly loamy sand. In some areas the surface layer is sand. In a few areas the lower part of the substratum is dominantly loamy and silty water-laid deposits. In places the sandy deposits have thin layers of gravelly sand or very gravelly sand, and in a few places they are less than 40 inches thick.

Included with this soil in mapping are small areas of very poorly drained soils in depressions, the somewhat poorly drained Au Gres soils in areas where the underlying loamy deposit is below a depth of 60 inches, and the moderately well drained Croswood and excessively drained Vilas soils on the higher parts of the landscape. Vilas soils are sandy throughout. Also included are areas where the surface soil is sandy loam or fine sandy loam, some areas where the sand fraction is fine or very fine, small very stony areas, and small ponds. Included areas make up less than 15 percent of the map unit.

Permeability is rapid in the upper layers of the Augwood soil and moderate in the loamy part of the substratum. Runoff is very slow. The available water capacity is low. The content of organic matter in the surface layer is moderate or moderately low. The potential for frost action is moderate. A perched seasonal high water table is at a depth of 0.5 foot to 2.0 feet. It limits the rooting depth of some plants.

Most areas are used as woodland. The timber stands are mostly red maple, red pine, paper birch, quaking aspen, and balsam fir, but yellow birch, eastern hemlock, eastern white pine, jack pine, and northern red oak are in most stands. The ground flora includes blueberry, bunchberry dogwood, goldthread, brackenfern, Canada mayflower, American starflower, wild sarsaparilla, beaked hazelnut, yellow beadlily, wintergreen, bigleaf aster, blackberry, and wild strawberry.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation, seedling mortality, and the windthrow hazard. The use of equipment is restricted in the spring and in other excessively wet periods because of the seasonal high water table. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. Logging roads and landings that have a gravel base can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited. Adequate culverts are needed on graveled roads to maintain the natural drainage system.

The seedling mortality resulting from soil wetness can be reduced by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the perched high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If drained, this soil is suited to cultivated crops, but only a few small areas are used as cropland. The soil is suited to pasture. Forage stands are difficult to establish and maintain because of the high water table and the low natural fertility in the sandy deposits. A cover of pasture plants is effective in controlling soil blowing. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates and rotation grazing help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is generally unsuited to septic tank absorption fields and dwellings mainly because of the seasonal high water table. This limitation is difficult to overcome. A better site should be selected.

This soil is poorly suited to local roads because of the seasonal high water table. The roadbed can be

raised above the level of wetness by adding a coarse base material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IVw. Based on red pine productivity, the woodland ordination symbol is 7W. The habitat type commonly is a vaccinium phase of TMC (TMC-V).

CoA—Comstock silt loam, 0 to 3 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on the lower parts of glacial lake basins. The surface of the land commonly is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are round or irregularly shaped. They generally range from 10 to 60 acres in size, but some are as large as 150 acres.

Typically, the surface layer is black silt loam about 2 inches thick. The subsurface layer is dark grayish brown and brown silt loam about 9 inches thick. It is mottled in the lower part. The next layer is brown and reddish brown silt loam and reddish brown silty clay loam about 11 inches thick. It is mottled. The subsoil is about 35 inches thick. The upper part is reddish brown, mottled silty clay loam. The lower part is reddish brown, mottled silt loam that has thin layers of silty clay loam and fine sand. The substratum to a depth of about 60 inches also is reddish brown, mottled silt loam that has thin layers of silty clay loam and fine sand. In some areas the upper layers are loam. In places the substratum has thin layers of sand and gravel, and in a few places it is loamy glacial till.

Included with this soil in mapping are small areas of the moderately well drained Crystal Lake soils on the higher or more sloping parts of the landscape. Also included are small areas where the substratum is sand, areas where the surface soil is very fine sandy loam or fine sandy loam, narrow areas that have steep slopes, and small ponds and wet spots. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Comstock soil and moderately slow in the lower part. Runoff is slow. The available water capacity is high. The content of organic matter in the surface layer is moderate. The potential for frost action is high. The shrink-swell potential is moderate in the subsoil. The surface layer can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after rainfall. A perched seasonal high water table is at a depth of 1 to 3 feet. It limits the rooting depth of some plants.

Most areas are used as woodland. The timber stands are mostly red maple, balsam fir, and quaking aspen, but sugar maple, white ash, yellow birch, paper birch, and American hornbeam are in most stands. The ground flora includes Virginia waterleaf, ladyfern, rosy twistedstalk, beaked hazelnut, wild sarsaparilla, Canada mayflower, yellow beadlily, American starflower, bunchberry dogwood, sensitive fern, trout lily, dewberry, and cinnamon fern. Blueberry, horsetail, or goldthread are in areas where the seasonal high water table persists for longer periods.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation and the windthrow hazard. The use of equipment is restricted in the spring, late in fall, and during other excessively 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 result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Also, culverts are needed to maintain the natural drainage system. Landings that are stabilized with gravel can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited.

A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. The wetness in undrained areas limits yields and the kinds of crops that can be grown. Some undrained areas formerly used as cropland are now idle or have been planted to spruce trees. Field ditches, land smoothing, land grading, or a combination of these can remove excess surface water that accumulates during spring runoff and after heavy rains. Diversions on adjoining uplands or field ditches at the base of the adjoining uplands help to intercept and control runoff on this soil. Field ditches and tile drains can lower the water table. Because the soil is unstable and may cave, the sides of the ditches should be flattened and continuous tubing should be used when tile drains are installed. Filters are needed to keep fine particles of silt and sand from clogging the drains. Drainage tile may be displaced by frost action. This displacement can be prevented by

using continuous tubing or by installing the tile drains below the depth of freezing. The field ditches can be used as outlets for tile drains in areas where a suitable drainage outlet is not available.

Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching improve fertility, increase the infiltration rate and the movement of air and water through the soil, and help to prevent crusting and puddling of the surface layer.

This soil is suited to pasture. Alfalfa stands for improved pasture are difficult to establish and maintain unless the soil is drained. Excess water during wet periods may damage the forage. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is generally unsuited to septic tank absorption fields and dwellings mainly because of the seasonal high water table. This limitation is difficult to overcome. A better site should be selected.

This soil is poorly suited to local roads because of the low strength and the risk of frost damage. These limitations can be overcome by covering the soil with a coarse base material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. Based on red maple productivity, the woodland ordination symbol is 3W. The primary habitat type commonly is AViO or TMC. The secondary habitat type commonly is ATM or AH.

CpA—Comstock-Magnor silt loams, 0 to 3 percent slopes. These nearly level and gently sloping, somewhat poorly drained soils are on the lower parts of glacial lake basins on morainic landscapes. The surface of the land is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are round or irregularly shaped. They commonly range from about 5 to 80 acres in size, but some are several hundred acres. The areas generally are about 45 to 55 percent Comstock soil and 35 to 45 percent Magnor soil. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Comstock soil has a surface layer of very dark gray silt loam about 3 inches thick. The subsurface layer is dark grayish brown and grayish brown, mottled silt loam about 9 inches thick. The next layer is brown and dark yellowish brown silt loam and dark yellowish brown silty clay loam about 10 inches thick. It is mottled. The subsoil is dark grayish brown, mottled silty clay loam and silt loam about 16 inches thick. The substratum to a depth of about 60 inches is brown and reddish brown, mottled silt loam that has thin layers of very fine sandy loam. In some areas the upper layers are loam. In places the substratum has thin layers of sand and gravel.

Typically, the Magnor soil has a surface layer of very dark gray silt loam about 3 inches thick. The subsurface layer is dark grayish brown and grayish brown, mottled silt loam about 8 inches thick. The next layer is brown and yellowish brown, mottled silt loam about 15 inches thick. The subsoil is reddish brown, mottled, firm sandy loam about 15 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, firm sandy loam. In some areas the upper layers are loam. In a few areas the upper silty deposits are more than 30 inches thick. In places the subsoil has a thin layer of sand and gravel. In a few places the lower part of the soil is friable.

Included with these soils in mapping are small areas of the moderately well drained Crystal Lake and Freeon soils on the higher or more sloping parts of the landscape. Also included are small areas where the surface soil is very fine sandy loam or fine sandy loam, narrow areas of steep slopes, and small ponds or wet spots. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Comstock and Magnor soils. It is moderately slow or slow in the loamy subsoil of the Magnor soil. It is moderately slow in the lower part of the Comstock soil and very slow in the lower part of the Magnor soil. Runoff is slow on both soils. The available water capacity is high. The content of organic matter in the surface layer is moderate in the Comstock soil and moderate or moderately low in the Magnor soil. The potential for frost action is high in both soils. The shrink-swell potential is moderate in the subsoil of the Comstock soil. The surface layer in both soils can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after rainfall. A perched seasonal high water table is at a depth of 1 to 3 feet in both soils. The rooting depth of some plants is limited by the seasonal high water table in both soils and the firm substratum in the Magnor soil.

Most areas are used as woodland. The timber stands on the Comstock soil are mostly red maple, balsam fir, and quaking aspen. The ground flora includes Virginia waterleaf, ladyfern, rosy twistedstalk, beaked hazelnut, wild sarsaparilla, Canada mayflower, yellow beadlily,

American starflower, bunchberry dogwood, sensitive fern, trout lily, dewberry, and cinnamon fern. Blueberry, horsetail, or goldthread are in areas where the seasonal high water table persists for longer periods. Red maple and sugar maple are the dominant species on the Magnor soil where blue cohosh, sweet cicely, and smooth yellow violet also are in the ground flora. American basswood and northern red oak also are in timber stands on the Magnor soil. Yellow birch, white ash, paper birch, and American hornbeam are in most stands on both soils.

These soils are suited to trees. The main concerns affecting woodland management are the equipment limitation and the windthrow hazard. The use of equipment is restricted in the spring, late in fall, and during other excessively wet periods because of the seasonal high water table and low soil strength. Ruts form easily if wheeled skidders are used when the soils are wet. Deep ruts restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soils are dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Also, culverts are needed to maintain the natural drainage system. Landings that are stabilized with gravel can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited.

A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

If drained, these soils are suited to corn and small grain and to grasses and legumes for hay and pasture. The wetness in undrained areas limits yields and the kinds of crops that can be grown. Some undrained areas formerly used as cropland are now idle or have been planted to spruce trees. The Magnor soil is difficult to drain because of the very slow internal drainage. Removing surface water helps to minimize the amount of water that infiltrates the soil. Field ditches, land smoothing, land grading, or a combination of these can be used on both soils to remove excess surface water that accumulates during spring runoff and after heavy rains. Diversions on adjoining uplands or field ditches at the base of the adjoining uplands help to intercept and control runoff on these soils.

Field ditches and tile drains can be used in areas of the Magnor soil to help remove the perched water table, except where the movement of water through the soil is too slow. They can be used in areas of the Comstock soil to lower the water table. The sides of ditches should be flattened in the Comstock soil because it is unstable and may cave, and continuous tubing should be used when tile drains are installed. Filters are needed in the Comstock soil to keep fine particles of silt and sand from clogging the drains. Drainage tile may be displaced by frost action in both soils. This displacement can be prevented by using continuous tubing or by installing the tile drains below the depth of freezing. The field ditches in both soils can be used as outlets for tile drains in areas where a suitable drainage outlet is not available.

Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching improve fertility, increase the movement of air and water through the soils, and help to prevent crusting and puddling of the surface layer.

These soils are suited to pasture. Alfalfa stands for improved pasture are difficult to establish and maintain unless the soils are drained. Red clover, which is tolerant of soil wetness, commonly is seeded with alfalfa. This combination helps to ensure a dependable forage crop. Excess water during wet periods may damage the forage. Overgrazing or grazing when the soils are wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

These soils are generally unsuited to septic tank absorption fields and dwellings mainly because of the seasonal high water table. This limitation is difficult to overcome. A better site should be selected.

These soils are poorly suited to local roads because of the risk of frost damage on both soils and the low strength of the Comstock soil. These limitations can be overcome by adding a coarse base material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. Based on red maple productivity, the woodland ordination symbol is 3W. The primary habitat type commonly is AViO or TMC. The secondary habitat type commonly is ATM or AH.

CrB—Croswell loamy sand, 1 to 6 percent slopes. This nearly level and gently sloping or undulating, moderately well drained soil is on low flats and in swales and drainageways on the higher parts of the landscape. The landscape is pitted in places. Areas are elongated or irregularly shaped and range from about 10 to several hundred acres in size.

Typically, the surface layer is very dark gray loamy sand about 3 inches thick. The subsurface layer is brown sand about 2 inches thick. The subsoil is about 26 inches thick. It is dark reddish brown loamy sand in the upper part and dark brown and yellowish brown sand in the lower part. The lower 7 inches is mottled. The substratum to a depth of about 60 inches is yellowish red and brown, mottled sand. In some areas the surface layer is sand. In places the substratum is loamy sand. In a few places the soil has thin layers of gravelly sand or very gravelly sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres soils in swales and drainageways, the moderately well drained Croswood soils in areas where loamy till is at a depth of 40 to 60 inches, and the excessively drained Sayner and Vilas soils on the higher parts of the landscape. Sayner soils have a substratum of sand and gravel. Also included are areas where the soil has thin layers of loamy deposits, areas where the sand fraction is fine or very fine, narrow areas that have steep slopes, areas where the surface soil is sandy loam or fine sandy loam, and small ponds and wet spots. Included areas make up less than 15 percent of the map unit.

Permeability is rapid in the Croswell soil. Runoff is very slow. The available water capacity and natural fertility are low. The content of organic matter in the surface layer is low or moderately low. The surface layer can be easily tilled throughout a wide range in moisture content. A seasonal high water table is at a depth of 2.5 to 3.5 feet.

Most areas are used as woodland. The mature timber stands are mostly red maple, northern red oak, paper birch, eastern white pine, and red pine, but jack pine, balsam fir, and quaking aspen are in most stands. The ground flora includes blueberry, brackenfern, wintergreen, bigleaf aster, beaked hazelnut, grasses, barren strawberry, American starflower, wild sarsaparilla, blackberry, wild strawberry, and pipsissewa.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation and seedling mortality. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads and landings that are subject to the repeated use of heavy equipment can be stabilized with gravel. Seedling survival during dry periods can be improved by planting containerized seedlings or vigorous nursery stock when the soil is moist. 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. Before trees are planted, site preparation by mechanical or chemical means may be needed to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. Some areas formerly used as cropland are now idle or have been planted to pine trees. Crop yields are generally limited because of the low available water capacity. Irrigation is necessary for dependable crop production. If cultivated, the soil is subject to soil blowing during dry periods. Field borders, field windbreaks, and vegetative row barriers help to control soil blowing. A conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface, cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing, improve fertility, and conserve the water available for plant growth. Additions of plant nutrients are needed because of the low natural fertility.

This soil is suited to pasture. It is droughty, however, and natural fertility is low. A cover of pasture plants is effective in controlling soil blowing. Overgrazing or grazing when the soil is dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage. The response to additions of plant nutrients is limited, however, by the low available water content during dry periods.

This soil is poorly suited to septic tank absorption fields because of the rapid permeability and the seasonal high water table. 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 higher, better suited soils.

This soil is suited to dwellings without basements and to local roads. It is only moderately suited to dwellings with basements because of the seasonal high water table, but basements can be constructed above the level of wetness. The soil may cave in if it is excavated.

The land capability classification is IVs. Based on red pine productivity, the woodland ordination symbol is 6A.

The habitat type commonly is ArQV or PMV.

CsB—Croswood loamy sand, 1 to 6 percent slopes. This nearly level and gently sloping, moderately well drained soil is on outwash-veneered moraines and drumlins. Areas are elongated or irregularly shaped and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark gray loamy sand about 4 inches thick. The subsurface layer is dark grayish brown and grayish brown sand about 2 inches thick. The subsoil is about 25 inches thick. It is dark reddish brown loamy sand in the upper part and dark brown and strong brown sand in the lower part. The lower 9 inches is mottled. The upper 24 inches of the substratum is brown, mottled sand. Below this to a depth of about 60 inches is mostly brown, mottled gravelly loamy sand. In some areas the surface layer is sand. In a few areas the slope is 6 to 15 percent. In some places the lower part of the substratum is dominantly loamy and silty water-laid deposits. In places the sandy deposits have thin layers of gravelly sand or very gravelly sand, and in a few places they are less than 40 inches thick.

Included with this soil in mapping are small areas of the somewhat poorly drained Augwood soils in swales and drainageways, the moderately well drained Croswell soils in areas where the underlying loamy till is below a depth of 60 inches, and the excessively drained Vilas soils on small swells or knolls. Vilas soils are sandy throughout. Also included are areas where the surface soil is sandy loam or fine sandy loam, some areas where the sand fraction is fine or very fine, narrow areas that have steep slopes, small very stony areas, small ponds, and wet spots. Included areas make up less than 15 percent of the map unit.

Permeability is rapid in the upper layers of the Croswood soil and moderate in the loamy part of the substratum. Runoff is very slow. The available water capacity is low. The content of organic matter in the surface layer is moderately low or moderate. The surface layer can be easily tilled throughout a wide range in moisture content. A perched seasonal high water table is at a depth of 2.5 to 3.5 feet.

Most areas are used as woodland. The mature timber stands are mostly red maple, northern red oak, paper birch, eastern white pine, and red pine, but balsam fir and quaking aspen are in most stands. The ground flora includes rosy twistedstalk, brackenfern, Canada mayflower, yellow beadlily, bigleaf aster, beaked hazelnut, grasses, barren strawberry, American starflower, wild sarsaparilla, blackberry, wild strawberry, and blueberry.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation and seedling mortality. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads and landings that are subject to the repeated use of heavy equipment can be stabilized with gravel. Seedling survival during dry periods can be improved by planting containerized seedlings or vigorous nursery stock when the soil is moist. 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. Before trees are planted, site preparation by mechanical or chemical means may be needed to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. Some areas formerly used as cropland are now idle or have been planted to pine trees. Crop yields are generally limited because of the low available water capacity. Irrigation is necessary for dependable crop production. If cultivated, the soil is subject to soil blowing during dry periods. Field borders, field windbreaks, and vegetative row barriers help to control soil blowing. A conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface, cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing, improve fertility, and conserve the water available for plant growth. Additions of plant nutrients are needed because of the low natural fertility in the sandy deposits.

This soil is suited to pasture. It is droughty, however, and natural fertility is low in the sandy deposits. A cover of pasture plants is effective in controlling soil blowing. Overgrazing or grazing when the soil is dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage. The response to additions of plant nutrients is limited, however, by the low available water content during dry periods.

This soil is poorly suited to septic tank absorption fields because of the rapid permeability in the sandy layers and the seasonal high water table. 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 higher, better suited soils.

This soil is suited to dwellings without basements

and to local roads. It is only moderately suited to dwellings with basements because of the seasonal high water table, but basements can be constructed above the level of wetness. The sandy layers may cave in if they are excavated.

The land capability classification is IVs. Based on red pine productivity, the woodland ordination symbol is 7A. The habitat type commonly is PMV.

CyB—Crystal Lake silt loam, 1 to 6 percent slopes. This nearly level and gently sloping, moderately well drained soil is on the higher parts of glacial lake basins. Areas are round or irregularly shaped. They generally range from about 5 to 40 acres in size, but some are as large as 100 acres.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is dark grayish brown silt loam about 1 inch thick. Below this is about 11 inches of dark yellowish brown silt loam. The subsoil is about 47 inches thick. The upper part is mostly reddish brown, mottled silty clay loam. The lower part is reddish brown, mottled silt loam that has thin layers of silty clay loam and fine sand. The substratum to a depth of about 60 inches is brown, mottled silt loam that has thin layers of silty clay loam and fine sand. In some areas the upper layers are loam. In some places the substratum has thin layers of sand and gravel, and in a few places it is loamy glacial till. In some areas the slope is 6 to 15 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Comstock soils in swales. Also included are small areas where the substratum is sand; areas where the surface soil is very fine sandy loam or fine sandy loam; narrow areas that have steep slopes; and small ponds, wet spots, and narrow gullies. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Crystal Lake soil and moderately slow in the lower part. Runoff is slow or medium. The available water capacity is high. The content of organic matter in the surface layer is moderate. The potential for frost action is high. The shrink-swell potential is moderate in the subsoil. The surface layer can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after rainfall. A perched seasonal high water table is at a depth of 2.5 to 3.5 feet.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but yellow birch and black cherry are in most stands. The ground flora includes blue cohosh, sweet cicely, smooth yellow violet, ladyfern, Virginia waterleaf, stinging nettle, largeflowered bellwort, snow trillium, and bloodroot.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Landings that are stabilized with gravel 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas where the slope is more than 2 percent. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. Land smoothing in nearly level areas can prevent the crop damage caused by ponding. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the soil, improve fertility, and help to prevent crusting and puddling of the surface layer. These measures also help to prevent excessive water erosion in areas where the slope is more than 2 percent.

This soil is suited to pasture. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields because of the moderately slow permeability in the substratum and the seasonal high water table.

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 higher, better suited soils.

Because of the shrink-swell potential, this soil is only moderately suited to dwellings without basements. It is only moderately suited to dwellings with basements because of the seasonal high water table. The soil is poorly suited to local roads because of the low strength and the risk of frost damage. Excavating the subsoil and replacing it with coarse fill material helps to prevent the structural damage caused by shrinking and swelling. Basements can be constructed above the level of wetness. The limitations affecting local roads can be overcome by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is AViO or AH. The secondary habitat type commonly is ATM.

CyC—Crystal Lake silt loam, 6 to 15 percent slopes. This sloping, moderately well drained soil is on side slopes of glacial lake basins. Areas are long and narrow and range from about 5 to 20 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is dark grayish brown silt loam about 1 inch thick. The next layer is dark yellowish brown and brown silt loam and reddish brown silty clay loam about 18 inches thick. It is mottled in the lower part. The subsoil is about 27 inches thick. The upper part is reddish brown, mottled silty clay loam. The lower part is brown, mottled silt loam that has thin layers of silty clay loam and fine sand. The substratum to a depth of about 60 inches also is brown, mottled silt loam that has thin layers of silty clay loam and fine sand. In some areas the upper layers are loam. In a few areas the slope is less than 6 percent. In places the substratum has thin layers of sand and gravel, and in a few places it is loamy glacial till.

Included with this soil in mapping are small areas of the somewhat poorly drained Comstock soils in drainageways. Also included are small areas where the substratum is sand, areas where the surface soil is very fine sandy loam or fine sandy loam, small areas where the slope is more than 15 percent, and some narrow gullies. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Crystal Lake soil and moderately slow in the lower part. Runoff is medium. The available water capacity is high. The content of organic matter in the surface layer is moderate. The potential for frost action is high. The shrink-swell potential is moderate in the subsoil. The surface layer can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after rainfall. A perched seasonal high water table is at a depth of 2.5 to 3.5 feet.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but yellow birch and black cherry are in most stands. The ground flora includes blue cohosh, sweet cicely, smooth yellow violet, ladyfern, Virginia waterleaf, stinging nettle, largeflowered bellwort, snow trillium, and bloodroot.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. The slope limits the selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the soil, improve fertility, help to prevent crusting and puddling of the surface layer, and help to prevent excessive water erosion.

This soil is suited to pasture. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the

growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields mainly because of the seasonal high water table and the moderately slow permeability in the substratum. Overcoming these limitations is difficult. A better site should be selected. In some areas the effluent can be pumped to an absorption field established on a better suited soil.

Because of the slope and the shrink-swell potential, this soil is only moderately suited to dwellings without basements. Because of the seasonal high water table and the slope, it is only moderately suited to dwellings with basements. The soil is poorly suited to local roads mainly because of low strength and the risk of frost damage. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. On sites for dwellings without basements, excavating the subsoil and replacing it with coarse fill material help to prevent the structural damage caused by shrinking and swelling. Also, basements can be constructed above the level of wetness. Interceptor tile may be needed to carry off the seepage from the higher adjacent slopes. The limitations affecting local roads can be overcome by replacing the upper part of the soil with coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is AViO or AH. The secondary habitat type commonly is ATM.

Fh—Fordum loam, 0 to 2 percent slopes. This nearly level, poorly drained and very poorly drained soil is on flood plains. It is frequently flooded and subject to ponding (figs. 10 and 11). The landscape is dissected by old stream channels in places. Areas are long and narrow and range from about 10 to 200 acres in size.

Typically, the surface layer is very dark brown, mottled loam about 4 inches thick. The subsurface layer is very dark grayish brown, mottled fine sandy loam about 5 inches thick. The upper part of the substratum is dark grayish brown, mottled sandy loam, dark gray loam, and very dark gray mucky loam that has thin layers of fine sand, very fine sand, or muck. Below this to a depth of about 60 inches is grayish brown, stratified very gravelly sand and sand. In places the upper part of the soil is muck. In some areas the lower part of the substratum is loamy or has thin layers of loamy deposits.

Included with this soil in mapping are small areas of somewhat poorly drained to excessively drained soils on the higher parts of the landscape. Also included are areas where the upper alluvial deposits are sandy; areas where hard bedrock is within a depth of 60 inches; and small marsh areas, fill areas, very stony areas, ponds, and springs. Included areas make up less than 15 percent of the map unit.

Permeability is moderate or moderately rapid in the upper part of the Fordum soil and rapid or very rapid in the lower part. Runoff is very slow or ponded. The available water capacity is moderate. The content of organic matter in the surface layer is high or very high. The potential for frost action is high. A seasonal high water table is above the surface or within a depth of 1 foot. The rooting depth of some plants is limited by the seasonal high water table and, in places, by the sand and gravel substratum.

Most areas of this soil support native wetland vegetation, such as tag alder, dogwood, willow, sedges, reeds, cattails, mosses, and wetland grasses and forbs. Some areas are used as woodland. The timber stands are variable but generally include silver maple, black ash, American elm, red maple, quaking aspen, eastern hemlock, and balsam fir. The ground flora includes mint and sedge.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation, seedling mortality, and the windthrow hazard. The high water table and frequent flooding restrict the use of equipment to periods in winter when the ground is frozen. The wetness and the flooding restrict the sites for landings to suitable adjacent soils or to small, included knolls of better drained soils. Trees generally are not planted on this soil because of the wetness. Reforestation is generally limited to natural regeneration. Seedling survival rates can be increased, however, by hand planting vigorous nursery stock on the crest of cradle-knolls.

Trees are shallow rooted because of the high water table. They can be uprooted by strong winds. The windthrow hazard can be minimized by using harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay the natural regeneration of desirable tree species. Sites harvested by clearcutting commonly regenerate to tag alder. Special harvest methods may be needed to control the competing plants.

This soil is generally not suited to farming because of the wetness, the frequent flooding, and a severe hazard

Figure 10.—A flooded area of Fordum loam, 0 to 2 percent slopes. This photograph was taken on March 31, 1986.

of frost damage. Most areas cannot be drained by tile or open ditches because suitable drainage outlets generally are not available and because nearby streams control the level of the water table.

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

The land capability classification is VIw. Based on silver maple productivity, the woodland ordination symbol is 2W. A habitat type is not assigned.

FoB—Freeon silt loam, 2 to 6 percent slopes. This gently sloping or undulating, moderately well drained soil is on low swells or knolls, on the sides of drainageways and basins, on the crests and sides of drumlins, and on the higher parts of glacial lake basins on morainic landscapes. Areas are elongated or irregularly shaped. They generally range from about 5 to 60 acres in size, but some are as large as 200 acres.

Typically, the surface layer is very dark gray silt loam

Figure 11.—The same area of Fordum loam, 0 to 2 percent slopes, when it was not flooded. This photograph was taken on May 27, 1986.

about 1 inch thick. The subsurface layer is brown silt loam about 3 inches thick. The next layer is brown and dark yellowish brown silt loam and dark brown and brown, mottled sandy loam about 27 inches thick. The subsoil is reddish brown, mottled, firm sandy loam about 11 inches thick. The substratum to a depth of about 60 inches also is reddish brown, mottled, firm sandy loam. In some areas the upper layers are loam. In a few areas the slope is 6 to 15 percent. In places the subsoil has thin layers of silty deposits. In some areas the substratum is sandy clay loam or grus, and in other areas the substratum is friable.

Included with this soil in mapping are small areas of the somewhat poorly drained Magnor soils in swales and drainageways, the moderately well drained Newood soils in areas where the surface deposit is fine sandy loam, and some areas of well drained soils on the more sloping parts of the landscape. Also included are small ponds and wet spots in closed depressions, areas where hard bedrock is within a depth of 60 inches, narrow areas that have steep slopes, areas where the soil has a thin layer of sand and gravel, and small very

stony areas. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the silty upper part of the Freeon soil, slow or moderately slow in the loamy subsoil, and very slow in the substratum. Runoff is medium. The available water capacity is high. The content of organic matter in the surface layer is moderate or moderately low. The potential for frost action is moderate. The surface layer can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. It tends to crust or puddle, however, after rainfall. A perched seasonal high water table is at a depth of 2.0 to 3.5 feet. The rooting depth of some plants is limited by the firm substratum.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but yellow birch, northern red oak, and eastern hophornbeam are in most stands. The ground flora includes blue cohosh, sweet cicely, smooth yellow violet, ladyfern, Virginia waterleaf, hog peanut, mapleleaf viburnum, largeflowered bellwort, snow trillium, and bloodroot.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Landings that are stabilized with gravel 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. Some small areas are used as ginseng gardens. The soil is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the soil, improve fertility, help to prevent crusting and puddling of the surface layer, and help to prevent excessive water erosion.

This soil is suited to pasture. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields because of the very slow permeability in the substratum and the seasonal high water table. These limitations can be overcome by constructing a mound of suitable filtering material.

This soil is only moderately suited to dwellings without basements and is poorly suited to dwellings with basements because of the seasonal high water table. Basements can be constructed above the level of wetness. The soil is only moderately suited to local roads because of the seasonal high water table and the risk of frost damage. These limitations can be overcome by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. Based on sugar maple productivity, the woodland ordination symbol is 3D. The primary habitat type commonly is AViO or ATM. The secondary habitat type commonly is AH.

FoC—Freeon silt loam, 6 to 15 percent slopes. This sloping or rolling, moderately well drained soil is on swells, hills, and ridges; on the sides of drumlins and valleys; and on the sides of glacial lake basins on morainic landscapes. Areas are elongated or irregularly shaped and range from about 5 to 200 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 1 inch thick. The next layer is dark yellowish brown silt loam and brown and reddish brown sandy loam about 33 inches thick. It is mottled in the lower part. The subsoil is reddish brown, mottled, firm sandy loam about 9 inches thick. The substratum to a depth of about 60 inches also is reddish brown, mottled, firm sandy loam. In some areas the upper layers are loam.

In a few areas the slope is less than 6 percent. In some places the subsoil has thin layers of silty deposits. In other places the substratum is sandy clay loam or grus. In a few areas the substratum is friable.

Included with this soil in mapping are small areas of the somewhat poorly drained Magnor soils in swales and drainageways, the moderately well drained Newood soils in areas where the surface deposit is sandy loam, and some areas of well drained soils on the crests of hills and ridges. Also included are small ponds and wet spots in closed depressions, small areas where the slope is more than 15 percent, areas where hard bedrock is within a depth of 60 inches, areas where the soil has a thin layer of sand and gravel, and small very stony areas. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the silty upper part of the Freeon soil, slow or moderately slow in the loamy subsoil, and very slow in the substratum. Runoff is medium. The available water capacity is high. The content of organic matter in the surface layer is moderate or moderately low. The potential for frost action is moderate. The surface layer can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. It tends to crust or puddle, however, after rainfall. A perched seasonal high water table is at a depth of 2.0 to 3.5 feet. The rooting depth of some plants is limited by the firm substratum.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but yellow birch, northern red oak, and eastern hophornbeam are in most stands. The ground flora includes blue cohosh, sweet cicely, smooth yellow violet, ladyfern, Virginia waterleaf, hog peanut, mapleleaf viburnum, largeflowered bellwort, snow trillium, and bloodroot.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. The slope limits the selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. Some small areas are used as ginseng gardens. The soil is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the soil, improve fertility, help to prevent crusting and puddling of the surface layer, and help to prevent excessive water erosion.

This soil is suited to pasture. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields mainly because of the seasonal high water table and the very slow permeability in the substratum. Overcoming these limitations is difficult. A better site should be selected. In some areas the effluent can be pumped to an absorption field established on a better suited soil.

Because of the slope and the seasonal high water table, this soil is only moderately suited to dwellings without basements. Because of the seasonal high water table, it is poorly suited to dwellings with basements. The soil is only moderately suited to local roads because of the risk of frost damage, the seasonal high water table, and the slope. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. Basements can be constructed above the level of wetness. Interceptor tile may be needed to carry off the seepage from the higher adjacent slopes. Frost action and wetness can be controlled on sites for local roads

by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIIe. Based on sugar maple productivity, the woodland ordination symbol is 3D. The primary habitat type commonly is AViO or ATM. The secondary habitat type commonly is AH.

FsB—Freeon-Sconsin silt loams, 2 to 6 percent slopes. These undulating, moderately well drained soils are on outwash-veneered moraines. The Freeon soil commonly is on the sides and foot slopes of low swells or knolls, and the Sconsin soil is on the shoulders and summits. Areas of these soils are irregularly shaped. They commonly range from about 5 to 100 acres in size, but some are as large as 500 acres. They generally are about 60 to 70 percent Freeon soil and 20 to 30 percent Sconsin soil. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Freeon soil has a surface layer of very dark gray silt loam about 4 inches thick. The next layer is dark yellowish brown, brown, and dark brown silt loam and reddish brown and brown loam about 25 inches thick. It is mottled in the lower part. The subsoil is reddish brown, mottled, firm gravelly sandy loam about 12 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, firm sandy loam. In some areas the upper layers are loam. In a few areas the slope is 6 to 15 percent. In some places the subsoil is very cobbly, has thin layers of silty deposits, or has a thin layer of sand and gravel. In other places the lower part of the soil is friable.

Typically, the Sconsin soil has a surface layer of very dark grayish brown silt loam about 5 inches thick. The next layer is yellowish brown, brown, and dark yellowish brown silt loam about 18 inches thick. It is mottled in the lower part. The subsoil is about 16 inches thick. The upper part is dark yellowish brown, mottled loam, and the lower part is dark brown, mottled gravelly sandy loam. The substratum to a depth of about 60 inches is brown gravelly sand. In some areas the upper layers are loam. In a few areas the slope is 6 to 15 percent. In places the substratum is very cobbly, has thin layers of loamy deposits, or is at a depth of more than 45 inches.

Included with these soils in mapping are small areas of the somewhat poorly drained Magnor and Ossmer soils in swales and drainageways, the moderately well drained Newood and Padwet soils in areas where the surface deposit is fine sandy loam or sandy loam, and some small areas of the well drained Antigo soils on the crests of knolls. Also included are small, narrow areas that have steep slopes; small ponds and wet spots in closed depressions; and small gravel pits and very stony areas. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the silty upper part of the Freeon soil, slow or moderately slow in the loamy subsoil, and very slow in the substratum. It is moderate in the upper part of the Sconsin soil and rapid or very rapid in the lower part. Runoff is medium on both soils. The available water capacity is high in the Freeon soil and moderate in the Sconsin soil. The content of organic matter in the surface layer is moderate or moderately low in the Freeon soil and moderate in the Sconsin soil. The potential for frost action is moderate in both soils. The surface layer in both soils can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. It tends to crust or puddle, however, after rainfall. A perched seasonal high water table is at a depth of 2.0 to 3.5 feet in the Freeon soil. During some parts of the year, a mottled zone that is nearly saturated is at a depth of 2.5 to 3.5 feet in the Sconsin soil. The rooting depth of some plants is limited by the firm substratum in the Freeon soil and, in places, by the sand and gravel substratum in the Sconsin soil.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but yellow birch is in most stands. The ground flora includes blue cohosh, sweet cicely, smooth yellow violet, ladyfern, Virginia waterleaf, largeflowered bellwort, snow trillium, and bloodroot. Northern red oak and eastern hophornbeam also are in timber stands on the Freeon soil where hog peanut and mapleleaf viburnum are in the ground flora. Black cherry is in stands on the Sconsin soil where four-lined honeysuckle is in the ground flora.

These soils are suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form easily if wheeled skidders are used when the soils are wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soils are dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Landings that are stabilized with gravel 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

Subsequent control of invading species may be needed.

These soils are suited to corn and small grain and to grasses and legumes for hay and pasture. Some small areas are used as ginseng gardens. The soils are subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. The substratum in the Sconsin soil is droughty and may be difficult to vegetate if exposed during the construction of diversions or grassed waterways. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching improve fertility, help to prevent excessive water erosion, increase the infiltration rate and the movement of air and water through the soil, help to prevent crusting and puddling of the surface layer, and conserve the water available for plant growth in the Sconsin soil.

These soils are suited to pasture. A cover of pasture plants is effective in controlling water erosion. Overgrazing or grazing when the soils are wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

These soils are poorly suited to septic tank absorption fields because of the seasonal high water table and the very slow permeability in the Freeon soil and because of the seasonal zone of near saturation and the rapid or very rapid permeability in the Sconsin soil. These limitations can be overcome by constructing a mound of suitable filtering material.

The Sconsin soil is suited to dwellings. The Freeon soil is only moderately suited to dwellings without basements and is poorly suited to dwellings with basements because of the seasonal high water table. Basements can be constructed above the level of wetness.

These soils are only moderately suited to local roads because of the risk of frost damage in both soils and the seasonal high water table in the Freeon soil. These limitations can be overcome by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. Based on sugar maple productivity, the woodland ordination symbol is 3D for the Freeon soil and 3L for the Sconsin soil. The primary habitat type commonly is AViO or ATM. The secondary habitat type commonly is AH.

GoC—Goodman silt loam, 6 to 15 percent slopes. This sloping or rolling, well drained soil is on swells, hills, and ridges and on the sides of valleys and glacial lake basins on morainic landscapes. Areas are elongated or irregularly shaped. They commonly range from about 5 to 200 acres in size, but some are as large as 500 acres.

Typically, the surface layer is very dark gray silt loam about 5 inches thick. The subsurface layer is brown silt loam about 1 inch thick. The next layer is about 28 inches thick. It is dark brown and brown silt loam in the upper part and reddish brown and brown sandy loam in the lower part. The subsoil is reddish brown sandy loam about 16 inches thick. The substratum to a depth of about 60 inches also is reddish brown sandy loam. In some areas the upper layers are loam. In a few areas the slope is less than 6 percent. In some places the subsoil has thin layers of silty deposits. In other places the lower part of the soil is loamy sand or gravelly loamy sand, and in a few areas it has a thin layer of sand and gravel.

Included with this soil in mapping are small areas of the somewhat poorly drained Hatley soils in swales and drainageways, the moderately well drained Goodwit soils on the less sloping parts of the landscape, and the well drained Sarona soils in areas where the surface deposit is sandy loam. Also included are small ponds and wet spots in closed depressions, small areas where the slope is more than 15 percent, and small very stony areas. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the Goodman soil. Runoff is medium. The available water capacity is high. The content of organic matter in the surface layer is moderate. The potential for frost action also is moderate. The surface layer can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. It tends to crust or puddle, however, after rainfall.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but yellow birch, black cherry, and eastern hophornbeam are in most stands. The ground flora includes blue cohosh, sweet cicely, smooth yellow violet, ladyfern, Virginia waterleaf, largeflowered bellwort, snow trillium, bloodroot, and hog peanut.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of

low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. The slope limits the selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. The soil is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the soil, improve fertility, help to prevent crusting and puddling of the surface layer, and help to prevent excessive water erosion.

This soil is suited to pasture. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is only moderately suited to septic tank absorption fields and dwellings because of the slope. It is only moderately suited to local roads because of the slope and the risk of frost damage. Lateral seepage and the surfacing of septic tank effluent in downslope areas can be controlled by installing a trench absorption system on the contour. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. Frost damage to local roads can be controlled by replacing the upper part of the soil with coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is AViO. The secondary habitat type commonly is ATM.

GwB—Goodwit silt loam, 2 to 6 percent slopes. This gently sloping or undulating, moderately well drained soil is on low swells or knolls and on the higher parts of glacial lake basins on morainic landscapes. Areas are elongated or irregularly shaped. They commonly range from about 5 to 60 acres in size, but some are as large as 200 acres.

Typically, the surface layer is very dark gray silt loam about 2 inches thick. The subsurface layer is brown silt loam about 1 inch thick. The next layer is dark brown silt loam, brown and dark yellowish brown fine sandy loam, and brown and dark brown sandy loam about 33 inches thick. It is mottled in the lower part. The subsoil is dark brown, mottled sandy loam about 14 inches thick. The substratum to a depth of about 60 inches is reddish brown sandy loam. In some areas the upper layers are loam. In a few areas the slope is 6 to 15 percent. In some places the subsoil has thin layers of silty deposits. In other places the lower part of the soil is loamy sand or gravelly loamy sand, and in a few areas it has a thin layer of sand and gravel.

Included with this soil in mapping are small areas of the somewhat poorly drained Hatley soils in swales and drainageways, the well drained Goodman soils on the more sloping parts of the landscape, and the moderately well drained Sarwet soils in areas where the surface deposit is sandy loam. Also included are narrow areas that have steep slopes, areas where the water table is not seasonally perched in the subsoil, small ponds and wet spots in closed depressions, and small very stony areas. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the Goodwit soil. Runoff is medium. The available water capacity is high. The content of organic matter in the surface layer is moderate. The potential for frost action also is moderate. The surface layer can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. It tends to crust or puddle, however, after rainfall. A perched seasonal high water table is at a depth of 2.5 to 3.5 feet.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but yellow birch, black cherry, and eastern hophornbeam are in most stands.

The ground flora includes blue cohosh, sweet cicely, smooth yellow violet, ladyfern, Virginia waterleaf, largeflowered bellwort, snow trillium, bloodroot, and hog peanut.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Landings that are stabilized with gravel 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the soil, improve fertility, help to prevent crusting and puddling of the surface layer, and help to prevent excessive water erosion.

This soil is suited to pasture. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields because of the perched 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. It is only moderately suited to dwellings with basements because of the seasonal high water table. Basements can be constructed above the level of wetness. The soil is only moderately suited to local roads because of the risk of frost damage. This limitation can be overcome by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is AViO. The secondary habitat type commonly is ATM.

HyB—Hatley silt loam, 0 to 4 percent slopes. This nearly level and gently sloping or undulating, somewhat poorly drained soil is in upland swales and drainageways and on low swells and knolls in low areas. The surface of the land commonly is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are elongated or irregularly shaped and commonly range from about 10 to 40 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown, mottled silt loam about 3 inches thick. The next layer is brown and dark brown, mottled silt loam and loam about 15 inches thick. The subsoil is reddish brown, mottled sandy loam about 25 inches thick. The substratum to a depth of about 60 inches is reddish brown sandy loam. In some areas the upper layers are loam. In a few areas the slope is 5 or 6 percent. In some places the subsoil has thin layers of silty deposits. In other places the lower part of the soil is loamy sand or gravelly loamy sand, and in a few areas it has a thin layer of sand and gravel. In some areas the upper silty deposits are more than 30 inches thick.

Included with this soil in mapping are small areas of the moderately well drained Goodwit and well drained Goodman soils on the higher or more sloping parts of the landscape, the very poorly drained Capitola soils in drainageways, and the somewhat poorly drained Moodig soils in areas where the surface deposit is sandy loam. Also included are small ponds and wet spots in closed depressions, narrow areas that have steep slopes, and small very stony areas. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the Hatley soil. Runoff is slow or medium. The available water capacity is high. The content of organic matter in the surface layer is moderate. The potential for frost action is high. The surface layer can be easily tilled throughout a wide

range in moisture content, except in the small included areas that are very stony. It tends to crust or puddle, however, after rainfall. A seasonal high water table is at a depth of 1 to 3 feet. It limits the rooting depth of some plants.

Most areas are used as woodland. The timber stands are mostly red maple and sugar maple, but yellow birch, white ash, and American basswood are in most stands. The ground flora includes Virginia waterleaf, blue cohosh, sweet cicely, smooth yellow violet, ladyfern, rosy twistedstalk, beaked hazelnut, wild sarsaparilla, Canada mayflower, yellow beadlily, and American starflower. Balsam fir and quaking aspen are in the timber stands on foot slopes where the seasonal high water table persists for longer periods. These wetter areas have sensitive fern, dewberry, or cinnamon fern in the ground flora.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation and the windthrow hazard. The use of equipment is restricted in the spring, late in fall, and during other excessively 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 result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Also, culverts are needed to maintain the natural drainage system. Landings that are stabilized with gravel can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited.

A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. The wetness in undrained areas limits yields and the kinds of crops that can be grown. Some undrained areas formerly used as cropland are now idle or have been planted to pine, fir, or spruce. Field ditches, land smoothing, land grading, or a combination of these can be used in the nearly level areas to remove excess surface water that accumulates during spring runoff and after heavy rains. Diversions on adjoining uplands or field ditches at the base of the adjoining uplands help to intercept and control runoff on this soil. Tile drains and field ditches can be used in the nearly level areas to lower the water table. The field ditches can be used as outlets for tile drains in areas where a suitable drainage outlet is not available. Drainage tile may be displaced by frost action. This displacement can be prevented by using continuous tubing or by installing the tile drains below the depth of freezing.

This soil is subject to water erosion in cultivated areas where the slope is more than 2 percent. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. In areas where contour farming, diversions, and terraces are used, establishing a slight grade towards grassed waterways helps to remove excess surface water. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching improve fertility, increase the movement of air and water through the soil, and help to prevent crusting and puddling of the surface layer. They also help to prevent excessive water erosion in areas where the slope is more than 2 percent.

This soil is suited to pasture. Alfalfa stands for improved pasture are difficult to establish and maintain, however, unless the soil is drained. Excess water during wet periods may damage the forage. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is generally unsuited to septic tank absorption fields and dwellings mainly because of the seasonal high water table. This limitation is difficult to overcome. A better site should be selected.

This soil is poorly suited to local roads because of the risk of frost damage. This limitation can be overcome by covering the soil with a coarse base material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. Based on red maple productivity, the woodland ordination symbol is 3W. The primary habitat type commonly is AViO. The secondary habitat type commonly is ATM or TMC.

KwC—Keweenaw sandy loam, 6 to 15 percent slopes. This rolling, well drained soil is on swells, hills, and ridges. Areas commonly are irregularly shaped. They generally range from about 10 to 300 acres in size, but many are less than 40 acres.

Typically, the surface layer is dark brown sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 1 inch thick. The subsoil is about 25 inches thick. It is dark reddish brown and reddish brown sandy loam in the upper part and dark brown loamy sand in the lower part. Below this to a depth of about 60 inches is brown sand and reddish brown loamy sand and sandy loam. In some areas the surface layer is loamy sand or fine sandy loam. In a few areas the slope is less than 6 percent. In places the lower part of the soil is sand and gravel.

Included with this soil in mapping are small areas of moderately well drained and somewhat poorly drained soils on the lower parts of the landscape. Also included are small areas where the slope is more than 15 percent and small wet spots, ponds, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is moderate or moderately rapid in the Keweenaw soil. Runoff is medium. The available water capacity is low. The content of organic matter in the surface layer is moderately low. The surface layer can be easily tilled throughout a wide range in moisture content.

Most areas are used as woodland. The mature timber stands are mostly red maple, sugar maple, paper birch, and northern red oak, but American basswood, aspen, and white ash are in most stands (fig. 12). The ground flora includes brackenfern, bigleaf aster, beaked hazelnut, grasses, American starflower, wild sarsaparilla, Canada mayflower, spinulose woodfern, rosy twistedstalk, yellow beadlily, blueberry, and mapleleaf viburnum.

This soil is suited to trees. The slope limits the selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping. 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. Crop yields are limited by the low available water content during dry periods. The soil is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish.

If cultivated, this soil is subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve moisture. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing and water erosion, improve fertility, and conserve the water available for plant growth.

This soil is suited to pasture, but it is droughty during dry periods. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soil is dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer when the soil is moist helps to maintain a productive stand of forage.

This soil is only moderately suited to septic tank absorption fields, dwellings, and local roads because of the slope. Lateral seepage and the surfacing of septic tank effluent in downslope areas can be controlled by installing a trench absorption system on the contour. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. The soil may cave in if it is excavated.

The land capability classification is VIs. Based on sugar maple productivity, the woodland ordination symbol is 3A. The habitat type commonly is AVVb.

KwD—Keweenaw sandy loam, 15 to 35 percent slopes. This hilly to very steep, well drained soil is on hills and ridges. Areas are elongated or irregularly shaped and range from about 5 to 1,000 acres in size.

Typically, the surface layer is very dark gray sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is dark reddish brown and reddish brown sandy loam and dark brown loamy sand about 16 inches thick. Below this to a depth of about 99 inches is brown sand, brown and reddish brown loamy sand, and reddish brown and

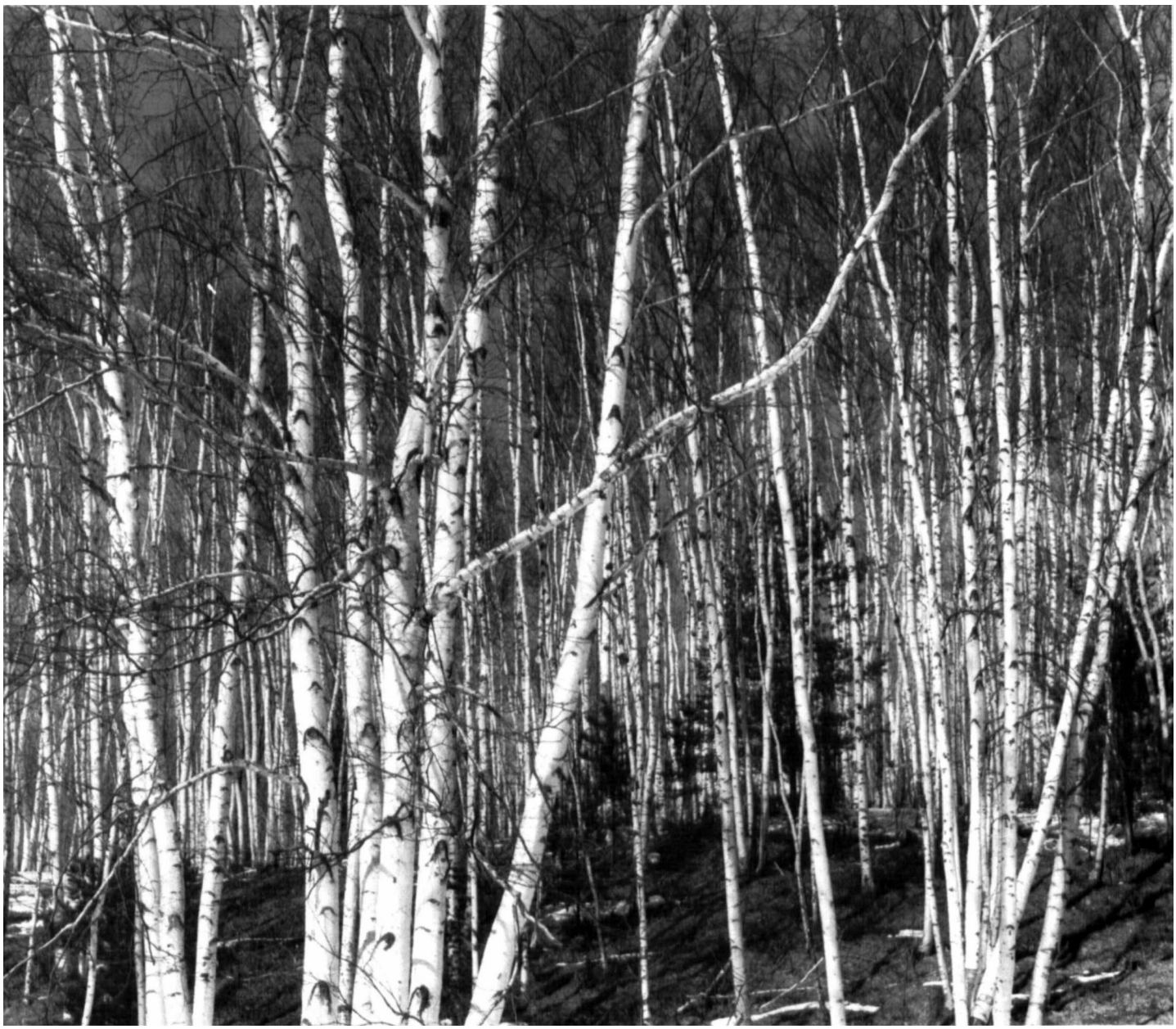


Figure 12.—A timber stand dominated by paper birch in an area of Keweenaw sandy loam, 6 to 15 percent slopes.

dark reddish brown sandy loam. In some areas the surface layer is loamy sand or fine sandy loam. In a few areas the slope is more than 35 percent. In places the lower part of the soil is sand and gravel.

Included with this soil in mapping are small areas of moderately well drained and somewhat poorly drained soils on the lower parts of the landscape. Also included are small areas where the slope is less than 15 percent and small wet spots, ponds, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is moderate or moderately rapid in the Keweenaw soil. Runoff is rapid. The available water capacity is low. The content of organic matter in the surface layer is moderately low.

Most areas are used as woodland. The mature timber stands are mostly red maple, sugar maple, paper birch, and northern red oak, but American basswood, aspen, and white ash are in most stands. The ground flora includes brackenfern, bigleaf aster, beaked hazelnut, grasses, American starflower, wild

sarsaparilla, Canada mayflower, spinulose woodfern, rosy twistedstalk, yellow beadlily, blueberry, and mapleleaf viburnum.

This soil is suited to trees. The main concerns affecting woodland management are the erosion hazard, the equipment limitation, and seedling mortality. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. It can be minimized by logging, planting trees, and establishing roads and trails on the contour; yarding uphill by cable; and removing water by water bars, out-sloping road surfaces, and culverts. Drop structures may be needed to stabilize highly erodible areas. Seeding areas exposed by logging activities helps to establish a protective vegetative cover.

The slope limits the selection of sites for logging roads and landings. Establishing the roads on the contour helps to maintain a low grade. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping. Yarding the logs by cable and planting trees by hand may be necessary in areas where the slope limits the use of equipment.

Seedling survival during dry periods can be improved on the droughty southern exposures by planting containerized seedlings or vigorous nursery stock when the soil is moist. 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is generally not suited to cultivated crops because of the slope, the low available water capacity, and a severe hazard of erosion.

This soil is suited to pasture. Forage yields are limited because of the low available water content during dry periods. The soil should be managed for bluegrass in areas where the slope prevents the use of machinery. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soil is dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation in areas where machinery can be used, and restricted use during dry periods help to keep the pasture in good condition. In areas where machinery can be used, clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer when the soil is moist helps to maintain a productive stand of forage.

Mainly because of the slope, this soil is generally unsuited to septic tank absorption fields and dwellings. Overcoming this limitation is difficult. A better site, such as a small included area of a better suited, less sloping soil, should be selected.

This soil is poorly suited to local roads because of the slope. Land shaping is needed to reduce the slope, or the roads can be built on the contour. The soil may cave in if it is excavated.

The land capability classification is VIIs. Based on sugar maple productivity, the woodland ordination symbol is 3R. The habitat type commonly is AVVb.

Lo—Loxley and Dawson peats, 0 to 1 percent slopes. These nearly level, very poorly drained soils are in kettles and basins. They are subject to ponding. They commonly have a hummocky surface. Areas are round, oblong, or irregularly shaped and range from about 5 to 700 acres in size. A single mapped area may be Loxley peat or Dawson peat or may contain both soils. Because the soils have similar behavior characteristics for present and anticipated uses in the survey area, mapping them separately was not considered practical.

Typically, the Loxley soil has an upper layer of light olive brown peat about 10 inches thick. The next layer is very dark grayish brown mucky peat about 10 inches thick. Below this to a depth of about 60 inches is dark reddish brown muck. In places the organic material is mostly mucky peat.

Typically, the Dawson soil has an upper layer of brown peat about 8 inches thick. The next layer is dark reddish brown and black muck about 32 inches thick. The substratum to a depth of about 60 inches is dark grayish brown sand. In places the organic material is mostly mucky peat, and in a few areas it is less than 16 inches thick.

Included with these soils in mapping are small areas of somewhat poorly drained to excessively drained soils on the higher parts of the landscape. Also included are some areas where the soils are less acid and support trees of merchantable size and quality; areas adjacent to lakes that are inundated throughout most of the year; and small marsh areas, fill areas, floating bogs, and ponds. Included areas make up less than 15 percent of the map unit.

Permeability is moderately rapid to moderately slow in the Loxley soil and in the organic part of the Dawson soil. It is rapid in the substratum of the Dawson soil. Runoff is very slow or ponded on both soils. The available water capacity is very high. The potential for frost action is high. A seasonal high water table is above the surface or within a depth of 1 foot. It limits the rooting depth of some plants.

Most areas of these soils support wetland vegetation, such as leatherleaf, Labrador tea, sphagnum moss, sedge, blueberry, cranberry, bog rosemary, pale laurel,

Figure 13.—A typical bog area of Loxley and Dawson peats, 0 to 1 percent slopes.

and wetland grasses. Some areas are wooded, but the soils are generally not suited to trees. They do not support trees of merchantable size or quality because of the extremely acid soil conditions (fig. 13). The timber stands are mostly widely spaced and stunted black spruce and tamarack.

These soils are generally not suited to farming because of the wetness, the extreme acidity, the low natural fertility, the poor trafficability, and a severe hazard of frost damage. Some small areas are used for the commercial production of cranberries. Most areas cannot be drained by tile or open ditches because suitable drainage outlets generally are not available.

Mainly because of subsidence, ponding, low strength, and the risk of frost damage, these soils are generally unsuited to septic tank absorption fields, dwellings, and local roads. Overcoming these limitations is difficult. A better site should be selected.

The land capability classification is VIIw for undrained areas. Based on black spruce productivity, the woodland ordination symbol is 2W. A habitat type is not assigned.

Lu—Lupton, Cathro, and Markey mucks, 0 to 1 percent slopes. These nearly level, very poorly drained soils are in drainageways and in kettles and basins.

They are subject to ponding. Areas are elongated or irregularly shaped and range from about 5 to several thousand acres in size. A single mapped area may contain one or more of the soils. Because the soils have similar behavior characteristics for present and anticipated uses in the survey area, mapping them separately was not considered practical or necessary.

Typically, the Lupton soil is dark reddish brown and black muck to a depth of about 60 inches. In places the organic material is mostly mucky peat.

Typically, the Cathro soil has an upper layer of black and dark reddish brown muck about 28 inches thick. The upper part of the substratum is dark gray, mottled loam. Below this to a depth of about 60 inches is dark grayish brown, mottled sandy loam. In some places the organic material is mostly mucky peat, and in a few other places it is less than 16 inches thick.

Typically, the Markey soil has an upper layer of black and dark brown muck about 36 inches thick. The substratum to a depth of about 60 inches is dark grayish brown sand. In places the organic material is mostly mucky peat, and in a few areas it is less than 16 inches thick.

Included with these soils in mapping are small areas of somewhat poorly drained to excessively drained soils on the higher parts of the landscape. Also included are some areas where the soils are extremely acid and do not support trees of merchantable size or quality; areas adjacent to lakes that are inundated throughout most of the year; and small springs, fill areas, marsh areas, and ponds. Included areas make up less than 15 percent of the map unit.

Permeability is moderately rapid to moderately slow in the organic part of the Lupton, Cathro, and Markey soils; moderate or moderately slow in the substratum of the Cathro soil; and rapid in the substratum of the Markey soil. Runoff is very slow or ponded on these soils. The available water capacity is very high. The potential for frost action is high. A seasonal high water table is above the surface or within a depth of 1 foot. It limits the rooting depth of some plants.

Most areas are used as woodland. Some areas support native wetland vegetation, such as tag alder, dogwood, willow, sedges, reeds, cattails, mosses, and wetland grasses and forbs (fig. 14). The timber stands are mostly northern whitecedar, black spruce, and balsam fir, but tamarack, red maple, American elm, eastern hemlock, and quaking aspen are in most stands. The ground flora includes sphagnum moss, horsetail, goldthread, bunchberry dogwood, and wood sorrel.

These soils are suited to trees. The main concerns affecting woodland management are the equipment limitation, seedling mortality, and the windthrow hazard. The high water table and the low strength of the organic material restrict the use of equipment to periods in winter when the ground is frozen. Sites for landings are limited to suitable adjacent soils or to small, included knolls of better drained mineral soils. Trees generally are not planted on these soils because of the wetness. Reforestation is generally limited to natural regeneration. Seedling survival rates can be increased, however, by hand planting vigorous nursery stock on the crest of cradle-knolls.

Trees are shallow rooted because of the high water table. They can be uprooted by strong winds (fig. 15). The windthrow hazard can be minimized by using harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay the natural regeneration of desirable tree species. Sites harvested by clearcutting commonly regenerate to tag alder. Special harvest methods may be needed to control the competing plants.

These soils are generally not suited to farming because of the wetness, the low natural fertility, the poor trafficability, and a severe hazard of frost damage. Most areas cannot be drained by tile or open ditches because suitable drainage outlets generally are not available.

Mainly because of subsidence, ponding, low strength, and the risk of frost damage, these soils are generally unsuited to septic tank absorption fields, dwellings, and local roads. Overcoming these limitations is difficult. A better site should be selected.

The land capability classification is VIw for undrained areas. Based on balsam fir productivity, the woodland ordination symbol is 7W. A habitat type is not assigned.

MaB—Magnor silt loam, 0 to 4 percent slopes. This nearly level and gently sloping or undulating, somewhat poorly drained soil is on broad swells of ground moraines, on knolls within depressions, on the broad crests and foot slopes of drumlins, and in upland swales and drainageways. The surface of the land commonly is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are elongated or irregularly shaped and range from about 10 to several thousand acres in size.

Typically, the surface layer is very dark gray silt loam about 5 inches thick. The subsurface layer is dark grayish brown, mottled silt loam about 5 inches thick. The next layer is grayish brown and yellowish brown, mottled silt loam about 15 inches thick. The subsoil is reddish brown, mottled, firm sandy loam about 14 inches thick. The substratum to a depth of about 60 inches also is reddish brown, mottled, firm sandy loam. In some areas the upper layers are loam. In a few

Figure 14.—A typical area of Lupton, Cathro, and Markey mucks, 0 to 1 percent slopes. The native wetland vegetation is mostly tag alder and sedges.

areas the slope is 5 or 6 percent. In some places the subsoil has thin layers of silty deposits. In other places the substratum is sandy clay loam or grus. In a few areas the substratum is friable. In places the upper silty deposits are more than 30 inches thick.

Included with this soil in mapping are small areas of the very poorly drained Capitola soils in drainageways, the moderately well drained Freeon soils on the higher or more sloping parts of the landscape, the somewhat poorly drained Magroc soils in areas where bedrock is at a depth of 40 to 60 inches, and the somewhat poorly drained Pesabic soils in areas where the surface deposit is fine sandy loam. Also included are small ponds and wet spots in closed depressions, narrow areas that have steep slopes, areas where the soil has a thin layer of sand and gravel, and small very stony areas. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the silty upper part of the Magnor soil, slow or moderately slow in the loamy subsoil, and very slow in the substratum. Runoff is slow or medium. The available water capacity is high. The content of organic matter in the surface layer is moderate or moderately low. The potential for frost action is high. The surface layer can be easily tilled throughout a wide range in moisture content, except in

the small included areas that are very stony. It tends to crust or puddle, however, after rainfall. A perched seasonal high water table is at a depth of 1 to 3 feet. The rooting depth of some plants is limited by the perched seasonal high water table and the firm substratum.

Most areas are used as woodland. The timber stands are mostly red maple and sugar maple, but yellow birch, American basswood, white ash, northern red oak, and American hornbeam are in most stands. The ground flora includes Virginia waterleaf, blue cohosh, sweet cicely, smooth yellow violet, ladyfern, rosy twistedstalk, beaked hazelnut, wild sarsaparilla, Canada mayflower, yellow beadlily, American starflower, Virginia creeper, and trout lily. Balsam fir and quaking aspen are in the timber stands on foot slopes in areas where the perched seasonal high water table persists for longer periods. These wetter areas have sensitive fern, dewberry, or cinnamon fern in the ground flora.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation and the windthrow hazard. The use of

Figure 15.—Windthrow in an area of Lupton, Cathro, and Markey mucks, 0 to 1 percent slopes. Trees on these soils are shallow rooted because of a seasonal high water table.

equipment is restricted in the spring, late in fall, and during other excessively 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 result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Also, culverts are needed to maintain the natural drainage system. Landings that are stabilized with gravel can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited.

A shallow rooting depth, which is caused by the perched high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. The wetness in undrained areas limits yields and the kinds of crops that can be grown. Some undrained areas formerly used as cropland are now idle or have been planted to pine, fir, or spruce. Some small areas are used as ginseng gardens.

This soil is difficult to drain because of the very slow internal drainage, especially in the nearly level areas. Removing surface water helps to minimize the amount of water that infiltrates the soil. Field ditches, land smoothing, land grading, or a combination of these can be used in the nearly level areas to remove excess surface water that accumulates during spring runoff and after heavy rains. Diversions on adjoining uplands or field ditches at the base of the adjoining uplands help to intercept and control runoff on this soil. Tile drains and field ditches can be used in the nearly level areas to help remove the perched water table, except where the movement of water through the soil is too slow. The field ditches can be used as outlets for tile drains where a suitable drainage outlet is not available. Drainage tile may be displaced by frost action. This displacement can be prevented by using continuous tubing or by installing the tile drains below the depth of freezing.

This soil is subject to water erosion in cultivated areas where the slope is more than 2 percent. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Contour stripcropping is effective in controlling erosion in included areas where the slope is 4 to 6 percent and the slopes are long and smooth. Many areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. In areas where contour farming, contour stripcropping, diversions, and terraces are used, establishing a slight grade towards grassed waterways helps to remove excess surface water. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching improve fertility, increase the movement of air and water through the soil, and help to prevent crusting and puddling of the surface layer. They also help to prevent excessive water erosion in areas where the slope is more than 2 percent.

This soil is suited to pasture. Alfalfa stands for improved pasture are difficult to establish and maintain unless the soil is drained. Red clover, which is tolerant of soil wetness, commonly is seeded with alfalfa. This combination helps to ensure a dependable forage crop. Excess water during wet periods may damage the forage. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is generally unsuited to septic tank absorption fields and dwellings mainly because of the seasonal high water table. This limitation is difficult to overcome. A better site should be selected.

This soil is poorly suited to local roads because of the risk of frost damage. This limitation can be overcome by covering the soil with a coarse base material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. Based on red maple productivity, the woodland ordination symbol is 3W. The primary habitat type commonly is AViO or AH. The secondary habitat type commonly is ATM or TMC.

MgB—Magnor-Ossmer silt loams, 0 to 4 percent slopes. These nearly level and gently sloping or undulating, somewhat poorly drained soils are on

outwash-veneered moraines. The Magnor soil commonly is on the summits and sides of knolls and swells. The Ossmer soil is on toe slopes and low flats where the slope is less than 3 percent. The surface of the land is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are irregularly shaped and range from about 10 to 500 acres in size. They generally are about 60 to 70 percent Magnor soil and 20 to 30 percent Ossmer soil. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Magnor soil has a surface layer of very dark gray silt loam about 3 inches thick. The subsurface layer is grayish brown, mottled silt loam about 7 inches thick. The next layer is pale brown and dark yellowish brown, mottled silt loam about 12 inches thick. The subsoil is about 33 inches thick. The upper part is dark yellowish brown, mottled loam; the next part is dark brown, mottled gravelly sandy loam; and the lower part is reddish brown, mottled, firm sandy loam. The substratum to a depth of about 60 inches is reddish brown, mottled, firm sandy loam. In some areas the upper layers are loam. In a few areas the upper silty deposits are more than 30 inches thick. In places the subsoil has thin layers of silty deposits or a thin layer of sand and gravel. In a few places the lower part of the soil is friable. In some areas the slope is 5 or 6 percent.

Typically, the Ossmer soil has a surface layer of very dark gray silt loam about 4 inches thick. The subsurface layer is pale brown, mottled silt loam about 5 inches thick. The next layer is brown and dark yellowish brown, mottled silt loam about 9 inches thick. The subsoil is about 12 inches thick. It is dark brown, mottled sandy loam in the upper part and dark brown gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown very gravelly sand. In some areas the upper layers are loam. In a few areas the upper silty deposits are more than 30 inches thick. In places the substratum has thin layers of loamy deposits, and in a few areas it is at a depth of more than 45 inches.

Included with these soils in mapping are small areas of the moderately well drained Freeon and Sconsin soils on the higher or more sloping parts of the landscape, the somewhat poorly drained Pesabic and Worcester soils in areas where the surface deposit is fine sandy loam or sandy loam, and many small areas of very poorly drained mineral and organic soils in depressions. Also included are small areas where the lower part of the soils is very cobbly, narrow areas that have steep slopes, and small ponds and very stony areas. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Magnor and Ossmer soils. It is slow or moderately slow in the loamy subsoil of the Magnor soil. It is very slow in the lower part of the Magnor soil and rapid or very rapid in the lower part of the Ossmer soil. Runoff is slow or medium on the Magnor soil and slow on the Ossmer soil. The available water capacity is high in the Magnor soil and moderate in the Ossmer soil. The content of organic matter in the surface layer is moderate or moderately low in the Magnor soil and moderate in the Ossmer soil. The potential for frost action is high in both soils. The surface layer in both soils can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. It tends to crust or puddle, however, after rainfall. A seasonal high water table is at a depth of 1 to 3 feet in both soils. The water table is perched in the Magnor soil. The rooting depth of some plants is limited by the seasonal high water table of both soils, by the firm substratum in the Magnor soil, and, in places, by the sand and gravel substratum in the Ossmer soil.

Most areas are used as woodland. The timber stands on the Magnor soil are mostly red maple and sugar maple, but American basswood and northern red oak are in most stands. The ground flora includes Virginia waterleaf, blue cohosh, sweet cicely, smooth yellow violet, ladyfern, rosy twistedstalk, beaked hazelnut, wild sarsaparilla, Canada mayflower, yellow beadlily, American starflower, Virginia creeper, and trout lily. Red maple, balsam fir, and quaking aspen are the dominant species on the Ossmer soil in areas where bunchberry dogwood, sensitive fern, dewberry, and cinnamon fern also are in the ground flora. Yellow birch, white ash, paper birch, and American hornbeam are in most stands on both soils.

These soils are suited to trees. The main concerns affecting woodland management are the equipment limitation and the windthrow hazard. The use of equipment is restricted in the spring, late in fall, and during other excessively wet periods because of the seasonal high water table and low soil strength. Ruts form easily if wheeled skidders are used when the soils are wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soils are dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Also, culverts are needed to maintain the natural drainage system. Landings that are stabilized with gravel can better withstand the repeated use of heavy equipment. They also can be established on adjacent or included soils that are better suited.

A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness.

Windthrow can be minimized by using 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

If drained, these soils are suited to corn and small grain and to grasses and legumes for hay and pasture. The wetness in undrained areas limits yields and the kinds of crops that can be grown. Some undrained areas formerly used as cropland are now idle or have been planted to pine, fir, or spruce. Some small areas are used as ginseng gardens.

The Magnor soil is difficult to drain because of the very slow internal drainage, especially in the nearly level areas. Removing surface water helps to minimize the amount of water that infiltrates the soil. Field ditches, land smoothing, land grading, or a combination of these can be used in the nearly level areas of both soils to remove excess surface water that accumulates during spring runoff and after heavy rains. Diversions on adjoining uplands or field ditches at the base of the adjoining uplands help to intercept and control runoff on these soils.

Tile drains and field ditches can be used in the nearly level areas of the Magnor soil to help remove the perched water table, except where the movement of water through the soil is too slow. They can be used in the Ossmer soil to lower the water table. The sides of ditches should be flattened in areas of the Ossmer soil because the substratum is unstable and may cave, and continuous tubing should be used when tile drains are installed. Filters are needed in the Ossmer soil to keep the fine particles of sand in the substratum from clogging the drains. The field ditches in both soils can be used as outlets for tile drains in areas where a suitable drainage outlet is not available. Drainage tile may be displaced by frost action. This displacement can be prevented by using continuous tubing or by installing the tile drains below the depth of freezing.

The Magnor soil is subject to erosion in cultivated areas where the slope is more than 2 percent. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Many areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. In areas where contour farming, diversions, and terraces are used, establishing a slight grade towards grassed waterways helps to remove excess surface water. On both soils, cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching improve fertility, increase the movement of air and water through the soil, and help to prevent crusting and puddling of the surface layer. On the Magnor soil, these measures also help to prevent excessive water erosion in areas where the slope is more than 2 percent.

These soils are suited to pasture. Alfalfa stands for improved pasture are difficult to establish and maintain unless the soils are drained. Red clover, which is tolerant of soil wetness, commonly is seeded with alfalfa. This combination helps to ensure a dependable forage crop. Excess water during wet periods may damage the forage. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soils are wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

These soils are generally unsuited to septic tank absorption fields and dwellings mainly because of the seasonal high water table. This limitation is difficult to overcome. A better site should be selected.

These soils are poorly suited to local roads because of the risk of frost damage. This limitation can be overcome by covering the soil with a coarse base material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. Based on red maple productivity, the woodland ordination symbol is 3W. The primary habitat type commonly is AViO or TMC. The secondary habitat type commonly is ATM or AH.

MkB—Magroc silt loam, 0 to 4 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on foot slopes of ridges underlain by hard bedrock on morainic landscapes. The surface of the land commonly is uneven in wooded areas because of trees that have been uprooted by the wind. Areas commonly are elongated and range from about 10 to 60 acres in size.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is grayish brown, mottled silt loam about 7 inches thick. The next layer is brown and dark yellowish brown silt loam and gravelly silt loam about 18 inches thick. It is mottled. The subsoil is reddish brown, mottled gravelly sandy

loam about 13 inches thick. Fractured metamorphic bedrock is at a depth of about 42 inches. In a few areas the upper layers are loam. In other areas the upper silty deposits are more than 30 inches thick. In places, the lower part of the soil is grus or it has a thin layer of sand and gravel. In a few areas the slope is 5 or 6 percent.

Included with this soil in mapping are small areas of very poorly drained soils in drainageways, the somewhat poorly drained Magnor soils in areas where the bedrock is below a depth of 60 inches, and the well drained Mequithy soils and moderately well drained soils on the higher parts of the landscape. Mequithy soils are underlain by bedrock at a depth of 20 to 40 inches. Also included are small areas where the surface soil is very fine sandy loam or fine sandy loam, small areas of rock outcrop, and small very stony areas. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the Magroc soil. Runoff is slow or medium. The available water capacity is moderate. The content of organic matter in the surface layer is moderate or moderately low. The potential for frost action is high. A seasonal high water table is at a depth of 1 to 3 feet. The rooting depth of most plants is limited by the seasonal high water table and by the bedrock.

Most areas are used as woodland. The mature timber stands are mostly red maple and sugar maple, but yellow birch, American basswood, white ash, northern red oak, and American hornbeam are in most stands. The ground flora includes Virginia waterleaf, blue cohosh, sweet cicely, smooth yellow violet, ladyfern, rosy twistedstalk, beaked hazelnut, wild sarsaparilla, Canada mayflower, yellow beadlily, American starflower, Virginia creeper, and trout lily. Balsam fir and quaking aspen are in the timber stands on foot slopes in areas where the seasonal high water table persists for longer periods. These wetter areas have sensitive fern, dewberry, or cinnamon fern in the ground flora.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation and the windthrow hazard. The use of equipment is restricted in the spring, late in fall, and during other excessively 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 tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Also, culverts are needed to maintain the natural drainage system. Landings that are stabilized with gravel can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited. Yarding the logs by cable and planting trees by hand may be necessary in some areas where stones or rock outcrops limit the use of equipment.

A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

If drained, this soil is suited to cultivated crops, but only a few small areas are used as cropland. The soil is suited to pasture. Alfalfa stands for improved pasture are difficult to establish and maintain unless the soil is drained. Excess water during wet periods may damage the forage. A cover of pasture plants is effective in controlling erosion in areas where the slope is more than 2 percent. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

Mainly because of the seasonal high water table, this soil is generally unsuited to septic tank absorption fields and dwellings. This limitation is difficult to overcome. A better site should be selected.

This soil is poorly suited to local roads because of the risk of frost damage. This limitation can be overcome by covering the soil with a coarse base material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. Based on red maple productivity, the woodland ordination symbol is 3W. The primary habitat type commonly is AViO or AH. The secondary habitat type commonly is ATM or TMC.

MoB—Mequithy silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on the summits and shoulders of ridges underlain by hard bedrock on morainic landscapes. Areas are elongated or irregularly

shaped and range from about 10 to 80 acres in size.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The next layer is dark brown, brown, and dark yellowish brown silt loam about 19 inches thick. The subsoil is dark brown sandy loam and strong brown cobbly sandy loam about 13 inches thick. Fractured igneous and metamorphic bedrock is at a depth of about 36 inches. In some areas the surface layer is loam. In a few areas the slope is 6 to 15 percent. In places, the lower part of the subsoil is grus or it has a thin layer of sand and gravel.

Included with this soil in mapping are small areas of Magroc soils and other somewhat poorly drained soils in drainageways and areas of Freeon soils and other moderately well drained soils on the lower parts of the landscape. Freeon soils do not have bedrock within a depth of 60 inches. Magroc soils have bedrock at a depth of 40 to 60 inches. Also included are small areas where bedrock is within a depth of 20 inches; small areas of bedrock outcrop or escarpment; areas where the surface soil is very fine sandy loam or fine sandy loam; narrow areas that have steep slopes; and small wet spots, very stony areas, and quarries. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the Mequithy soil. Runoff is medium. The available water capacity is moderate or low. The content of organic matter in the surface layer is moderate. The potential for frost action is moderate. The surface layer can be easily tilled throughout a wide range in moisture content, except in the small included areas of bedrock outcrop or escarpment and the small very stony areas. It tends to crust or puddle, however, after rainfall. The rooting depth of most plants is limited by the underlying bedrock.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but yellow birch, black cherry, eastern hophornbeam, and northern red oak are in most stands. The ground flora includes blue cohosh, Virginia waterleaf, snow trillium, largeflowered bellwort, bloodroot, hog peanut, mapleleaf viburnum, sweet cicely, smooth yellow violet, and ladyfern.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Landings that are stabilized with gravel can better withstand the repeated use of heavy equipment. Yarding the logs by cable and planting trees by hand may be necessary in some areas where stones or rock outcrops limit the use of equipment. Excavation of deep cuts and road ditches is restricted by the underlying bedrock.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. Crop yields are limited by the shallow root zone. Rock outcrops or stones restrict tilling and harvesting in places. The soil is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. The moderate depth to bedrock can limit the construction of diversions, grassed waterways, and terraces. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the soil, improve fertility, help to prevent crusting and puddling of the surface layer, conserve the water available for plant growth, and help to prevent excessive water erosion.

This soil is suited to pasture. It can be managed for bluegrass in areas where rock outcrops or stones prevent the use of machinery. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields because of the thin layer of soil over hard bedrock. This limitation can be overcome by constructing a mound of suitable filtering material. In some places the absorption field can be established on better suited included or adjacent soils where the layer of soil is more than 5 feet thick.

Mainly because of the thin layer of soil over hard bedrock, this soil is only moderately suited to dwellings without basements and is poorly suited to dwellings with basements. Sites for dwellings without basements can be raised by adding fill material. In some areas large stones or rock outcrops limit the use of machinery.

This soil is only moderately suited to local roads because of the thin layer of soil over hard bedrock and the risk of frost damage. Frost action can be controlled by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts. Additions of fill material may be needed to raise the roadbed above the level of bedrock. Excavations for road ditches and other cuts may be limited by the underlying bedrock. In some areas stones or rock outcrops limit the use of machinery.

The land capability classification is IIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is AViO or ATM. The secondary habitat type commonly is AH.

MoC—Mequithy silt loam, 6 to 15 percent slopes. This sloping, well drained soil is on the sides of ridges underlain by hard bedrock on morainic landscapes. Areas are elongated and range from about 10 to 400 acres in size.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 1 inch thick. The next layer is about 23 inches thick. It is dark brown silt loam and loam in the upper part and brown and dark yellowish brown silt loam in the lower part. The subsoil is dark brown cobbly loam about 10 inches thick. Fractured igneous and metamorphic bedrock is at a depth of about 38 inches. In some areas the surface layer is loam. In a few areas the slope is less than 6 percent. In places, the lower part of the subsoil is grus or it has a thin layer of sand and gravel.

Included with this soil in mapping are small areas of Magroc and other somewhat poorly drained soils in drainageways and areas of Freeon and other moderately well drained soils on foot slopes. Freeon soils do not have bedrock within a depth of 60 inches. Magroc soils have bedrock at a depth of 40 to 60 inches. Also included are small areas where bedrock is within a depth of 20 inches, areas of bedrock outcrop or escarpment, areas where the surface soil is very fine sandy loam or fine sandy loam, small areas where the slope is more than 15 percent, and small very stony areas and quarries. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the Mequithy soil. Runoff is medium. The available water capacity is moderate or low. The content of organic matter in the surface layer is moderate. The potential for frost action also is moderate. The surface layer can be easily tilled throughout a wide range in moisture content, except in the small included areas of bedrock outcrop or escarpment and the small very stony areas. It tends to crust or puddle, however, after rainfall. The rooting depth of most plants is limited by the underlying bedrock.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but northern red oak, black cherry, yellow birch, and eastern hophornbeam are in most stands. The ground flora includes blue cohosh, sweet cicely, smooth yellow violet, ladyfern, Virginia waterleaf, largeflowered bellwort, snow trillium, bloodroot, mapleleaf viburnum, and hog peanut.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively 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 result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. The slope limits the selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping. Yarding the logs by cable and planting trees by hand may be necessary in some areas where stones or rock outcrops limit the use of equipment (fig. 16). Excavation of deep cuts and road ditches is restricted by the underlying bedrock.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. Crop yields are limited by the shallow root zone. Rock outcrop or stones restrict tilling and harvesting in places. The soil is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. The moderate

Figure 16.—Rock outcrops in an area of Mequithy silt loam, 6 to 15 percent slopes. These small areas of protruding bedrock can limit the use of forestry equipment.

depth to bedrock may limit the construction of diversions, grassed waterways, and terraces. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the soil, improve fertility, help to prevent crusting and puddling of the surface layer, conserve the water available for plant growth, and help to prevent excessive water erosion.

This soil is suited to pasture. It can be managed for bluegrass in areas where rock outcrops or stones prevent the use of machinery. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in depletion of the plant cover, surface compaction, and the growth of

undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields mainly because of the thin layer of soil over hard bedrock. Overcoming this limitation is difficult. A better site should be selected. In some areas the absorption field can be established on better suited included or adjacent soils where the layer of soil is more than 5 feet in thickness.

This soil is only moderately suited to dwellings without basements mainly because of the slope and the thin layer of soil over hard bedrock. It is poorly suited to dwellings with basements because of the thin layer of soil over hard bedrock. Dwellings can be designed so that they conform to the natural slope of the land. Level sites for dwellings without basements can be constructed by adding coarse textured fill material to the downslope area. In some areas large stones or rock outcrops can limit the use of machinery.

This soil is only moderately suited to local roads because of the thin layer of soil over hard bedrock, the slope, and the risk of frost damage. Frost action can be controlled by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts. Excavation for road ditches and other cuts is restricted by the underlying bedrock. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway. Additions of fill material may be needed to raise the roadbed above the level of bedrock. In some areas stones or rock outcrops limit the use of machinery.

The land capability classification is IIIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is AViO or ATM. The secondary habitat type commonly is AH.

Ms—Minocqua and Capitola mucks, 0 to 2 percent slopes. These nearly level, very poorly drained soils are in kettles, basins, drainageways, and upland swales. They are subject to ponding. Areas are long and narrow or irregularly shaped and range from about 5 to 200 acres in size. A single mapped area may be made up of only one of the soils, or it may contain both soils. Because the soils have similar behavior characteristics for present and anticipated uses in the survey area, mapping them separately was not considered practical or necessary.

Typically, the Minocqua soil has a surface layer of black muck about 4 inches thick. The subsurface layer is very dark gray silt loam about 1 inch thick. The subsoil is about 32 inches thick. It is gray, greenish gray, and dark greenish gray, mottled silt loam in the upper part; greenish gray, mottled loam in the next part; and dark gray, mottled gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is dark grayish brown very gravelly sand. In places the surface layer is mostly mineral soil. In a few places the organic part of the surface layer is more than 6 inches thick. In some areas the substratum is at a depth of more than 40 inches, and in a few areas it has thin layers of loamy deposits. In a few places the upper part of the soil is loamy alluvium.

Typically, the Capitola soil has a surface layer of black muck about 5 inches thick. The subsurface layer is very dark gray, mottled silt loam about 2 inches thick. The subsoil is about 26 inches thick. It is gray and dark grayish brown, mottled silt 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. In places the surface layer is mostly mineral soil. In a few places the organic part of the surface layer is more than 6 inches thick. In some areas the substratum and the lower part of the subsoil are sandy clay loam, and in a few areas they are firm.

Included with these soils in mapping are small areas of somewhat poorly drained to excessively drained soils on the higher parts of the landscape, areas where hard bedrock is within a depth of 60 inches, and areas where the deposits below the surface layer are mostly sandy. Also included are small ponds, springs, marsh areas, and very stony areas. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Minocqua soil, moderately rapid or rapid in the lower part of the subsoil, and rapid or very rapid in the substratum. It is moderate or moderately slow in the upper part of the Capitola soil and moderately slow in the lower part. Runoff is very slow or ponded on both soils. The available water capacity is moderate in the Minocqua soil and high in the Capitola soil. The potential for frost action is high in both soils. A seasonal high water table is above the surface or within a depth of 1 foot in both soils. It limits the rooting depth of some plants. In places the rooting depth also is limited by a sand and gravel substratum in the Minocqua soil and by a firm substratum in the Capitola soil.

Most areas are used as woodland. Some areas support native wetland vegetation, such as tag alder, dogwood, willow, sedges, reeds, cattails, mosses, and wetland grasses and forbs. Composition of the timber stands is variable. Some are mostly black ash with

sedge and mint in the ground flora. Other stands are mostly northern whitecedar, black spruce, balsam fir, and tamarack. Sphagnum moss, naked miterwort, and northern twinflower are in the ground flora. Red maple, American elm, eastern hemlock, and quaking aspen are in most stands.

These soils are suited to trees. The main concerns affecting woodland management are the equipment limitation, seedling mortality, and the windthrow hazard. The high water table restricts the use of equipment to periods in winter when the ground is frozen. Wetness limits the sites for landings to suitable adjacent soils or to small, included knolls of better drained soils. Trees generally are not planted on these soils because of the wetness. Reforestation is generally limited to natural regeneration. Seedling survival rates can be increased, however, by hand planting vigorous nursery stock on the crest of cradle-knolls.

Trees are shallow rooted because of the high water table. They can be uprooted by strong winds. The windthrow hazard can be minimized by using harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can prevent or delay the natural regeneration of desirable tree species. Sites harvested by clearcutting commonly regenerate to tag alder. Special harvest methods may be needed to control the competing plants.

These soils are generally not suited to farming because of the wetness, the poor trafficability, and a severe hazard of frost damage. Most areas cannot be drained by tile or open ditches because suitable drainage outlets generally are not available.

Mainly because of the ponding, these soils are generally unsuited to septic tank absorption fields and dwellings. Overcoming this limitation is difficult. A better site should be selected.

These soils are poorly suited to local roads because of the ponding and the risk of frost damage. These limitations can be overcome by adding coarse base material to raise the roadbed above the level of wetness and by installing a good drainage system of adequate side ditches and culverts.

The land capability classification is VIw for undrained areas. Based on balsam fir productivity, the woodland ordination symbol is 7W. A habitat type is not assigned.

MxB—Moodig sandy loam, 0 to 4 percent slopes. This nearly level and gently sloping or undulating, somewhat poorly drained soil is on small swells and knolls in low areas, on the broad crests and foot slopes of drumlins, and in upland swales and drainageways. The surface of the land commonly is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are mostly elongated and range from about 10 to 200 acres in size.

Typically, the surface layer is very dark gray sandy loam about 3 inches thick. The subsurface layer is brown gravelly sandy loam about 2 inches thick. The upper part of the subsoil is dark brown, mostly mottled sandy loam and gravelly sandy loam about 17 inches thick. The next layer is about 31 inches of mostly brown, mottled sandy loam and gravelly sandy loam and some brown, mottled loamy sand and gravelly loamy sand. The lower part of the subsoil is brown, mottled gravelly sandy loam about 20 inches thick. The substratum to a depth of about 95 inches is brown gravelly sandy loam. In some areas the surface layer is loam or fine sandy loam. In places the lower part of the soil has a thin layer of sand and gravel. In a few places the slope is 5 or 6 percent.

Included with this soil in mapping are small areas of the very poorly drained Capitola soils in drainageways, the somewhat poorly drained Hatley soils in areas where the surface deposit is silt loam, and the moderately well drained Sarwet and well drained Sarona soils on the higher parts of the landscape. Also included are many small areas of very poorly drained organic soils in depressions, some areas where the surface soil is sandy and droughty, narrow areas that have steep slopes, small areas where the subsoil has thin layers of silty deposits, and small very stony areas and ponds. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the Moodig soil. Runoff is slow. The available water capacity is moderate. The content of organic matter in the surface layer also is moderate. The potential for frost action is high. The surface layer can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. A perched seasonal high water table is at a depth of 0.5 foot to 2.0 feet. It limits the rooting depth of some plants.

Most areas are used as woodland. The timber stands are mostly red maple and sugar maple, but yellow birch, eastern hemlock, and paper birch are in most stands. The ground flora includes bunchberry dogwood, goldthread, smooth yellow violet, ladyfern, Canada mayflower, American starflower, rosy twistedstalk, mapleleaf viburnum, wild sarsaparilla, beaked hazelnut, and yellow beadlily. Red maple, balsam fir, and quaking aspen are the dominant species on foot slopes where the perched seasonal high water table persists for longer periods. These wetter areas have wood sorrel, sensitive fern, or cinnamon fern in the ground flora.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation and the windthrow hazard. The use of

equipment is restricted in the spring and in other excessively wet periods because of the seasonal high water table and low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. Logging roads and landings that have a gravel base can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited. Adequate culverts are needed on graveled roads to maintain the natural drainage system.

A shallow rooting depth, which is caused by the perched high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. The high water table in undrained areas limits yields and the kinds of crops that can be grown. Field ditches and tile drains can be used in the nearly level areas to help remove the perched water table. The field ditches can be used as outlets for tile drains where a suitable drainage outlet is not available. Drainage tile may be displaced by frost action. This displacement can be prevented by using continuous tubing or by installing the tile drains below the depth of freezing.

This soil is subject to water erosion in cultivated areas where the slope is more than 2 percent. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas.

If drained and cultivated, this soil is subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure improve fertility and help to control soil blowing. These measures also help to prevent excessive water erosion in areas where the slope is more than 2 percent.

This soil is suited to pasture. Alfalfa stands for improved pasture are difficult to establish and maintain unless the soil is drained. Excess water during wet periods may damage the forage. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, and pasture renovation help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

Mainly because of the seasonal high water table, this soil is generally unsuited to septic tank absorption fields and dwellings. This limitation is difficult to overcome. A better site should be selected.

This soil is poorly suited to local roads because of the seasonal high water table and the risk of frost damage. These limitations can be overcome by covering the soil with a coarse base material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. Based on red maple productivity, the woodland ordination symbol is 3W. The primary habitat type commonly is TMC. The secondary habitat type commonly is ATM.

NeC—Newood sandy loam, 6 to 15 percent slopes. This sloping or rolling, moderately well drained soil is on swells, hills, and ridges and on the sides of drumlins and valleys. Areas are elongated or irregularly shaped and range from about 10 to 1,000 acres in size.

Typically, the surface layer is very dark gray sandy loam about 4 inches thick. The subsurface layer is brown gravelly sandy loam about 1 inch thick. The next layer is dark brown, brown, and reddish brown gravelly sandy loam about 32 inches thick. The subsoil is reddish brown, mottled, firm gravelly sandy loam and sandy loam about 21 inches thick. The substratum to a depth of about 60 inches is reddish brown, firm sandy loam. In some areas the surface layer is very fine sandy loam or fine sandy loam. In a few areas the slope is less than 6 percent. In places the lower part of the soil is friable, and in some places it has a thin layer of sand and gravel.

Included with this soil in mapping are small areas of the moderately well drained Freeon soils in areas where the surface deposit is silty, the somewhat poorly drained Pesabic soils in swales and drainageways, and some areas of the well drained Newot soils on the sides of hills and ridges. Also included are many small areas of very poorly drained organic soils in depressions, small areas where the slope is more than 15 percent,

areas where the surface soil is loam, and small very stony areas and ponds. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Newood soil, slow in the lower part of the subsoil, and very slow in the substratum. Runoff is medium. The available water capacity is moderate. The content of organic matter in the surface layer is moderately low or moderate. The potential for frost action is moderate. The surface layer can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. A perched seasonal high water table is at a depth of 2.5 to 3.5 feet. The rooting depth of some plants is limited by the firm substratum.

Most areas are used as woodland. The mature timber stands are mostly red maple, sugar maple, eastern hemlock, paper birch, and northern red oak, but white ash, aspen, yellow birch, and eastern hophornbeam are in most stands. The ground flora includes beaked hazelnut, wild sarsaparilla, rosy twistedstalk, Canada mayflower, grasses, partridgeberry, yellow beadlily, and mapleleaf viburnum. American starflower, bigleaf aster, brackenfern, wintergreen, and blueberry are in the ground flora in formerly burned areas.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. The slope limits the selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish.

If cultivated, this soil is subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve moisture. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing and water erosion, improve fertility, and conserve the water available for plant growth.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, pasture renovation, and rotation grazing help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields mainly because of the seasonal high water table and the very slow permeability in the substratum. Overcoming these limitations is difficult. A better site should be selected. In some areas the effluent can be pumped to an absorption field established on a better suited soil.

Because of the slope, this soil is only moderately suited to dwellings without basements. Because of the seasonal high water table and the slope, it is moderately suited to dwellings with basements. The soil is only moderately suited to local roads because of the slope and the risk of frost damage. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. Basements can be constructed above the level of wetness. Interceptor tile may be needed to carry off the seepage from the higher adjacent slopes. On sites for local roads, frost action can be controlled by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIIe. Based on sugar maple productivity, the woodland ordination symbol is 3D. The habitat type commonly is ATM.

NoB—Newood fine sandy loam, 2 to 6 percent slopes. This gently sloping or undulating, moderately well drained soil is on small knolls and on the crests and sides of drumlins. Areas are elongated or irregularly shaped and range from about 5 to 100 acres in size.

Typically, the surface layer is very dark gray fine sandy loam about 4 inches thick. The subsurface layer is brown loam about 1 inch thick. The subsoil is dark brown sandy loam and fine sandy loam about 11 inches thick. The next layer is brown fine sandy loam and

brown and reddish brown, mottled gravelly sandy loam and sandy loam about 29 inches thick. It is firm in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled, firm sandy loam. In some areas the surface layer is sandy loam or very fine sandy loam. In other areas the slope is 6 to 15 percent. In a few areas the subsoil has thin layers of silty deposits. In some places the lower part of the soil is friable, and in other places it has a thin layer of sand and gravel.

Included with this soil in mapping are small areas of the moderately well drained Freeon soils in areas where the surface deposit is silty, the somewhat poorly drained Pesabic soils in swales and drainageways, and some areas of the well drained Newot soils on the more sloping parts of the landscape. Also included are many small areas of very poorly drained organic soils in depressions, narrow areas that have steep slopes, areas where the surface soil is loam, and small very stony areas and ponds. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Newood soil, slow in the lower part of the subsoil, and very slow in the substratum. Runoff is slow. The available water capacity is moderate. The content of organic matter in the surface layer is moderately low or moderate. The potential for frost action is moderate. The surface layer can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. A perched seasonal high water table is at a depth of 2.5 to 3.5 feet. The rooting depth of some plants is limited by the firm substratum.

Most areas are used as woodland. The mature timber stands are mostly red maple, sugar maple, eastern hemlock, paper birch, and northern red oak, but white ash, aspen, yellow birch, and eastern hophornbeam are in most stands. The ground flora includes beaked hazelnut, wild sarsaparilla, rosy twistedstalk, Canada mayflower, bigleaf aster, partridgeberry, yellow beadlily, and mapleleaf viburnum. American starflower, bigleaf aster, brackenfern, wintergreen, and blueberry are in the ground flora in formerly burned areas.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas.

If cultivated, this soil is subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve moisture. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing and water erosion, improve fertility, and conserve the water available for plant growth.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, and pasture renovation help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and the very slow 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. It is only moderately suited to dwellings with basements because of the seasonal high water table, but basements can be constructed above the level of wetness.

Because of the risk of frost damage, this soil is only moderately suited to local roads. Frost action can be controlled by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. Based on sugar maple productivity, the woodland ordination symbol is 3D. The habitat type commonly is ATM.

NpC—Newood-Pence sandy loams, 6 to 15 percent slopes. These rolling, moderately well drained and well drained soils are on outwash-veneered moraines. They are on swells, hills, and ridges and on the sides of valleys. Areas are elongated or irregularly shaped and commonly range from about 5 to 40 acres in size, but some are as large as 200 acres. The areas generally are about 55 to 65 percent Newood soil and 25 to 35 percent Pence soil. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

The Newood soil is moderately well drained. Typically, the surface layer is very dark gray sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The next layer is dark brown and brown sandy loam and brown and reddish brown gravelly loamy sand and gravelly sandy loam about 31 inches thick. The subsoil is reddish brown, mottled, firm gravelly sandy loam about 23 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, firm gravelly sandy loam. In some areas the surface soil is very fine sandy loam or fine sandy loam. In a few areas the slope is less than 6 percent. In some places the subsoil is very cobbly or has a thin layer of sand and gravel. In other places the lower part of the soil is friable.

The Pence soil is well drained. Typically, the surface layer is black sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is about 22 inches thick. It is dark brown sandy loam and gravelly sandy loam in the upper part and strong brown gravelly sand in the lower part. The substratum to a depth of about 60 inches is brown sand. In some areas the surface soil is fine sandy loam or very fine sandy loam. In a few areas the slope is less than 6 percent. In places the substratum has thin layers of loamy deposits. In some places the soil is very cobbly.

Included with these soils in mapping are small areas of the moderately well drained Freeon and Sconsin soils and the somewhat poorly drained Magnor and Ossmer soils on the lower, less sloping parts of the landscape where the surface deposit is silty. Also included are small areas where the surface soil is loam, small ponds and wet spots in closed depressions, small areas where the slope is more than 15 percent, and small gravel pits and very stony areas. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Newood soil, slow in the lower part of the subsoil, and very slow in the substratum. It is moderately rapid in the upper part of the Pence soil and rapid or very rapid in the lower part. Runoff is medium on both soils. The available water capacity is moderate in the Newood soil and low in the Pence soil. The content of organic matter in the surface layer is moderate or moderately low in both soils. The potential for frost action is moderate in the Newood soil. The surface layer in both soils can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. A perched seasonal high water table is at a depth of 2.5 to 3.5 feet in the Newood soil. The rooting depth of some plants is limited by the firm substratum in the Newood soil and, in places, by a substratum of sand and gravel in the Pence soil.

Most areas are used as woodland. The mature timber stands on the Newood soil are mostly red maple, sugar maple, and northern red oak, but paper birch, yellow birch, and eastern hophornbeam are in most stands. The ground flora includes beaked hazelnut, wild sarsaparilla, rosy twistedstalk, Canada mayflower, bigleaf aster, partridgeberry, yellow beadlily, mapleleaf viburnum, American starflower, spinulose woodfern, brackenfern, wintergreen, and blueberry. Eastern white pine is in the timber stands on the less productive Pence soil where mapleleaf viburnum is not in the ground flora.

These soils are suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted on the Newood soil in the spring and in other excessively wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. The slope limits the selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping.

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

These soils are suited to corn and small grain and to grasses and legumes for hay and pasture. Crop yields are limited on the Pence soil because of the low available water content during dry periods. The soils are subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish. The substratum in the Pence soil is droughty and may be

difficult to vegetate if exposed during the construction of diversions or grassed waterways.

If cultivated, these soils are subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve moisture. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing and water erosion, improve fertility, and conserve the water available for plant growth.

These soils are suited to pasture, but the Pence soil is droughty during dry periods. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the Pence soil is dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, pasture renovation, and controlled grazing help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer when the soils are moist helps to maintain a productive stand of forage.

The Newood soil is poorly suited to septic tank absorption fields mainly because of the seasonal high water table and the very slow permeability in the substratum. Overcoming these limitations is difficult. A better site should be selected. The Pence soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity of the substratum may result in the pollution of ground water.

Because of the slope, the Newood soil is only moderately suited to dwellings without basements. It is moderately suited to dwellings with basements because of the seasonal high water table and the slope. It is moderately suited to local roads because of the slope and the risk of frost damage. The Pence soil is only moderately suited to dwellings and local roads because of the slope. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. In areas of the Newood soil, basements can be constructed above the level of wetness, but interceptor tile may be needed to carry off seepage from the higher adjacent slopes. The substratum of the Pence soil may cave in if it is excavated. It is droughty and is difficult to vegetate if it is exposed by land shaping. In areas of the Newood soil, the risk of frost damage on sites for local roads can be overcome by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts. The substratum of the Pence soil is a probable source of sand and gravel.

The land capability classification is IVe. Based on sugar maple productivity, the woodland ordination symbol is 3D for the Newood soil and 3A for the Pence soil. The habitat type commonly is ATM.

NwD—Newot gravelly sandy loam, 15 to 35 percent slopes. This hilly to very steep, well drained soil is on hills and ridges. Areas are elongated or irregularly shaped and range from about 5 to 200 acres in size.

Typically, the surface layer is black gravelly sandy loam about 2 inches thick. The subsurface layer is brown gravelly sandy loam about 3 inches thick. The next layer is dark brown, brown, and reddish brown gravelly sandy loam about 33 inches thick. The subsoil is reddish brown, firm gravelly sandy loam about 19 inches thick. The substratum to a depth of about 60 inches is reddish brown, firm gravelly sandy loam. In some areas the surface layer is very fine sandy loam or fine sandy loam. In a few areas the slope is more than 35 percent. In some places the lower part of the soil is friable, and in other places it has a thin layer of sand and gravel.

Included with this soil in mapping are small areas of the somewhat poorly drained Pesabic soils in swales and drainageways and the moderately well drained Newood soils on the less sloping parts of the landscape. Also included are small areas where the slope is less than 15 percent; areas where the surface soil is loam or silt loam; and small very stony areas, wet spots, and ponds. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Newot soil, slow in the lower part of the subsoil, and very slow in the substratum. Runoff is rapid. The available water capacity is moderate. The content of organic matter in the surface layer is moderately low or moderate. The potential for frost action is moderate. The rooting depth of some plants is limited by the firm substratum.

Most areas are used as woodland. The mature timber stands are mostly red maple, sugar maple, eastern hemlock, paper birch, and northern red oak, but white ash, aspen, yellow birch, and eastern hophornbeam are in most stands. The ground flora includes beaked hazelnut, wild sarsaparilla, rosy twistedstalk, Canada mayflower, grasses, partridgeberry, yellow beadlily, and mapleleaf viburnum. American starflower, bigleaf aster, brackenfern, wintergreen, and blueberry are in the ground flora in formerly burned areas.

This soil is suited to trees. The main concerns affecting woodland management are the erosion hazard, the equipment limitation, and seedling mortality. Erosion results from the concentration of runoff on

logging roads, skid trails, and landings. It can be minimized by logging, planting trees, and establishing roads and trails on the contour; yarding uphill by cable; and removing water by water bars, out-sloping road surfaces, and culverts. Drop structures may be needed to stabilize highly erodible areas. Seeding areas exposed by logging activities helps to establish a protective vegetative cover.

The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. The slope limits the selection of sites for logging roads and landings. Establishing the roads on the contour helps to maintain a low grade. Landings can be established on the included or adjacent soils that are nearly level or gently sloping. Yarding the logs by cable and planting trees by hand may be necessary in areas where the slope limits the use of equipment.

Seedling survival during dry periods can be improved on the droughty southern exposures by planting containerized seedlings or vigorous nursery stock when the soil is moist. 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is generally not suited to cultivated crops because of the slope and a severe hazard of erosion.

This soil is suited to pasture. It should be managed for bluegrass in areas where the slope prevents the use of machinery. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, and pasture renovation in areas where machinery can be used help to keep the pasture in good condition. In areas where machinery can be used, clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

Mainly because of the slope, this soil is generally unsuited to septic tank absorption fields and dwellings. Overcoming this limitation is difficult. A better site, such as a small included area of a better suited less sloping soil, should be selected.

This soil is poorly suited to local roads because of the slope. Land shaping is needed to reduce the slope, or the roads can be built on the contour.

The land capability classification is VIe. Based on sugar maple productivity, the woodland ordination symbol is 3R. The habitat type commonly is ATM.

OsA—Ossmer silt loam, 0 to 3 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on low flats, on the lower parts of glacial lake basins, and in swales and drainageways in the uplands. The landscape is pitted in places. The surface of the land commonly is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are elongated or irregularly shaped and range from about 10 to 500 acres in size.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is grayish brown, mottled silt loam about 2 inches thick. The next layer is brown and yellowish brown, mottled silt loam about 20 inches thick. The subsoil is dark brown, mottled loam and sandy loam about 12 inches thick. The substratum to a depth of about 60 inches is brown, mottled, stratified sand and gravelly sand. In some areas the upper layers are loam. In a few areas the upper silty deposits are more than 30 inches thick. In some places the substratum has thin layers of loamy deposits, and in other places it is at a depth of more than 45 inches. In some areas the substratum is cobbly.

Included with this soil in mapping are small areas of the very poorly drained Minocqua soils in depressions, the moderately well drained Sconsin soils on the higher parts of the landscape, and the somewhat poorly drained Worcester soils in areas where the surface deposit is sandy loam. Also included are small areas where loamy till or hard bedrock is within a depth of 60 inches; narrow areas that have steep slopes; areas where the substratum is within a depth of 20 inches; and small ponds, very stony areas, and sandy spots. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Ossmer soil and rapid or very rapid in the lower part. Runoff is slow. The available water capacity is moderate. The content of organic matter in the surface layer also is moderate. The potential for frost action is high. The surface layer can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after rainfall. A seasonal high water table is at a depth of 1 to 3 feet. The rooting depth of some plants is limited by the seasonal high water table and, in places, by the sand and gravel substratum.

Most areas are used as woodland. The timber stands are mostly red maple, balsam fir, and quaking aspen, but sugar maple, white ash, yellow birch, paper birch, and American hornbeam are in most stands. The ground flora includes Virginia waterleaf, ladyfern, rosy

twistedstalk, beaked hazelnut, wild sarsaparilla, Canada mayflower, yellow beadlily, American starflower, bunchberry dogwood, sensitive fern, trout lily, dewberry, and cinnamon fern. Horsetail, blueberry, or goldthread are in areas where the seasonal high water table persists for longer periods.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation and the windthrow hazard. The use of equipment is restricted in the spring, late in fall, and during other excessively 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 result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Also, culverts are needed to maintain the natural drainage system. Landings that are stabilized with gravel can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited.

A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. The wetness in undrained areas limits yields and the kinds of crops that can be grown. Some undrained areas formerly used as cropland are now idle or have been planted to pine, fir, or spruce. Field ditches, land smoothing, land grading, or a combination of these can remove excess surface water that accumulates during spring runoff and after heavy rains. Diversions on adjoining uplands or field ditches at the base of the adjoining uplands help to intercept and control runoff on this soil. Field ditches and tile drains can lower the water table. Because the substratum is unstable and may cave, the sides of the ditches should be flattened and continuous tubing should be used when tile drains are installed. Filters are needed to keep the fine particles of sand in the substratum from clogging the drains. Drainage tile may be displaced by frost action. This displacement can be prevented by using continuous tubing or by installing the tile drains below the depth of freezing. The field ditches can be used as outlets for tile drains in areas where a suitable drainage outlet is not available. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching improve fertility, increase the infiltration rate and the movement of air and water through the soil, and help to prevent crusting and puddling of the surface layer.

This soil is suited to pasture. Alfalfa stands for improved pasture are difficult to establish and maintain unless the soil is drained. Excess water during wet periods may damage the forage. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is generally unsuited to septic tank absorption fields and dwellings mainly because of the seasonal high water table. This limitation is difficult to overcome. A better site should be selected.

This soil is poorly suited to local roads because of the risk of frost damage. This limitation can be overcome by covering the soil with a coarse base material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. Based on red maple productivity, the woodland ordination symbol is 3W. The primary habitat type commonly is AViO or TMC. The secondary habitat type commonly is ATM or AH.

PaB—Padwet sandy loam, 1 to 6 percent slopes. This nearly level and gently sloping or undulating, moderately well drained soil is on knolls and low flats and in swales and drainageways in the uplands. The landscape is pitted in places. Areas are elongated or irregularly shaped and range from about 10 to 200 acres in size.

Typically, the surface layer is black sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 3 inches thick. The next layer is brown and dark brown sandy loam about 29 inches thick. It is mottled in the lower part. The subsoil is dark brown, mottled sandy loam about 5 inches thick. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravelly sand. In some areas the surface layer is fine sandy loam. In a few areas the

slope is 6 to 15 percent. In some places the substratum has thin layers of loamy deposits, and in other places it is loamy sand or gravelly loamy sand. In some areas the substratum is at a depth of more than 45 inches.

Included with this soil in mapping are small areas of the well drained Padus soils on the higher parts of the landscape, the moderately well drained Padwood soils in areas where stratified lacustrine deposits are at a depth of 40 to 60 inches, the moderately well drained Sconsin soils in areas where the surface deposit is silty, and the somewhat poorly drained Worcester soils in swales and drainageways. Also included are small areas where the substratum is within a depth of 24 inches; areas where the surface soil is loam or loamy sand; narrow areas that have steep slopes; areas where loamy till is within a depth of 60 inches; areas where a seasonal zone of near saturation is not present in the subsoil; and small ponds, wet spots, very stony areas, depressions, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Padwet soil and rapid or very rapid in the lower part. Runoff is slow. The available water capacity is moderate. The content of organic matter in the surface layer and the potential for frost action also are moderate. The surface layer can be easily tilled throughout a wide range in moisture content. A mottled, seasonal zone of near saturation is at a depth of 2.5 to 3.5 feet. The rooting depth of some plants is limited by the sand and gravel substratum.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, but red maple, northern red oak, American basswood, eastern hemlock, and white ash are in most stands. The ground flora includes wild sarsaparilla, Canada mayflower, beaked hazelnut, rosy twistedstalk, sweet cicely, smooth yellow violet, and ladyfern.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas where the slope is more than 2 percent. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. The substratum is droughty and may be difficult to vegetate if exposed during the construction of diversions, grassed waterways, or terraces.

If cultivated, this soil is subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve moisture. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing, improve fertility, and conserve the water available for plant growth. These measures also help to prevent excessive water erosion in areas where the slope is more than 2 percent.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, and pasture renovation help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields because of the rapid or very rapid permeability in the substratum and the seasonal zone of near saturation. 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 higher, better suited soils.

This soil is suited to dwellings, but the substratum may cave in if it is excavated. Because of the risk of frost damage, the soil is only moderately suited to local roads. Frost action can be controlled by replacing the upper part of the soil with coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is ATM. The secondary habitat type commonly is AViO.

PbB—Padwood sandy loam, 1 to 6 percent slopes. This nearly level and gently sloping, moderately well

drained soil is on low terraces within or bordering the lower depressional areas and on the higher parts of glacial lake basins. Areas are elongated or irregularly shaped. They generally range from about 5 to 40 acres in size, but some are as large as 300 acres.

Typically, the surface layer is very dark gray sandy loam about 4 inches thick. The subsurface layer is brown sandy loam about 1 inch thick. The upper part of the subsoil is dark reddish brown and dark brown sandy loam about 10 inches thick. The next layer is brown and dark brown gravelly sandy loam about 12 inches thick. The lower part of the subsoil is strong brown gravelly loamy sand about 9 inches thick. The upper part of the substratum is light yellowish brown, mottled sand about 14 inches thick. The lower part to a depth of about 70 inches is strata of yellowish brown very fine sand, brown very fine sandy loam and silt loam, and strong brown fine sand. It is mottled. In some areas the surface layer is fine sandy loam or very fine sandy loam. In a few areas the slope is 6 to 15 percent. In places the lower part of the substratum is mostly stratified fine sand and loamy fine sand. In some places the lower part of the substratum is within a depth of 40 inches, and in other places it is loamy glacial till or contains strata of gravelly or very gravelly sand.

Included with this soil in mapping are small areas of the well drained Padus and moderately well drained Padwet soils in areas where the underlying deposit is sand and gravel to a depth of at least 60 inches and the somewhat poorly drained Worwood soils in swales. Padus soils are on the higher parts of the landscape. Also included are areas where the substratum is within a depth of 24 inches, areas where the surface soil is loam or loamy sand, narrow areas that have steep slopes, and small ponds and wet spots. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Padwood soil, rapid or very rapid in the upper part of the substratum, and moderately slow in the lower part of the substratum. Runoff is slow. The available water capacity is moderate. The content of organic matter in the surface layer and the potential for frost action also are moderate. The surface layer can be easily tilled throughout a wide range in moisture content. A perched seasonal high water table is at a depth of 2.5 to 3.5 feet. The rooting depth of some plants is limited by the sand and gravel in the upper part of the substratum.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, but red maple, northern red oak, American basswood, eastern hemlock, and white ash are in most stands. The ground flora includes wild sarsaparilla, Canada mayflower, beaked hazelnut, rosy twistedstalk, sweet cicely, ladyfern, and smooth yellow violet.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas where the slope is more than 2 percent. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. The upper part of the substratum is droughty and may be difficult to vegetate if exposed during the construction of diversions, grassed waterways, or terraces.

If cultivated, this soil is subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve available water. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing, improve fertility, and conserve the water available for plant growth. These measures also help to prevent excessive water erosion in areas where the slope is more than 2 percent.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, and pasture renovation help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields because of the moderately slow permeability in the lower part of the substratum, the rapid or very rapid permeability in the upper part of the substratum, and

the seasonal high water table. 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 higher, better suited soils.

This soil is suited to dwellings without basements. It is only moderately suited to dwellings with basements because of the seasonal high water table, but basements can be constructed above the level of wetness.

Because of the risk of frost damage, this soil is only moderately suited to local roads. Frost action can be controlled by replacing the upper part of the soil with coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is ATM. The secondary habitat type commonly is AViO.

PbC—Padwood sandy loam, 6 to 15 percent slopes. This sloping, moderately well drained soil is on side slopes of glacial lake basins. Areas are long and narrow and range from about 5 to 20 acres in size.

Typically, the surface layer is very dark gray sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 1 inch thick. The subsoil is dark brown sandy loam about 6 inches thick. The next layer is brown and dark brown sandy loam about 26 inches thick. The upper part of the substratum is yellowish brown sand about 7 inches thick. The lower part to a depth of about 60 inches is strata of dark yellowish brown silt loam and brown very fine sand, loamy very fine sand, and fine sand. It is mottled. In some areas the surface layer is fine sandy loam or very fine sandy loam. In a few areas the slope is less than 6 percent. In places the lower part of the substratum is mostly stratified fine sand and loamy fine sand. In some areas the lower part of the substratum is within a depth of 40 inches, and in a few places it is loamy glacial till or contains strata of gravelly or very gravelly sand.

Included with this soil in mapping are small areas of the well drained Padus soils in positions on the landscape similar to those of the Padwood soil. Padus soils have a substratum of sand and gravel to a depth of about 60 inches. Also included are areas where the substratum is within a depth of 24 inches, areas where the surface soil is loam or loamy sand, small areas where the slope is more than 15 percent, and small ponds and wet spots. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Padwood soil, rapid or very rapid in the upper part of the substratum, and moderately slow in the lower part of the substratum. Runoff is medium. The available water capacity is moderate. The content of organic matter in the surface layer and the potential for frost action also are moderate. The surface layer can be easily tilled throughout a wide range in moisture content. A perched seasonal high water table is at a depth of 2.5 to 3.5 feet. The rooting depth of some plants is limited by the sand and gravel in the upper part of the substratum.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, but red maple, northern red oak, American basswood, eastern hemlock, and white ash are in most stands. The ground flora includes wild sarsaparilla, Canada mayflower, beaked hazelnut, rosy twistedstalk, sweet cicely, ladyfern, and smooth yellow violet.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. The slope limits the selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish. The upper part of the substratum is droughty and may be difficult to vegetate if exposed during the construction of diversions or grassed waterways.

If cultivated, this soil is subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve available water. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing and

water erosion, improve fertility, and conserve the water available for plant growth.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, and pasture renovation help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields mainly because of the seasonal high water table, the moderately slow permeability in the lower part of the substratum, and the rapid or very rapid permeability in the upper part of the substratum. Overcoming these limitations is difficult. A better site should be selected. In some areas the effluent can be pumped to an absorption field established on a better suited soil.

Because of the slope, this soil is only moderately suited to dwellings without basements. Because of the seasonal high water table and the slope, it is moderately suited to dwellings with basements. The soil is only moderately suited to local roads because of the risk of frost damage and the slope. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. Basements can be constructed above the level of wetness. Interceptor tile may be needed to carry off the seepage from the higher adjacent slopes. On sites for local roads, frost action can be controlled by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is ATM. The secondary habitat type commonly is AViO.

PcC—Pence-Antigo complex, 6 to 15 percent slopes. These sloping or rolling, well drained soils are on swells, hills, and ridges and on the sides of valleys, kettles, and basins. Areas are long and narrow or irregularly shaped and range from about 5 to 60 acres in size. They are about 65 to 75 percent Pence soil and 15 to 25 percent Antigo soil. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Pence soil has a surface layer of very dark gray loam about 3 inches thick. The subsurface layer is brown loam about 2 inches thick. The subsoil is dark brown loam, gravelly sandy loam, and very gravelly loamy sand about 17 inches thick. The substratum to a depth of about 60 inches is brown, stratified gravelly sand and very gravelly sand. In some areas the surface layer is silt loam or gravelly loam. In a few areas the slope is less than 6 percent. In places the substratum has thin layers of loamy deposits, and in a few areas the soil is very cobbly.

Typically, the Antigo soil has a surface layer of very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 1 inch thick. The next layer is dark brown, brown, and dark yellowish brown silt loam and loam about 21 inches thick. The subsoil is dark brown gravelly sandy loam and gravelly loamy sand about 9 inches thick. The substratum to a depth of about 60 inches is brown, stratified very gravelly sand and gravelly sand. In some areas the upper layers are loam. In a few areas the slope is less than 6 percent. In places the substratum is at a depth of more than 40 inches, and in a few areas it has thin layers of loamy deposits. In some areas the substratum is very cobbly.

Included with these soils in mapping are small areas of the somewhat poorly drained Ossmer and moderately well drained Sconsin soils in swales and drainageways. Also included are small areas where loamy till is within a depth of 60 inches; areas where the surface soil is very fine sandy loam to sandy loam; small areas where the slope is more than 15 percent; and small ponds, wet spots, very stony areas, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is moderately rapid in the upper part of the Pence soil and moderate in the upper part of the Antigo soil. It is rapid or very rapid in the lower part of both soils. Runoff is medium on both soils. The available water capacity is low in the Pence soil and moderate in the Antigo soil. The content of organic matter in the surface layer is moderate or moderately low. The potential for frost action is high in the Antigo soil. The surface layer of both soils can be easily tilled throughout a wide range in moisture content. The surface layer of the Antigo soil tends to crust or puddle after rainfall. In places the rooting depth of some plants is limited by the sand and gravel substratum in both soils.

Most areas are used as woodland. The mature timber stands on the droughty Pence soil are mostly sugar maple, paper birch, and red maple, but northern red oak and eastern white pine are in most stands. The ground flora includes grasses, wild sarsaparilla, beaked hazelnut, Canada mayflower, bigleaf aster, yellow beadlily, and brackenfern. Sugar maple, American basswood, and white ash are the dominant species on the Antigo soil where blue cohosh, sweet cicely, four-lined honeysuckle, smooth yellow violet, ladyfern, Virginia waterleaf, largeflowered bellwort, snow trillium, and bloodroot are in the ground flora. Black cherry and

yellow birch also are in the timber stands on the Antigo soil.

These soils are suited to trees. The main concern affecting woodland management is the equipment limitation in areas of the Antigo soil. The use of equipment is restricted in the spring and in other excessively 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 result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. The slope limits the selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping.

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

These soils are suited to corn and small grain and to grasses and legumes for hay and pasture. Crop yields are limited on the Pence soil because of the low available water content during dry periods. The soils are subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish. The substratum in both soils is droughty and may be difficult to vegetate if exposed during construction of diversions or grassed waterways. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the Antigo soil, improve fertility, help to prevent crusting and puddling of the surface layer in the Antigo soil, conserve moisture, and help to prevent excessive water erosion.

These soils are suited to pasture, but the Pence soil is droughty during dry periods. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the Antigo soil is too wet or when the Pence soil is too dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, pasture renovation, and controlled grazing help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer when the soils are moist helps to maintain a productive stand of forage.

These soils readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity of the substratum may result in the pollution of ground water. The soils are only moderately suited to dwellings because of the slope. The Pence soil is only moderately suited to local roads because of the slope. The Antigo soil is poorly suited to local roads because of the risk of frost damage. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. The substratum may cave in if it is excavated. It is droughty and is difficult to vegetate if it is exposed by land shaping. On the Antigo soil, frost damage to local roads can be controlled by replacing the upper part of the soil with coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts. The substratum is a probable source of sand and gravel.

The land capability classification is IVe. Based on sugar maple productivity, the woodland ordination symbol is 3A for the Pence soil and 3L for the Antigo soil. The primary habitat type commonly is ATM. The secondary habitat type commonly is AViO.

PeB—Pence-Padus sandy loams, 1 to 6 percent slopes. These nearly level and gently sloping or undulating, well drained soils are on knolls and upland flats and on the sides of drainageways, kettles, and basins. The landscape is pitted in places. Areas are elongated or irregularly shaped and range from about 10 to 500 acres in size. They are about 55 to 65 percent Pence soil and 25 to 35 percent Padus soil. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Pence soil has a surface layer of very dark gray sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 1 inch thick. The subsoil is about 30 inches thick. It is dark brown sandy loam in the upper part and strong brown gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified gravelly sand and sand. In some areas the surface layer is fine sandy loam. In a few areas the slope is 6 to 15 percent. In places the substratum has thin layers of loamy deposits, and in a few areas it is loamy sand or gravelly loamy sand.

Typically, the Padus soil has a surface layer of very dark gray sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 1 inch

thick. The next layer is dark brown and brown sandy loam about 25 inches thick. The subsoil is strong brown very gravelly loamy sand about 9 inches thick. The substratum to a depth of about 60 inches is brown very gravelly sand. In some areas the surface layer is fine sandy loam. In a few areas the slope is 6 to 15 percent. In places the substratum has thin layers of loamy deposits, and in a few areas it is loamy sand or gravelly loamy sand. In some areas the substratum is at a depth of more than 45 inches.

Included with these soils in mapping are small areas of the well drained Antigo soils in areas where the surface deposit is silty and the moderately well drained Padwet and somewhat poorly drained Worcester soils in swales and drainageways. Also included are small areas where the surface soil is loam or loamy sand; areas where loamy till is within a depth of 60 inches; narrow areas that have steep slopes; and small ponds, wet spots, very stony areas, gravel pits, and depressions. Included areas make up less than 15 percent of the map unit.

Permeability is moderately rapid in the upper part of the Pence soil and moderate in the upper part of the Padus soil. It is rapid or very rapid in the lower part of both soils. Runoff is slow on both soils. The available water capacity is low in the Pence soil and moderate in the Padus soil. The content of organic matter in the surface layer is moderate or moderately low in both soils. The potential for frost action is moderate in the Padus soil. The surface layer of both soils can be easily tilled throughout a wide range in moisture content. In places the rooting depth of some plants is limited by the sand and gravel substratum in both soils.

Most areas are used as woodland. The mature timber stands on the Pence soil are mostly sugar maple, paper birch, and red maple. The ground flora includes grasses, Canada mayflower, brackenfern, beaked hazelnut, yellow beadlily, wild sarsaparilla, and bigleaf aster. Sugar maple is the dominant species on the more productive Padus soil where sweet cicely, smooth yellow violet, and ladyfern are in the ground flora. American basswood, northern red oak, white ash, and eastern hemlock are in most stands. Eastern white pine also is in timber stands on the Pence soil (fig. 17).

These soils are suited to trees. The main concern affecting woodland management is the equipment limitation in areas of the Padus soil. The use of equipment is restricted in the spring and in other excessively 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 result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen.

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

These soils are suited to corn and small grain and to grasses and legumes for hay and pasture. Crop yields are limited on the Pence soil because of the low available water content during dry periods. The soils are subject to water erosion in cultivated areas where the slope is more than 2 percent. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. The substratum in both soils is droughty and may be difficult to vegetate if exposed during the construction of diversions, grassed waterways, or terraces.

If cultivated, these soils are subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve moisture. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing, improve fertility, and conserve the water available for plant growth. They also help to prevent excessive water erosion in areas where the slope is more than 2 percent.

These soils are suited to pasture, but the Pence soil is droughty during dry periods. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the Pence soil is dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, pasture renovation, and controlled grazing help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer when the soils are moist helps to maintain a productive stand of forage.

These soils readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity of the substratum may result in the pollution of ground water. The soils are suited to dwellings, but the substratum may cave in if it is excavated. The Pence soil is suited to local roads. The Padus soil is only moderately suited because of the risk of frost damage. Frost action can be controlled by replacing the upper part of the soil with a coarse base material and by

Figure 17.—Eastern white pine in an area of Pence-Padus sandy loams, 1 to 6 percent slopes. The pine grows in the droughty areas of the Pence soil, where sugar maple is less competitive.

installing a good subsurface drainage system of adequate side ditches and culverts. The substratum is a probable source of sand and gravel.

The land capability classification is IIIe. Based on sugar maple productivity, the woodland ordination symbol is 3A for the Pence soil and 3L for the Padus

soil. The primary habitat type commonly is ATM. The secondary habitat type commonly is AViO.

PeC—Pence-Padus sandy loams, 6 to 15 percent slopes. These sloping or rolling, well drained soils are on swells, hills, and ridges and on the sides of valleys, kettles, and basins. Areas are long and narrow or irregularly shaped and range from about 5 to 500 acres in size. They are about 60 to 70 percent Pence soil and 20 to 30 percent Padus soil. The two soils commonly occur as areas so intricately intermingled or so small that mapping them separately was not practical.

Typically, the Pence soil has a surface layer of very dark gray sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is about 22 inches thick. It is dark brown sandy loam in the upper part and strong brown very gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified gravelly sand and very gravelly sand. In some areas the surface layer is fine sandy loam. In a few areas the slope is less than 6 percent. In places the substratum has thin layers of loamy deposits, and in a few areas it is loamy sand or gravelly loamy sand.

Typically, the Padus soil has a surface layer of very dark gray sandy loam about 4 inches thick. The subsurface layer is brown sandy loam about 6 inches thick. The next layer is dark reddish brown, brown, and dark brown sandy loam about 13 inches thick. The subsoil is about 16 inches thick. It is dark brown sandy loam in the upper part and dark brown very gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is brown, stratified gravelly sand and sand. In some areas the surface layer is fine sandy loam. In a few areas the slope is less than 6 percent. In places the substratum has thin layers of loamy deposits, and in a few areas it is loamy sand or gravelly loamy sand. In some areas the substratum is at a depth of more than 45 inches.

Included with these soils in mapping are small areas of the well drained Antigo soils in areas where the surface deposit is silty, the moderately well drained Padwet soils, the excessively drained Sayner soils, and the somewhat poorly drained Worcester soils. Worcester and Padwet soils are in swales and drainageways. Sayner soils are in positions on the landscape similar to those of the Pence and Padus soils. They have sandy upper layers. Also included are small areas where the surface soil is loam; areas where loamy till is within a depth of 60 inches; small areas where the slope is more than 15 percent; and small ponds, wet spots, very stony areas, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is moderately rapid in the upper part of the Pence soil and moderate in the upper part of the Padus soil. It is rapid or very rapid in the lower part of both soils. Runoff is medium on both soils. The available water capacity is low in the Pence soil and moderate in the Padus soil. The content of organic matter in the surface layer is moderate or moderately low in both soils. The potential for frost action is moderate in the Padus soil. The surface layer of both soils can be easily tilled throughout a wide range in moisture content. In places the rooting depth of some plants is limited by the sand and gravel substratum in both soils.

Most areas are used as woodland. The mature timber stands on the Pence soil are mostly sugar maple, paper birch, and red maple. The ground flora includes grasses, Canada mayflower, brackenfern, beaked hazelnut, yellow beadlily, wild sarsaparilla, and bigleaf aster. Sugar maple is the dominant species on the more productive Padus soil where sweet cicely, smooth yellow violet, and ladyfern are in the ground flora. American basswood, northern red oak, white ash, and eastern hemlock are in most stands. Eastern white pine also is in timber stands on the Pence soil.

These soils are suited to trees. The main concern affecting woodland management is the equipment limitation in areas of the Padus soil. The use of equipment is restricted in the spring and in other excessively 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 result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. The slope limits the selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping.

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

These soils are suited to corn and small grain and to grasses and legumes for hay and pasture. Crop yields are limited on the Pence soil because of the low available water content during dry periods. The soils are subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish. The

substratum in both soils is droughty and may be difficult to vegetate if exposed during the construction of diversions or grassed waterways.

If cultivated, these soils are subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve moisture. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing and water erosion, improve fertility, and conserve the water available for plant growth.

These soils are suited to pasture, but the Pence soil is droughty during dry periods. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the Pence soil is dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, pasture renovation, and controlled grazing help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer when the soils are moist helps to maintain a productive stand of forage.

These soils readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity of the substratum may result in the pollution of ground water. The soils are only moderately suited to dwellings because of the slope. They are only moderately suited to local roads because of the slope. The risk of frost damage is an additional problem affecting local roads in areas of the Padus soil. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. The substratum may cave in if it is excavated. It is droughty and is difficult to vegetate if it is exposed by land shaping. On the Padus soil, frost damage to local roads can be controlled by replacing the upper part of the soil with coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts. The substratum is a probable source of sand and gravel.

The land capability classification is IVe. Based on sugar maple productivity, the woodland ordination symbol is 3A for the Pence soil and 3L for the Padus soil. The primary habitat type commonly is ATM. The secondary habitat type commonly is AViO.

PeD—Pence-Padus sandy loams, 15 to 35 percent slopes. These moderately steep or hilly to very steep, well drained soils are on hills and ridges and on the sides of valleys, kettles, and basins. Areas are long and narrow or irregularly shaped and range from about 5 to 800 acres in size. They are about 65 to 75 percent Pence soil and 15 to 25 percent Padus soil. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Pence soil has a surface layer of very dark gray sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 1 inch thick. The subsoil is about 22 inches thick. It is dark reddish brown sandy loam in the upper part, reddish brown loamy sand in the next part, and dark brown sand in the lower part. The substratum to a depth of about 60 inches is brown very gravelly sand. In some areas the surface layer is fine sandy loam. In a few areas the slope is more than 35 percent. In places the substratum has thin layers of loamy deposits, and in a few areas it is loamy sand or gravelly loamy sand.

Typically, the Padus soil has a surface layer of black sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 1 inch thick. The next layer is dark reddish brown, dark brown, brown, and reddish brown sandy loam about 24 inches thick. The subsoil is reddish brown sandy loam about 6 inches thick. The substratum to a depth of about 60 inches is brown gravelly sand. In some areas the surface layer is fine sandy loam. In a few areas the slope is more than 35 percent. In places the substratum has thin layers of loamy deposits, and in a few areas it is loamy sand or gravelly loamy sand. In some areas the substratum is at a depth of more than 45 inches.

Included with these soils in mapping are small areas of the moderately well drained Padwet, excessively drained Sayner, and somewhat poorly drained Worcester soils. Worcester and Padwet soils are in swales and drainageways. Sayner soils are in positions on the landscape similar to those of the Pence and Padus soils. They have sandy upper layers. Also included are small areas where the surface soil is loam or silt loam; areas where loamy till is within a depth of 60 inches; small areas where the slope is less than 15 percent; and small ponds, wet spots, very stony areas, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is moderately rapid in the upper part of the Pence soil and moderate in the upper part of the Padus soil. It is rapid or very rapid in the lower part of both soils. Runoff is rapid on both soils. The available water capacity is low in the Pence soil and moderate in the Padus soil. The content of organic matter in the surface layer is moderate or moderately low in both soils. The potential for frost action is moderate in the Padus soil. In places the rooting depth of some plants is limited by a sand and gravel substratum in both soils.

Most areas are used as woodland. The mature timber stands on the Pence soil are mostly sugar

maple, paper birch, and red maple. The ground flora includes grasses, Canada mayflower, brackenfern, beaked hazelnut, yellow beadlily, wild sarsaparilla, and bigleaf aster. Sugar maple is the dominant species on the more productive Padus soil where sweet cicely, smooth yellow violet, and ladyfern are in the ground flora. American basswood, northern red oak, white ash, and eastern hemlock are in most stands. Eastern white pine also is in timber stands on the Pence soil.

These soils are suited to trees. The main concerns affecting woodland management are the erosion hazard, the equipment limitation, and seedling mortality. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. It can be minimized by logging, planting trees, and establishing roads and trails on the contour; yarding uphill by cable; and removing water by water bars, out-sloping road surfaces, and culverts. Drop structures may be needed to stabilize highly erodible areas. Seeding areas exposed by logging activities helps to establish a protective vegetative cover.

On the Padus soil, the use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. The slope limits the selection of sites for logging roads and landings. Establishing the roads on the contour helps to maintain a low grade. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping. Yarding the logs by cable and planting trees by hand may be necessary in areas where the slope limits the use of equipment.

Seedling survival during dry periods can be improved on the droughty southern exposures by planting containerized seedlings or vigorous nursery stock when the soils are moist. After trees are cut, plant competition can be expected to delay the natural regeneration of desirable tree species in areas of the Padus soil. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

These soils are generally not suited to cultivated crops because of the slope, the low available water capacity of the Pence soil, and a severe hazard of erosion.

These soils are suited to pasture. Forage yields are limited on the Pence soil because of the low available water content during dry periods. The soils should be managed for bluegrass in areas where the slope prevents the use of machinery. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the Pence soil is dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation in areas where machinery can be used, and restricted use of the Pence soil during dry periods help to keep the pasture in good condition. In areas where machinery can be used, clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer when the soils are moist helps to maintain a productive stand of forage.

These soils are generally unsuited to septic tank absorption fields and dwellings mainly because of the slope. Overcoming this limitation is difficult. A better site, such as a small included area of a better suited less sloping soil, should be selected.

These soils are poorly suited to local roads because of the slope. Land shaping is needed to reduce the slope, or the roads can be built on the contour. The substratum may cave in if it is excavated. It is droughty and is difficult to vegetate if exposed by land shaping. It also is a probable source of sand and gravel.

The land capability classification is VIIe. Based on sugar maple productivity, the woodland ordination symbol is 3R. The primary habitat type commonly is ATM. The secondary habitat type commonly is AViO.

PsB—Pesabic fine sandy loam, 0 to 4 percent slopes. This nearly level and gently sloping or undulating, somewhat poorly drained soil is on low swells and knolls in low areas, on the broad crests and foot slopes of drumlins, and in upland swales and drainageways. The surface of the land commonly is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are elongated or irregularly shaped and range from about 10 to 200 acres in size.

Typically, the surface layer is black fine sandy loam about 4 inches thick. The subsurface layer is brown fine sandy loam about 1 inch thick. The upper part of the subsoil is dark brown, mottled fine sandy loam about 8 inches thick. The next layer is brown, dark brown, and reddish brown sandy loam and gravelly sandy loam about 20 inches thick. It is mottled. The lower part of the subsoil is reddish brown, mottled, firm sandy loam about 20 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, firm fine sandy loam. In some areas the surface layer is sandy loam or very fine sandy loam. In a few areas the slope is 5 or 6 percent. In places the subsoil has thin layers of silty deposits. In some areas the lower part of the soil is

friable, and in a few areas it has a thin layer of sand and gravel.

Included with this soil in mapping are small areas of the somewhat poorly drained Magnor soils in areas where the surface deposit is silty, the moderately well drained Newood soils on the higher parts of the landscape, and the very poorly drained Capitola soils in drainageways. Also included are many small areas of very poorly drained organic soils in depressions, areas where the surface layer is loam, narrow areas that have steep slopes, small very stony areas, and ponds. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Pesabic soil, slow in the lower part of the subsoil, and very slow in the substratum. Runoff is slow. The available water capacity is moderate. The content of organic matter in the surface layer also is moderate. The potential for frost action is high. The surface layer can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. A perched seasonal high water table is at a depth of 0.5 foot to 2.0 feet. The rooting depth of some plants is limited by the perched seasonal high water table and the firm substratum.

Most areas are used as woodland. The timber stands are mostly red maple and sugar maple, but northern red oak, yellow birch, paper birch, and eastern hemlock are in most stands. The ground flora includes beaked hazelnut, bunchberry dogwood, goldthread, Canada mayflower, American starflower, wild sarsaparilla, yellow beadlily, rosy twistedstalk, partridgeberry, and mapleleaf viburnum. Red maple, balsam fir, and quaking aspen are the dominant species on foot slopes where the perched seasonal high water table persists for longer periods (fig. 18). These wetter areas have sensitive fern, wood sorrel, horsetail, or cinnamon fern in the ground flora.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation, seedling mortality, and the windthrow hazard. The use of equipment is restricted in the spring and in other excessively wet periods because of the perched seasonal high water table and low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. Logging roads and landings that have a gravel base can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited. Adequate culverts are needed on graveled roads to maintain the natural drainage system.

The seedling mortality resulting from soil wetness can be reduced by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the perched high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. The wetness in undrained areas limits yields and the kinds of crops that can be grown. Field ditches and tile drains can be used in the nearly level areas to help remove the perched water table. The field ditches can be used as outlets for tile drains in areas where a suitable drainage outlet is not available. Drainage tile may be displaced by frost action. This displacement can be prevented by using continuous tubing or by installing the tile drains below the depth of freezing.

This soil is subject to water erosion in cultivated areas where the slope is more than 2 percent. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas.

If drained and cultivated, this soil is subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure improve fertility and help to control soil blowing. These measures also help to prevent excessive water erosion in areas where the slope is more than 2 percent.

This soil is suited to pasture. Alfalfa stands for improved pasture are difficult to establish and maintain unless the soil is drained. Excess water during wet periods may damage the forage. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, and pasture renovation help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth

Figure 18.—Balsam fir in an area of Pesabic fine sandy loam, 0 to 4 percent slopes.

and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is generally unsuited to septic tank absorption fields and dwellings mainly because of the seasonal high water table. This limitation is difficult to overcome. A better site should be selected.

This soil is poorly suited to local roads because of the seasonal high water table and the risk of frost damage. These limitations can be overcome by adding a coarse base material to raise the roadbed above the level of wetness. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. Based on red maple productivity, the woodland ordination symbol is

3W. The primary habitat type commonly is TMC. The secondary habitat type commonly is ATM.

Pt—Pits, gravel. This map unit is in areas where sand and gravel have been removed. It is mostly on moraines, outwash plains, eskers, or kames. The floors of the pits commonly are nearly level or gently sloping. The sidewalls range from moderately steep to nearly vertical. Areas have linear borders or are irregular in shape and range from about 5 to 50 acres in size.

Typically, the floors and sides of the pits are sand and gravel in which the content of cobbles is as much as 15 percent. In places the floors and sides are loamy sand, gravelly loamy sand, sandy loam, or gravelly sandy loam that contains stones.

Included in mapping are piles of soil material removed from the pit area prior to excavation and piles of material within the pits that were discarded because of excess fines or a lack of gravel. Also included are stones or boulders too large to be crushed.

Many pits are still in use. Some have been abandoned and are overgrown with brush and weeds. Some of the abandoned pits are used as sanitary landfills. Water is in a few pits.

The main management concern is reclamation of the pits after excavation. In most of the pits, land shaping and additions of suitable topsoil are needed before a plant cover can be established. Vegetation can be established if the piles of finer textured material that was pushed aside prior to excavation are spread over the coarse sand and gravel. The slope of the sidewalls can be reduced by cutting and filling.

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

This map unit is not assigned a land capability classification, a woodland ordination symbol, or a habitat type.

SaC—Sarona-Pence sandy loams, 6 to 15 percent slopes. These sloping or rolling, well drained soils are on swells, hills, and ridges and on the sides of drumlins. Areas are elongated or irregularly shaped and range from about 10 to several thousand acres in size. They generally are 55 to 65 percent Sarona soil and 25 to 35 percent Pence soil, but some areas are entirely Sarona soil. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Sarona soil has a surface layer of very dark gray sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is dark reddish brown, reddish brown, and dark brown sandy loam about 13 inches thick. Below this to a depth of about 60 inches is reddish brown and brown sandy loam and brown loamy sand. In some areas the surface layer is loam or fine sandy loam. In a few areas the slope is less than 6 percent. In places the lower part of the soil has a thin layer of sand and gravel.

Typically, the Pence soil has a surface layer of black sandy loam about 4 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is about 24 inches thick. It is dark reddish brown gravelly sandy loam in the upper part and dark reddish brown and dark brown very gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown gravelly sand. In some areas the surface layer is loam, fine sandy loam, or gravelly sandy loam. In a few areas the slope is less than 6 percent. In places the substratum has thin layers of loamy deposits. In a few places the soil is very gravelly or very cobbly throughout.

Included with these soils in mapping are small areas of the well drained Goodman soils in areas where the surface deposit is silty, the somewhat poorly drained Moodig soils in swales and drainageways, and the moderately well drained Sarwet soils on the less sloping parts of the landscape. Also included are many small areas of very poorly drained organic soils in depressions; small areas where the slope is more than 15 percent; some areas where the surface soil is sandy and droughty; and small very stony areas, ponds, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Sarona soil and moderate or moderately rapid in the substratum. It is moderately rapid in the upper part of the Pence soil and rapid or very rapid in the lower part. Runoff is medium on both soils. The available water capacity is moderate in the Sarona soil and low in the Pence soil. The content of organic matter in the surface layer of both soils is moderate or moderately low. The potential for frost action is moderate in the Sarona soil. The surface layer of both soils can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. In places the rooting depth of some plants is limited by a sand and gravel substratum in the Pence soil.

Most areas are used as woodland. The mature timber stands on the more productive Sarona soil are mostly sugar maple. The ground flora includes wild sarsaparilla, Canada mayflower, rosy twistedstalk, mapleleaf viburnum, beaked hazelnut, sweet cicely, smooth yellow violet, and ladyfern. Sugar maple, red maple, and paper birch are the dominant species on the Pence soil where sweet cicely, smooth yellow violet, and ladyfern are not in the ground flora. Northern red

oak, American basswood, eastern hemlock, and white ash are in most stands. Eastern white pine also is in timber stands on the Pence soil.

These soils are suited to trees. The main concern affecting woodland management is the equipment limitation in areas of the Sarona soil. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. The slope limits the selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping.

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

These soils are suited to corn and small grain and to grasses and legumes for hay and pasture. Crop yields are limited on the Pence soil because of the low available water content during dry periods. The soils are subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Critical-area planting helps to stabilize highly erodible areas where vegetation is difficult to establish. The substratum in the Pence soil is droughty and may be difficult to vegetate if exposed during the construction of diversions or grassed waterways.

If cultivated, these soils are subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve moisture. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing and water erosion, improve fertility, and conserve the water available for plant growth.

These soils are suited to pasture, but the Pence soil is droughty during dry periods. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the Pence soil is dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, pasture renovation, and controlled grazing help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer when the soils are moist helps to maintain a productive stand of forage.

The Sarona soil is only moderately suited to septic tank absorption fields because of the slope. Lateral seepage and the surfacing of septic tank effluent in downslope areas can be controlled by installing a trench absorption system on the contour. The Pence soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity of the substratum may result in the pollution of ground water.

Because of the slope, these soils are only moderately suited to dwellings. They are only moderately suited to local roads because of the slope. The risk of frost damage is an additional problem affecting local roads in areas of the Sarona soil. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. The substratum of the Pence soil may cave in if it is excavated. It is droughty and is difficult to vegetate if it is exposed by land shaping. In areas of the Sarona soil, frost damage to local roads can be controlled by replacing the upper part of the soil with coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts. The substratum of the Pence soil is a probable source of sand and gravel.

The land capability classification is IVe. Based on sugar maple productivity, the woodland ordination symbol is 3L for the Sarona soil and 3A for the Pence soil. The primary habitat type commonly is ATM. The secondary habitat type commonly is AViO.

SaD—Sarona-Pence sandy loams, 15 to 35 percent slopes. These hilly to very steep, well drained soils are on hills and ridges. Areas are elongated or irregularly shaped. They generally range from about 5 to 500 acres in size, but many are less than 40 acres. The areas generally are 65 to 75 percent Sarona soil and 15 to 25 percent Pence soil, but some are entirely Sarona soil. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Sarona soil has a surface layer of very dark gray sandy loam about 1 inch thick. The subsurface layer is brown sandy loam about 1 inch thick. The subsoil is dark reddish brown and reddish brown sandy loam about 13 inches thick. Below this to a depth of about 60 inches is brown and reddish brown loamy sand and reddish brown sandy loam. In some areas the surface layer is loam or fine sandy loam. In a

few areas the slope is more than 35 percent. In places the lower part of the soil has a thin layer of sand and gravel.

Typically, the Pence soil has a surface layer of black sandy loam about 4 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is about 20 inches thick. It is dark reddish brown gravelly sandy loam in the upper part, reddish brown very gravelly loamy sand in the next part, and dark brown very gravelly sand in the lower part. The substratum to a depth of about 60 inches is brown gravelly sand. In some areas the surface layer is loam, fine sandy loam, or gravelly sandy loam. In a few areas the slope is more than 35 percent. In places the substratum has thin layers of loamy deposits. In a few places the soil is very gravelly or very cobbly throughout.

Included with these soils in mapping are small areas of the somewhat poorly drained Moodig soils in swales and drainageways and the moderately well drained Sarwet soils on the lower parts of the landscape. Also included are some areas where the surface soil is sandy and droughty; small areas where the surface soil is silt loam; small areas where the slope is less than 15 percent; and small very stony areas, ponds, wet spots, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Sarona soil and moderate or moderately rapid in the substratum. It is moderately rapid in the upper part of the Pence soil and rapid or very rapid in the lower part. Runoff is rapid on both soils. The available water capacity is moderate in the Sarona soil and low in the Pence soil. The content of organic matter in the surface layer of both soils is moderate or moderately low. The potential for frost action is moderate in the Sarona soil. In places the rooting depth of some plants is limited by a sand and gravel substratum in the Pence soil.

Most areas are used as woodland. The mature timber stands on the more productive Sarona soil are mostly sugar maple. The ground flora includes wild sarsaparilla, Canada mayflower, rosy twistedstalk, mapleleaf viburnum, beaked hazelnut, sweet cicely, smooth yellow violet, and ladyfern. Sugar maple, red maple, and paper birch are the dominant species on the Pence soil where sweet cicely, smooth yellow violet, and ladyfern are not in the ground flora. Northern red oak, American basswood, eastern hemlock, and white ash are in most stands. Eastern white pine also is in timber stands on the Pence soil.

These soils are suited to trees. The main concerns affecting woodland management are the erosion hazard, the equipment limitation, and seedling mortality. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. It can be minimized by logging, planting trees, and establishing roads and trails on the contour; yarding uphill by cable; and removing water by water bars, out-sloping road surfaces, and culverts. Drop structures may be needed to stabilize highly erodible areas. Seeding areas exposed by logging activities helps to establish a protective vegetative cover.

On the Sarona soil, the use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. The slope limits the selection of sites for logging roads and landings. Establishing the roads on the contour helps to maintain a low grade. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping. Yarding the logs by cable and planting trees by hand may be necessary in areas where the slope limits the use of equipment.

Seedling survival during dry periods can be improved on the droughty southern exposures by planting containerized seedlings or vigorous nursery stock when the soils are moist. After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species in areas of the Sarona soil. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

These soils are generally not suited to cultivated crops because of the slope, the low available water capacity of the Pence soil, and a severe hazard of erosion.

These soils are suited to pasture. Forage yields are limited on the Pence soil because of the low available water content during dry periods. The soils should be managed for bluegrass in areas where the slope prevents the use of machinery. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the Pence soil is dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation in areas where machinery can be used, and restricted use of the Pence soil during dry periods help to keep the pasture in good condition. In areas where machinery can be used, clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of

regrowth and grazing. Topdressing with fertilizer when the soils are moist helps to maintain a productive stand of forage.

These soils are generally unsuited to septic tank absorption fields and dwellings mainly because of the slope. Overcoming this limitation is difficult. A better site, such as a small included area of a better suited less sloping soil, should be selected.

These soils are poorly suited to local roads because of the slope. Land shaping is needed to reduce the slope, or the roads can be built on the contour. The substratum of the Pence soil may cave in if it is excavated. It is droughty and is difficult to vegetate if exposed by land shaping. It also is a probable source of sand and gravel.

The land capability classification is VIIe. Based on sugar maple productivity, the woodland ordination symbol is 3R. The primary habitat type commonly is ATM. The secondary habitat type commonly is AViO.

SbB—Sarwet sandy loam, 2 to 6 percent slopes. This gently sloping or undulating, moderately well drained soil is on low swells or knolls and on the crests and sides of drumlins. Areas are elongated or irregularly shaped and range from about 5 to 100 acres in size.

Typically, the surface layer is very dark gray sandy loam about 5 inches thick. The subsurface layer is brown loamy sand about 1 inch thick. The upper part of the subsoil is dark brown sandy loam about 16 inches thick. The next layer is mostly pale brown and brown, mottled gravelly sandy loam about 49 inches thick. The lower part of the subsoil is brown, mottled gravelly sandy loam about 13 inches thick. The substratum to a depth of about 90 inches is brown very gravelly sandy loam. In some areas the surface layer is loam or fine sandy loam. In a few areas the slope is 6 to 15 percent. In places the lower part of the soil has a thin layer of sand and gravel.

Included with this soil in mapping are small areas of the moderately well drained Goodwit soils in areas where the surface deposit is silt loam, the somewhat poorly drained Moodig soils in swales and drainageways, and the well drained Sarona soils on the more sloping parts of the landscape. Also included are many small areas of very poorly drained organic soils in depressions, some areas where the surface soil is sandy and droughty, narrow areas that have steep slopes, areas where the water table is not seasonally perched in the subsoil, small areas where the subsoil has thin layers of silty deposits, and small very stony areas and ponds. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the Sarwet soil. Runoff is slow. The available water capacity is moderate. The content of organic matter in the surface layer and the potential for frost action also are moderate. The surface layer can be easily tilled throughout a wide range in moisture content, except in the small included areas that are very stony. A perched seasonal high water table is at a depth of 2.5 to 3.5 feet.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, but American basswood, northern red oak, eastern hemlock, and white ash are in most stands (fig. 19). The ground flora includes rosy twistedstalk, wild sarsaparilla, mapleleaf viburnum, Canada mayflower, beaked hazelnut, smooth yellow violet, sweet cicely, and ladyfern.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen.

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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas.

If cultivated, this soil is subject to soil blowing during dry periods. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve moisture. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing and water erosion, improve fertility, and conserve the water available for plant growth.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, and pasture renovation help to keep the pasture in good condition.

Figure 19.—A stand of northern hardwoods, mostly sugar maple, in an area of Sarwet sandy loam, 2 to 6 percent slopes.

Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

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. In some areas the effluent can be pumped to an absorption field established on higher, better suited soils.

This soil is suited to dwellings without basements. It is only moderately suited to dwellings with basements because of the seasonal high water table, but basements can be constructed above the level of wetness.

Because of the risk of frost damage, this soil is only moderately suited to local roads. Frost action can be controlled by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is

ATM. The secondary habitat type commonly is AViO.

ScB—Sconsin silt loam, 1 to 6 percent slopes. This nearly level and gently sloping or undulating, moderately well drained soil is on knolls and low flats, in swales and drainageways in the uplands, and on the higher parts of glacial lake basins. The landscape is pitted in places. Areas are elongated or irregularly shaped and range from about 10 to 300 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 1 inch thick. The next layer is dark brown, dark yellowish brown, and brown silt loam and loam about 29 inches thick. It is mottled in the lower part. The subsoil is dark yellowish brown, mottled sandy loam about 4 inches thick. The substratum to a depth of about 60 inches is yellowish brown, stratified very gravelly sand and sand. In some areas the upper layers are loam. In a few areas the slope is 6 to 15 percent. In some places the substratum has thin layers of loamy deposits, and in a few places it is at a depth of more than 45 inches. It is cobbly in some areas. In places the upper silty deposits are more than 30 inches thick.

Included with this soil in mapping are small areas of the well drained Antigo soils on the higher parts of the landscape, the somewhat poorly drained Ossmer soils in swales and drainageways, and the moderately well drained Padwet soils in areas where the surface deposit is sandy loam. Also included are areas where loamy till is within a depth of 60 inches; small areas where the substratum is within a depth of 22 inches; areas where a water table is seasonally perched in the subsoil; narrow areas that have steep slopes; and small ponds, wet spots, very stony areas, depressions, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Sconsin soil and rapid or very rapid in the lower part. Runoff is slow or medium. The available water capacity is moderate. The content of organic matter in the surface layer and the potential for frost action also are moderate. The surface layer can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after rainfall. A mottled, seasonal zone of near saturation is at a depth of 2.5 to 3.5 feet. The rooting depth of some plants is limited by the sand and gravel substratum.

Most areas are used as woodland. The mature timber stands are mostly sugar maple, American basswood, and white ash, but yellow birch and black cherry are in most stands. The ground flora includes blue cohosh, sweet cicely, four-lined honeysuckle, smooth yellow violet, ladyfern, Virginia waterleaf, largeflowered bellwort, snow trillium, and bloodroot.

This soil is suited to trees. The main concern affecting woodland management is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low soil strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. All-weather logging roads need a gravel base because unsurfaced roads are slippery and easily rutted during wet periods. Landings that are stabilized with gravel 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion in cultivated areas where the slope is more than 2 percent. Grassed waterways and a conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. Diversions also help to control erosion in these areas. The substratum is droughty and may be difficult to vegetate if exposed during the construction of diversions, grassed waterways, or terraces. Land smoothing in nearly level areas can prevent the crop damage caused by ponding. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infiltration rate and the movement of air and water through the soil, improve fertility, help to prevent crusting and puddling of the surface layer, and conserve the water available for plant growth. They also help to prevent excessive water erosion in areas where the slope is more than 2 percent.

This soil is suited to pasture. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction, depletion of the plant cover, and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing

with fertilizer helps to maintain a productive stand of forage.

This soil is poorly suited to septic tank absorption fields because of the rapid or very rapid permeability in the substratum and the seasonal zone of near saturation. 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 higher, better suited soils.

This soil is suited to dwellings, but the substratum may cave in if it is excavated. Because of the risk of frost damage, the soil is only moderately suited to local roads. Frost action can be controlled by replacing the upper part of the soil with a coarse base material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. Based on sugar maple productivity, the woodland ordination symbol is 3L. The primary habitat type commonly is AViO or ATM. The secondary habitat type commonly is AH.

VsB—Vilas-Sayner loamy sands, 1 to 6 percent slopes. These nearly level and gently sloping or undulating, excessively drained soils are on upland flats, on low swells or knolls, and on the sides of drainageways, kettles, and basins. The landscape is pitted in places. Areas are elongated or irregularly shaped and range from about 10 to several thousand acres in size. They generally are about 55 to 65 percent Vilas soil and 25 to 35 percent Sayner soil, but some areas are made up entirely of only one of the soils. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Vilas soil has a surface layer of very dark gray loamy sand about 2 inches thick. The subsurface layer is brown loamy sand about 1 inch 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 and yellowish brown sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown sand. In some areas the surface layer is sand. In a few areas the slope is 6 to 15 percent. In places the substratum is loamy sand. In a few places the soil has thin layers of gravelly sand, fine sand, very fine sand, or loamy fine sand.

Typically, the Sayner soil has a surface layer of very dark gray loamy sand about 2 inches thick. The subsurface layer is brown loamy sand about 3 inches thick. The subsoil is about 27 inches thick. It is dark reddish brown, reddish brown, and dark brown loamy sand in the upper part and brown gravelly sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown gravelly sand. In some areas the surface layer is sand or gravelly loamy sand. In a few areas the slope is 6 to 15 percent. In places the substratum is sand, loamy sand, or gravelly loamy sand. In a few places the content of gravel in the soil is more than 35 percent.

Included with these soils in mapping are small areas of Au Gres, Croswell, Croswood, and Pence soils. The somewhat poorly drained Au Gres soils and the moderately well drained Croswell and Croswood soils are in swales and drainageways. Croswood soils have loamy till at a depth of 40 to 60 inches. The well drained Pence soils are in positions on the landscape similar to those of the Vilas and Sayner soils. They are sandy loam in the upper layers. Also included are areas where the soils have thin layers of loamy deposits; narrow areas that have steep slopes; and small ponds, wet spots, depressions, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is rapid in the Vilas soil. It is moderately rapid or rapid in the upper part of the Sayner soil and rapid or very rapid in the lower part. Runoff is very slow on both soils. The available water capacity and natural fertility are low. The content of organic matter in the surface layer is low or very low in the Vilas soil and low or moderately low in the Sayner soil. The surface layer of both soils can be easily tilled throughout a wide range in moisture content.

Most areas are used as woodland. The mature timber stands are mostly red maple, northern red oak, paper birch, eastern white pine, and red pine, but jack pine, balsam fir, and quaking aspen are in most stands. The ground flora includes blueberry, brackenfern, wintergreen, bigleaf aster, beaked hazelnut, grasses, barren strawberry, American starflower, wild sarsaparilla, blackberry, wild strawberry, and pipsissewa. Canada mayflower, yellow beadlily, and rosy twistedstalk are in the ground flora in areas of the more productive Sayner soil.

These soils are suited to trees. In areas of the Vilas soil, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads and landings that are subject to the repeated use of heavy equipment can be stabilized with gravel, or they can be established in areas of the Sayner soil. Seedling survival during dry periods can be improved on these droughty soils by planting containerized seedlings or vigorous nursery stock when the soils are moist. Before trees are planted, site preparation by mechanical or chemical means may be needed to control competing vegetation.

These soils are suited to corn and small grain and to grasses and legumes for hay and pasture. Some areas

formerly used as cropland are now idle or have been planted to pine trees. Crop yields are generally limited because of the low available water capacity. Irrigation is necessary for dependable crop production. If cultivated, these soils are subject to soil blowing during dry periods. Field borders, field windbreaks, and vegetative row barriers help to control soil blowing. A conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface, cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to control soil blowing, improve fertility, and conserve the water available for plant growth. Additions of plant nutrients are needed because of the low natural fertility.

These soils are suited to pasture. They are droughty, however, and natural fertility is low. A cover of pasture plants is effective in controlling soil blowing. Overgrazing or grazing when the soils are dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage. The response to additions of plant nutrients is limited, however, by the low available water content during dry periods.

These soils readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity may result in the pollution of ground water. The soils are suited to dwellings and to local roads. They may cave in if they are excavated. They are a probable source of sand or gravel.

The land capability classification is IVs. Based on red pine productivity, the woodland ordination symbol is 6A for the Vilas soil and 7A for the Sayner soil. The primary habitat type commonly is ArQV. The secondary habitat type commonly is PMV.

VsC—Vilas-Sayner loamy sands, 6 to 15 percent slopes. These sloping or rolling, excessively drained soils are on swells, hills, and ridges and on the sides of valleys, kettles, and basins. Areas are elongated or irregularly shaped and range from about 10 to several hundred acres in size. They generally are about 50 to 60 percent Vilas soil and 30 to 40 percent Sayner soil, but some areas are made up entirely of only one of the soils. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Vilas soil has a surface layer of black loamy sand about 3 inches thick. The subsurface layer is brown loamy sand about 1 inch thick. The subsoil is about 23 inches thick. It is 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 yellowish brown sand. In some areas the surface layer is sand. In a few areas the slope is less than 6 percent. In places the substratum is loamy sand. In a few places the soil has thin layers of gravelly sand, fine sand, very fine sand, or loamy fine sand.

Typically, the Sayner soil has a surface layer of very dark grayish brown loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 3 inches thick. The subsoil is about 22 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 light yellowish brown, stratified gravelly sand and sand. In some areas the surface layer is sand or gravelly loamy sand. In a few areas the slope is less than 6 percent. In places the substratum is sand, loamy sand, or gravelly loamy sand. In a few places the content of gravel in the soil is more than 35 percent.

Included with these soils in mapping are small areas of the somewhat poorly drained Au Gres and moderately well drained Croswell soils in swales and drainageways and the well drained Pence soils. Pence soils are sandy loam in the upper layers. They are in positions on the landscape similar to those of the Vilas and Sayner soils. Also included are areas where loamy till is at a depth of 40 to 60 inches; areas where the soils have thin layers of loamy deposits; small areas where the slope is more than 15 percent; and small ponds, wet spots, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is rapid in the Vilas soil. It is moderately rapid or rapid in the upper part of the Sayner soil and rapid or very rapid in the lower part. Runoff is slow on both soils. The available water capacity and natural fertility are low. The content of organic matter in the surface layer is low or very low in the Vilas soil and low or moderately low in the Sayner soil.

Most areas are used as woodland. The mature timber stands are mostly red maple, northern red oak, paper birch, eastern white pine, and red pine, but jack pine, balsam fir, and quaking aspen are in most stands. The ground flora includes blueberry, brackenfern, wintergreen, bigleaf aster, beaked hazelnut, grasses, barren strawberry, American starflower, wild sarsaparilla, blackberry, wild strawberry, and pipsissewa. Canada mayflower, yellow beadlily, and rosy twistedstalk are in the ground flora on the more productive Sayner soil.

These soils are suited to trees. The slope limits the

selection of landing sites. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping. In areas of the Vilas soil, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel, or they can be established in areas of the Sayner soil. Seedling survival during dry periods can be improved on these droughty soils by planting containerized seedlings or vigorous nursery stock when the soils are moist. Before trees are planted, site preparation by mechanical or chemical means may be needed to control competing vegetation.

These soils are generally not suited to cultivated crops because of the low available water capacity and the low natural fertility. Some areas formerly used as cropland are now idle or have been planted to pine trees.

These soils are suited to pasture, but they are droughty. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soils are dry results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage. The response to additions of plant nutrients is limited, however, by the low available water content during dry periods.

These soils readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity may result in the pollution of ground water. Because of the slope, the soils are only moderately suited to dwellings and local roads. The slope can be reduced by land shaping. Dwellings can be designed so that they conform to the natural slope of the land. The substratum is droughty and is difficult to vegetate if it is exposed by land shaping. The soils may cave in if they are excavated. They are a probable source of sand or gravel.

The land capability classification is VIs. Based on red pine productivity, the woodland ordination symbol is 6A for the Vilas soil and 7A for the Sayner soil. The primary habitat type commonly is ArQV. The secondary habitat type commonly is PVM.

VsD—Vilas-Sayner loamy sands, 15 to 35 percent slopes. These moderately steep or hilly to very steep, excessively drained soils are on hills and ridges and on the sides of valleys, kettles, and basins. Areas are long and narrow or irregularly shaped. They generally range from about 5 to 40 acres in size, but some are as large as several hundred acres. They generally are about 45 to 55 percent Vilas soil and 35 to 45 percent Sayner soil, but some areas are made up entirely of only one of the soils. The two soils commonly occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Vilas soil has a surface layer of black loamy sand about 3 inches thick. The subsurface layer is brown loamy sand about 1 inch thick. The subsoil is about 25 inches thick. It is dark reddish brown loamy sand in the upper part and dark brown and strong brown sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand. In some areas the surface layer is sand. In a few areas the slope is more than 35 percent. In places the substratum is loamy sand. In a few places the soil has thin layers of gravelly sand, fine sand, very fine sand, or loamy fine sand.

Typically, the Sayner soil has about 1 inch of partially decomposed leaf litter at the surface. The surface layer is brown loamy sand about 2 inches thick. The subsoil is about 26 inches thick. It is dark reddish brown loamy sand in the upper part and reddish brown and strong brown gravelly sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified gravelly sand and sand. In some areas the surface layer is sand or gravelly loamy sand. In a few areas the slope is more than 35 percent. In places the substratum is sand, loamy sand, or gravelly loamy sand. In a few places the content of gravel in the soil is more than 35 percent.

Included with these soils in mapping are small areas of the somewhat poorly drained Au Gres and moderately well drained Croswell soils in swales and drainageways and the well drained Pence soils. Pence soils are sandy loam in the upper layers. They are in positions on the landscape similar to those of the Vilas and Sayner soils. Also included are small areas where the soils have thin layers of loamy deposits; areas where loamy till is at a depth of 40 to 60 inches; small areas where the slope is less than 15 percent; and small ponds, wet spots, and gravel pits. Included areas make up less than 15 percent of the map unit.

Permeability is rapid in the Vilas soil. It is moderately rapid or rapid in the upper part of the Sayner soil and rapid or very rapid in the lower part. Runoff is medium on both soils. The available water capacity and natural fertility are low. The content of organic matter in the surface layer is low or very low in the Vilas soil and low or moderately low in the Sayner soil.

Most areas are used as woodland. The mature timber stands are mostly red maple, northern red oak,

paper birch, eastern white pine, and red pine, but jack pine, balsam fir, and quaking aspen are in most stands. The ground flora includes blueberry, brackenfern, wintergreen, bigleaf aster, beaked hazelnut, grasses, barren strawberry, American starflower, wild sarsaparilla, blackberry, wild strawberry, and pipsissewa. Canada mayflower, yellow beadlily, and rosy twistedstalk are in the ground flora on the more productive Sayner soil.

These soils are suited to trees. The main concerns affecting woodland management are the erosion hazard, the equipment limitation, and seedling mortality. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. It can be minimized by logging, planting trees, and establishing roads and trails on the contour; yarding uphill by cable; and removing water by water bars, out-sloping road surfaces, and culverts. Drop structures may be needed to stabilize highly erodible areas. Seeding areas exposed by logging activities helps to establish a protective vegetative cover.

The slope limits the selection of sites for logging roads and landings. The roads can be established on the contour. Landings can be established on the better suited included or adjacent soils that are nearly level or gently sloping. Yarding the logs by cable and planting trees by hand may be needed in areas where the slope limits the use of equipment. In areas of the Vilas soil, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel, or they can be established in areas of the Sayner soil.

Seedling survival during dry periods, especially on the southern exposures, can be improved on these droughty soils by planting containerized seedlings or vigorous nursery stock when the soils are moist. Before trees are planted, site preparation by mechanical or chemical means may be needed to control competing vegetation.

These soils are generally not suited to farming because of the slope, the low available water capacity, the low natural fertility, and a severe hazard of erosion.

These soils are generally unsuited to septic tank absorption fields and dwellings mainly because of the slope. Overcoming this limitation is difficult. A better site, such as a small included area of a less sloping soil, should be selected.

These soils are poorly suited to local roads because of the slope. Land shaping is needed to reduce the slope, or the roads can be built on the contour. The substratum is droughty and is difficult to vegetate if exposed by land shaping. The soils may cave in if they are excavated. They are a probable source of sand or gravel.

The land capability classification is VIIs. Based on red pine productivity, the woodland ordination symbol is 6R for the Vilas soil and 7R for the Sayner soil. The primary habitat type commonly is ArQV. The secondary habitat type commonly is PMV.

WoA—Worcester sandy loam, 0 to 3 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on low flats and in swales and drainageways in the uplands. The landscape is pitted in places. The surface of the land commonly is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are elongated or irregularly shaped and range from about 10 to 200 acres in size.

Typically, the surface layer is very dark gray sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 1 inch thick. The next layer is dark reddish brown, dark brown, and brown sandy loam about 17 inches thick. It is mottled in the lower part. The subsoil is about 19 inches thick. It is dark brown, mottled sandy loam in the upper part and strong brown gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown gravelly sand. In some areas the surface layer is fine sandy loam. In a few areas the substratum has thin layers of loamy deposits, and in other areas it is loamy sand or gravelly loamy sand. In some places the substratum is at a depth of more than 45 inches.

Included with this soil in mapping are small areas of the very poorly drained Minocqua soils in depressions, the somewhat poorly drained Ossmer soils in areas where the surface deposit is silty, the moderately well drained Padwet soils on the higher parts of the landscape, and the somewhat poorly drained Worwood soils in areas where stratified lacustrine deposits are at a depth of 40 to 60 inches. Also included are areas where the substratum is within a depth of 24 inches; areas where the surface soil is loam or loamy sand; areas where loamy till is within a depth of 60 inches; narrow areas that have steep slopes; and small ponds, very stony areas, and sandy spots. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Worcester soil and rapid or very rapid in the lower part. Runoff is slow. The available water capacity is moderate. The content of organic matter in the surface layer is moderate or moderately low. The potential for frost action is high. The surface layer can be easily tilled throughout a wide range in moisture content. A seasonal high water table is at a depth of 0.5 foot to 2.0 feet. The rooting depth of some plants is limited by the seasonal high water table and, in places, by a

substratum of sand and gravel.

Most areas are used as woodland. The timber stands are mostly sugar maple, red maple, paper birch, quaking aspen, and balsam fir, but yellow birch and eastern hemlock are in most stands. The ground flora includes bunchberry dogwood, goldthread, smooth yellow violet, ladyfern, Canada mayflower, American starflower, rosy twistedstalk, wild sarsaparilla, beaked hazelnut, and yellow beadlily.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation and the windthrow hazard. The use of equipment is restricted in the spring and in other excessively wet periods because of the seasonal high water table and low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. Logging roads and landings that have a gravel base can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited. Adequate culverts are needed on graveled roads to maintain the natural drainage system.

A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. The high water table in undrained areas limits yields and the kinds of crops that can be grown. Field ditches and tile drains can lower the water table. Because the substratum is unstable and may cave, the sides of the ditches should be flattened and continuous tubing should be used when tile drains are installed. Filters are needed to keep the fine particles of sand in the substratum from clogging the drains. Drainage tile may be displaced by frost action. This displacement can be prevented by using continuous tubing or by installing the tile drains below the depth of freezing. The field ditches can be used as outlets for tile drains in areas where a suitable drainage outlet is not available.

If drained and cultivated, this soil is subject to soil blowing during dry periods. A conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface, field borders, field windbreaks, and vegetative row barriers help to control soil blowing. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure improve fertility and help to control soil blowing.

This soil is suited to pasture. Alfalfa stands for improved pasture are difficult to establish and maintain unless the soil is drained. Excess water during wet periods may damage the forage. A cover of pasture plants is effective in controlling soil blowing. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, and pasture renovation help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is generally unsuited to septic tank absorption fields and dwellings mainly because of the seasonal high water table. This limitation is difficult to overcome. A better site should be selected.

This soil is poorly suited to local roads because of the seasonal high water table and the risk of frost damage. These limitations can be overcome by adding a coarse base material to raise the roadbed above the level of wetness. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. Based on red maple productivity, the woodland ordination symbol is 2W. The habitat type commonly is TMC.

WsA—Worwood loam, 0 to 3 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on low terraces within or bordering the lower depressional areas and on the lower parts of glacial lake basins. The surface of the land commonly is uneven in wooded areas because of trees that have been uprooted by the wind. Areas are elongated or irregularly shaped and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark gray loam about 3 inches thick. The subsurface layer is dark grayish brown, mottled gravelly sandy loam about 1 inch thick. The upper part of the subsoil is dark brown, mottled gravelly sandy loam about 7 inches thick. The next layer is dark brown and brown, mottled sandy loam about 13 inches thick. The lower part of the subsoil is dark brown, mottled gravelly sandy loam about 10 inches thick. The upper part of the substratum is brown, mottled gravelly coarse sand about 8 inches thick. The lower part to a depth of about 60 inches is mostly

mottled strata of gray silt loam and reddish brown very fine sandy loam. In some areas the surface layer is sandy loam, fine sandy loam, or very fine sandy loam. In a few areas the lower part of the substratum is mostly stratified fine sand and loamy fine sand. In places the lower part of the substratum is within a depth of 40 inches, and in a few areas it is loamy glacial till or contains strata of gravelly or very gravelly sand.

Included with this soil in mapping are small areas of very poorly drained soils in depressions, the moderately well drained Padwood and well drained Padus soils on the higher parts of the landscape, and the somewhat poorly drained Worcester soils in areas where the underlying deposit is sand and gravel to a depth of at least 60 inches. Padus soils have a substratum of sand and gravel to a depth of about 60 inches. Also included are areas where the substratum is within a depth of 24 inches, narrow areas that have steep slopes, areas where the surface soil is loamy sand, and small ponds. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Worwood soil. It is rapid or very rapid in the upper part of the substratum and moderately slow in the lower part. Runoff is slow. The available water capacity is moderate. The content of organic matter in the surface layer also is moderate. The potential for frost action is high. The surface layer can be easily tilled throughout a wide range in moisture content. A perched seasonal high water table is at a depth of 0.5 foot to 2.0 feet. The rooting depth of some plants is limited by the perched seasonal high water table and, in places, by sand and gravel in the upper part of the substratum.

Most areas are used as woodland. The timber stands are mostly sugar maple, red maple, paper birch, quaking aspen, and balsam fir, but yellow birch and eastern hemlock are in most stands. The ground flora includes bunchberry dogwood, goldthread, smooth yellow violet, ladyfern, Canada mayflower, American starflower, rosy twistedstalk, wild sarsaparilla, beaked hazelnut, and yellow beadlily.

This soil is suited to trees. The main concerns affecting woodland management are the equipment limitation, seedling mortality, and the windthrow hazard. The use of equipment is restricted in the spring and in other excessively wet periods because of the seasonal high water table and low soil strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or when the ground is frozen. Logging roads and landings that have a gravel base can better withstand the repeated use of heavy equipment. Also, the landings can be established on adjacent or included soils that are better suited. Adequate culverts are needed on graveled roads to maintain the natural drainage system.

The seedling mortality resulting from soil wetness can be reduced by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the perched high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by using 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. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. The high water table in undrained areas limits yields and the kinds of crops that can be grown. Field ditches and tile drains can lower the water table. Because the substratum is unstable and may cave, the sides of the ditches should be flattened and continuous tubing should be used when tile drains are installed. Filters are needed to keep the fine particles of silt and sand in the substratum from clogging the drains. Drainage tile may be displaced by frost action. This displacement can be prevented by using continuous tubing or by installing the tile drains below the depth of freezing. The field ditches can be used as outlets for tile drains in areas where a suitable drainage outlet is not available.

If drained and cultivated, this soil is subject to soil blowing during dry periods. A conservation tillage system, such as chisel plowing, that leaves all or part of the crop residue on the surface, field borders, field windbreaks, and vegetative row barriers help to control soil blowing. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure improve fertility and help to control soil blowing.

This soil is suited to pasture. Alfalfa stands for improved pasture are difficult to establish and maintain unless the soil is drained. Excess water during wet periods may damage the forage. A cover of pasture plants is effective in controlling soil blowing. Overgrazing results in depletion of the plant cover and the growth of undesirable plant species. Proper stocking rates, rotation grazing, and pasture renovation help to keep the pasture in good condition. Clipping or mowing the pasture controls weeds and brush and results in a more uniform pattern of regrowth and grazing.

Topdressing with fertilizer helps to maintain a productive stand of forage.

This soil is generally unsuited to septic tank absorption fields and dwellings mainly because of the seasonal high water table. This limitation is difficult to overcome. A better site should be selected.

This soil is poorly suited to local roads because of the seasonal high water table and the risk of frost damage. These limitations can be overcome by adding a coarse base material to raise the roadbed above the level of wetness. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. Based on red maple productivity, the woodland ordination symbol is 3W. The habitat type commonly 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 Natural Resources Conservation Service.

About 276,800 acres in the survey area, or nearly 49 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the southern and western parts, mainly in associations 1, 2, 3, 5, and 6, which are described under the heading "General Soil Map Units." About 44,000 acres of this prime farmland is currently used for crops, mainly hay, oats, and corn.

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.

Accessibility Statement

The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The USDA Target Center can convert USDA information and documents into alternative formats, including Braille, large print, video description, diskette, and audiotape. For more information, visit the TARGET Center's Web site (http://www.targetcenter.dm.usda.gov/) or call (202) 720-2600 (Voice/TTY).

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).