United States
Department of
Agriculture

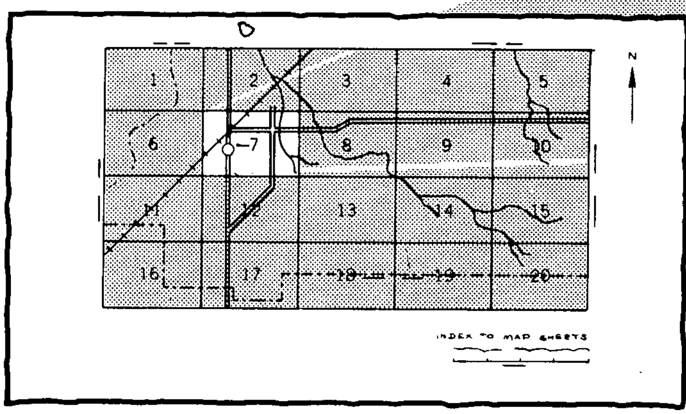
Soil
Conservation
Service

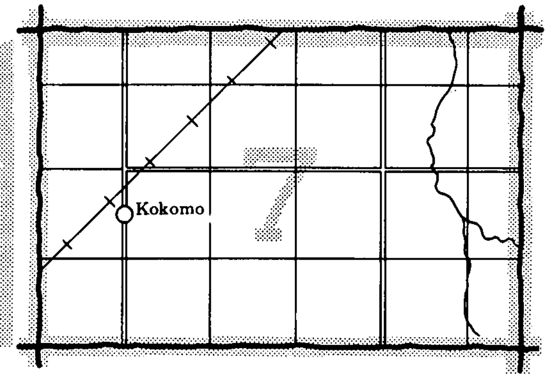
In cooperation with
United States Department of
Agriculture, Forest Service,
and the Research Division of
the College of Agricultural
and Life Sciences,
University of Wisconsin

Soil Survey of Langlade County, Wisconsin

HOW TO USE

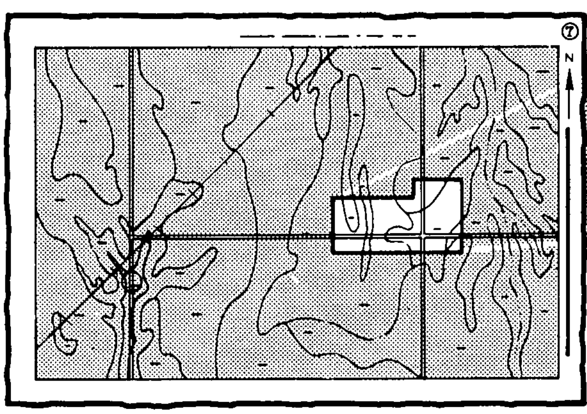
1. Locate your area of interest on the "Index to Map Sheets."

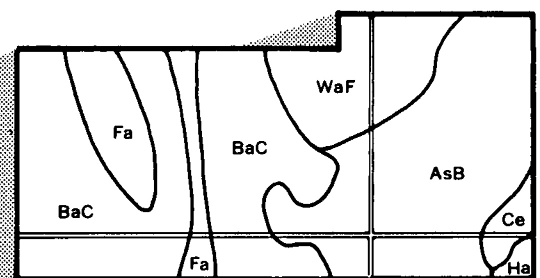




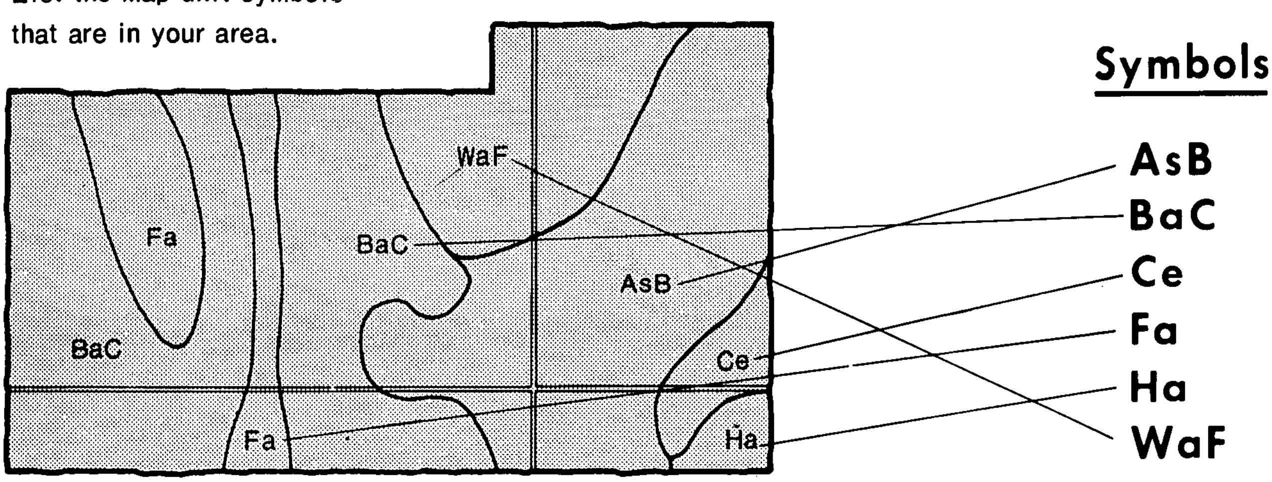
2. Note the number of the map sheet and turn to that sheet.

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



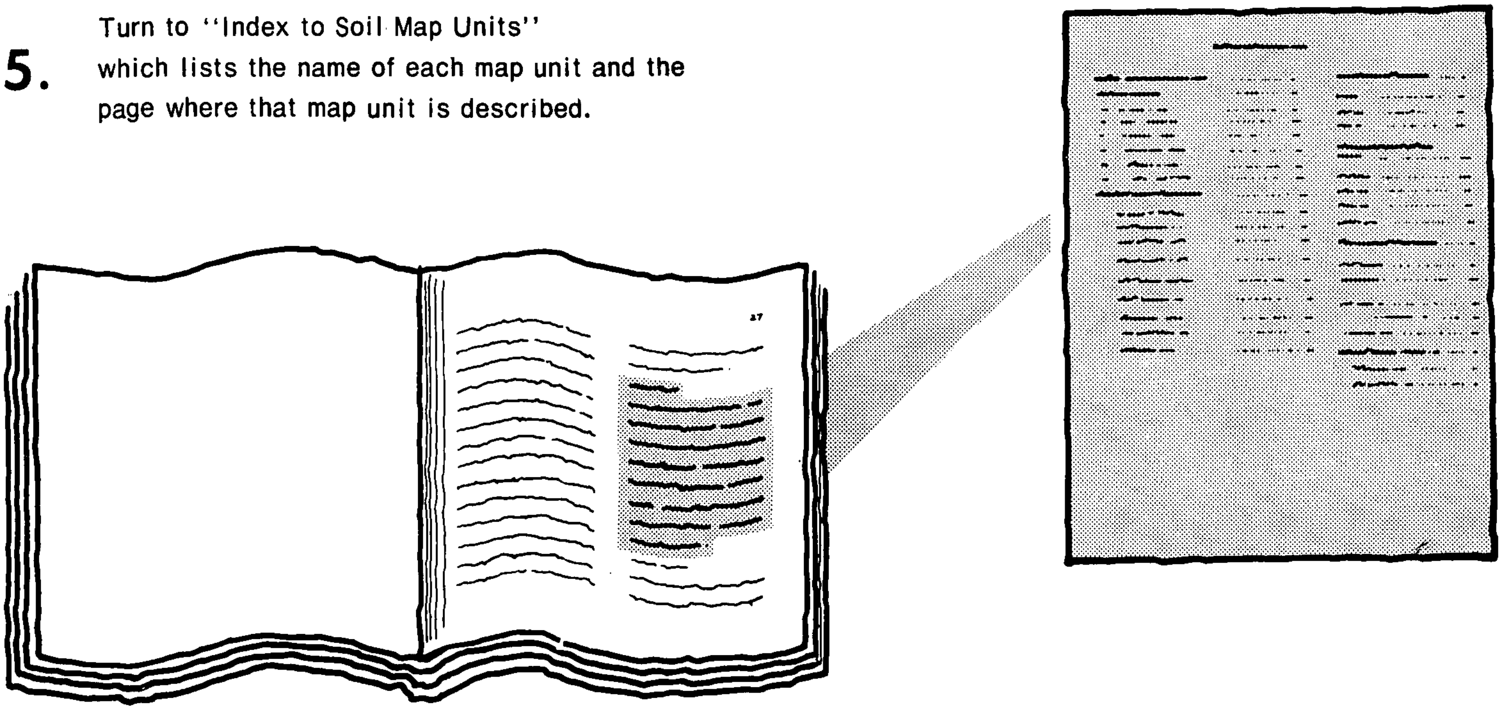


4. List the map unit symbols that are in your area.

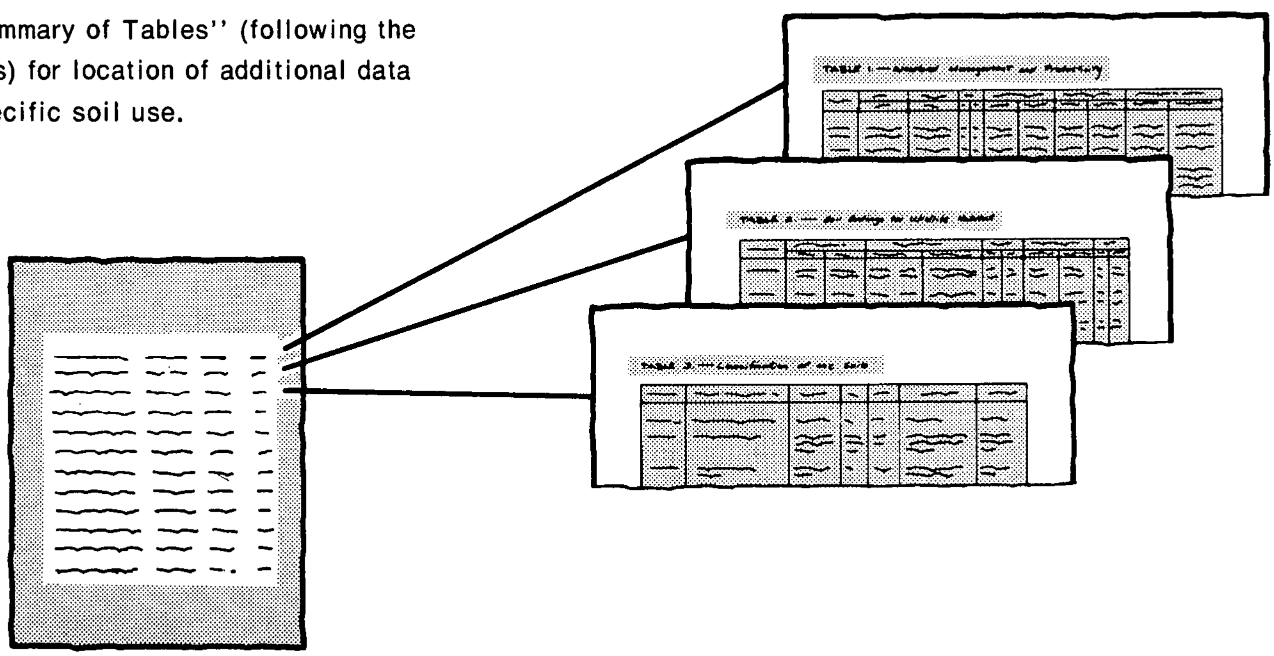


THIS SOIL SURVEY

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



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



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

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

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1984. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service, the Forest Service, and the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the Langlade 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.

Cover: Sap collection from sugar maple trees on a Langlade soil. Most of Langlade County is wooded.

Contents

Soil Series

Issued May 1986

Index to Map Units

Summary of Tables

Foreword

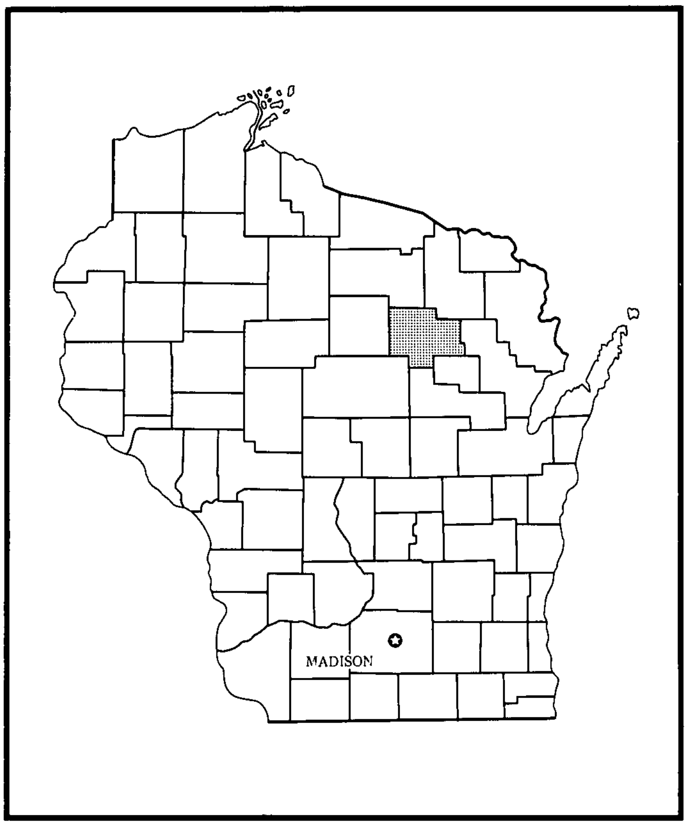
This soil survey contains information that can be used in land-planning programs in Langlade County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact 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 shallow to bedrock. 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 Soil Conservation Service or the Cooperative Extension Service.

Cliffton A. Maguire
State Conservationist
Soil Conservation Service



Location of Langlade County in Wisconsin.

Soil Survey of Langlade County, Wisconsin

By Michael J. Mitchell, Soil Conservation Service

Fieldwork by Kim C. Goerg, Michael J. Mitchell, and David L. Omernik, Soil Conservation Service, and L. Lindwall, D. Mayer, and E. Neumann, Forest Service

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

LANGLADE COUNTY is in the northeastern part of Wisconsin. It has a total area of 568,333 acres, of which 9,344 acres is water. About 30 percent of the county is publicly owned land, including about 39,680 acres of the Nicolet National Forest. Antigo, in the south-central part of the county, is the county seat. In 1980, it had a population of 8,653. In the same year, the county had a population of 19,978. It has 17 townships.

Agriculture, manufacturing, forestry, tourism, and recreational facilities provide Langlade County with a diversified economic base. The 355,795 wooded acres, 843 lakes, and 225 streams in the county are the basis of the businesses related to tourism and recreation. The strong retail trade in the county reflects purchases by tourists and other vacationers. Dairying, based mostly in the southern part of the county, is the major farming enterprise. The production of potatoes and snap beans, however, also is an important part of the economy. The principal feed crops on dairy farms are hay, oats, and corn. Most of the industry is related to processing agricultural and forest products.

This survey updates the soil survey of Langlade County published in 1947 (*4*). It provides additional information and larger, more detailed soil maps. The soil names may differ from those in the earlier survey because of a better knowledge of the soils and changes in soil concepts.

Most of the map units in Langlade County were designed to meet the needs of low-intensity land uses, such as forestry, because of the large acreages that are currently used for woodland and recreation. Many of these areas are publicly owned or are generally not suited to farming because of wetness, slope, stoniness, or a severe frost hazard.

General Nature of the County

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

Climate

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

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

Table 1 gives data on temperature and precipitation for the survey area as recorded at Antigo, Wisconsin, in the period 1951 to 1980. 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 16 degrees F, and the average daily minimum temperature is 6 degrees. The lowest temperature on record, which occurred at Antigo on January 18, 1967, is -39 degrees. The soils occasionally freeze to a depth of several feet during periods of very cold temperatures before the ground is appreciably covered with snow. Unless the snow cover is removed, the soils usually freeze only in the top few inches or to a depth of about 1 foot. In summer the average temperature is 66 degrees, and the average daily maximum temperature is 78 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 31.61 inches. Of this, 23 inches, or about 73 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 20 inches. The heaviest 1-day rainfall during the period of record was 5.16 inches at Antigo on August 22, 1959. Thunderstorms occur on about 35 days each year.

The average seasonal snowfall is about 54 inches. The greatest snow depth at any one time during the period of record was 32 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

The physiography, relief, and drainage of Langlade County are primarily the result of glaciation. The landscape is characterized mostly by moraines and outwash plains and partly by drumlins, eskers, kames, lake plains, bogs and other depressional areas where organic soils have formed, and alluvial deposits in drainageways. The moraines include the older drift area in the southwestern part of the county. The outwash plains include the Antigo Flats, a triangular area in the south-central part of the county.

The older drift area and the adjacent Antigo Flats encompass some of the smoothest land in the county. These areas were not covered by glacial ice during the most recent glaciation. Generally, the end moraines are the roughest terrain.

Slopes are short, complex, and mostly rolling to very steep on the moraines. In the older drift area, however, they are mostly long, smooth, and gently sloping. Most of the slopes on the lake plains and outwash plains are long, smooth, and nearly level or gently sloping. Some areas of outwash deposits near moraines, however, are rough and irregular and have short, complex slopes. Short, smooth slopes predominate on the eskers and kames. The areas of alluvium commonly are pitted and marked by old stream channels. The surface of most of the organic soils is hummocky.

Elevation ranges from about 1,070 feet above sea level in an area where the Wolf River leaves the county to about 1,903 feet above sea level in the northwestern part of sec. 21, T. 32 N., R. 13 E., in Langlade Township. The highest elevations are on the terminal moraines. Antigo is about 1,498 feet above sea level.

The eastern part of the county is within the drainage basin of the Wolf River, and the western part is within the drainage basin of the Wisconsin River. In Langlade County, the Wolf River starts at Lower Post Lake, flows generally south and east, and leaves the county just south of Markton. It drops about 440 feet in the county, mostly between Lily and Markton. Seven principal tributaries of this river are at least partly in the county. They are Swamp Creek, Pickerel Creek, Hunting River, Lily River, Ninemile Creek, Evergreen River, and Red River. Four principal tributaries of the Wisconsin River drain the western part of the county. They are the Prairie, Pine, Trappe, and Eau Claire Rivers.

The Antigo Flats are drained by Spring Brook, a tributary of the Eau Claire River, and by the east and west branches of the Eau Claire River. All of these streams drop about 7 feet per mile. The drainage valleys are large in relation to the size of the streams occupying them because of the large volume of glacial meltwater that they once carried.

Water Supply

Robert N. Cheetham, geologist, Soil Conservation Service, helped prepare this section.

Langlade County has abundant and readily available supplies of surface and ground water. Sources are the surface water from the 843 lakes and 225 streams and the ground water, which is primarily from glacial deposits.

Most of the lakes are spring lakes or seepage lakes. The others are drainage lakes or drained lakes (*11*). The majority of the lakes, including most of the spring lakes, known as spring ponds, are small. Only 13 lakes are 100 acres or larger, but these make up about half of the surface area of lakes. White Lake is the largest spring lake. Sawyer Lake and the other seepage lakes are landlocked. Upper Post Lake, an impoundment and a drainage lake, is the largest lake in the county. The deepest lake is Jack Lake, which is as much as 85 feet deep.

The streams in Langlade County have a total surface area of about 1,800 acres. The total stream length is about 513 miles. The largest body of water in the county is the Wolf River, which has a surface area of about 984 acres.

The surface water in the county is used mostly for recreational activities, partly for watering stock, and occasionally for irrigation. The quality of the water is generally good. Eutrophication is the only major pollution problem. During the summer, shallow water areas contain algae and weeds. The water is mostly clear or light brown. The landlocked lakes and the lakes and streams bordered by bogs or swamps are more acid than the other water areas. The spring lakes have the highest pH value. The water is predominantly very soft in the seepage lakes, drained lakes, and drainage lakes, but it is hard in the spring lakes and streams.

The ground water in the county meets municipal, industrial, rural, and irrigation needs. The largest consumer is Antigo. The source of this water is local precipitation. The average recharge from precipitation on 1 square mile of the Antigo Flats is about 256,000 gallons per day (*3*). The ground water generally moves southward. The water levels fluctuate closely with fluctuations in seasonal precipitation and in average precipitation over a period of years. The level generally rises in spring, declines in summer, rises slightly in fall, and declines in winter. Use of ground water for irrigation has caused a measurable decline in the level only in the immediate vicinity of the withdrawal. The depth to ground water ranges to as much as 138 feet. It is greatest beneath the hills on the moraines. On the Antigo Flats, it averages about 25 feet and is the greatest in the eastern part of the flats.

Ground water yields from the glacial deposits vary. Generally, the outwash yields more than the glacial till. The underlying crystalline bedrock yields little or no water.

Ground water quality in Langlade County is very good. Many of the soils, however, have very porous layers that are poor filters for domestic waste and agricultural chemicals. The impact of development and agriculture may cause deterioration of the ground water. Generally, the content of dissolved solids in the ground water is relatively low in the western half of the county and relatively high in the eastern half. The higher content in the eastern part probably results from a higher content of limestone in the glacial deposits.

History and Settlement

The original inhabitants of Langlade County included Chippewa, Menominee, Pottawattomie, Sac, Ottawa, Huron, and Winnebago Indians. French fur traders and trappers, accompanied by Jesuit priests, entered the area during the 1700's, followed by the British and Scotch (*16*). They came from the settlements at Green Bay, followed the Lake Superior Indian Trail along the Wolf River, and established a trading post at Post Lake. Langlade County is named after Charles de Langlade, a French trader who never saw the county.

The first known settlement was established in the eastern part of Ackley Township in 1853 by Willard L. Ackley. His farm and trading post became a headquarters for early settlers. 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.

Francis A. Deleglise, a lumberman, surveyor, and real estate dealer, persuaded early settlers to locate at Springbrook Settlement about 1876. This settlement was later called Antigo. Eastern Langlade County was opened to loggers and settlers when Old Military Road was constructed along the Wolf River during the 1860's. The roadbuilders were paid in land grants. Many of these grants were subsequently bought by Squire Taylor, who persuaded settlers to move into the area and buy his land. In 1872, one of the earliest settlements in this area was established near the present village of Langlade.

Settlement increased rapidly after a railroad was built in the area in 1881. The railroad opened markets for all kinds of forest and farm products.

Langlade County was established in 1879 from part of Oconto County and was known as New County until 1880. Norwood and Rolling Townships joined the county in 1881. Evergreen, Langlade, and Wolf River Townships joined in 1883. The present boundaries were established in 1885.

Farming

Farming in Langlade County began as an auxiliary to lumbering. Clearings were made in areas where oxen could graze and wild hay could be cut. These areas were later used for other kinds of feed and produce for the oxen and loggers. The oxen were used as draft animals in lumbering.

The first farm was established in 1853. Some of the earliest farming took place in the valley of the Wolf River, close to the logging camps, which offered a ready market for feed and produce. Most farmers worked in the logging camps in winter and enlarged and cultivated their cropland in summer. Some traveled south to cities for winter employment. The farmers used their winter earnings to improve their farms.

Farming progressed slowly until 1881, when the arrival of the railroad opened markets for farm products. There were only 97 farms in 1880. These averaged 148 acres in size. Oats was the major crop, but potatoes and wheat were also grown. By 1900, additional crops included hay and barley.

Most early farmers kept a few cows for milk, which was also converted to butter and cottage cheese. Dairying started with the sale of surplus butter. By 1900, most

Figure 1.—Harvest of certified seed potatoes on a Langlade soil.

farmers had herds of milk cows and dairying became a major farming enterprise. Most of the dairy output was marketed as cheese. Milk production increased sharply after 1924, when a large cheese plant opened and milk was collected by truck.

Dairying is still the main farming enterprise. The trend is toward fewer dairy farms and larger herds, more productive livestock, and more efficient husbandry. In recent years the number of milk cows has decreased, but milk production has increased. The number of hogs and chickens and the production of eggs have decreased. The number of sheep has remained constant.

Potato farming has always been an important part of agriculture in the county. Potatoes were grown by the first settler. The production of this crop reached a peak in 1930, when numerous small areas totaling 13,000 acres were used for potatoes. Later, mechanization tended to concentrate the enterprise among fewer growers and larger production units. Yields increased because of improved cultural practices, heavy applications of fertilizer, and systematic rotation. Irrigation also increased yields. In recent years more growers have turned to the production of certified seed potatoes (fig. 1). Potatoes are by far the most important cash crop in the county.

About 27 percent of the acreage in the county was farmed in 1980. Following the trend in the state, the number of farms declined between 1935 and 1980 and the average farm size increased.

Forestry

The forests of Langlade County were exploited soon after the Menominee Indians relinquished the land by the Treaty of Cedars during the 1830's. Lumbering began along the Wolf and Eau Claire Rivers as early as 1860. It became more extensive along the Wolf River when Old Military Road was constructed during the late 1860's. White pine was cut first, and hardwoods were cut later. Logs were floated downstream to sawmills in Oshkosh and Wausau. River channels were altered and dams were built to facilitate the movement of logs. Later, the logs were hauled by horses and railroads to local sawmills.

The arrival of the railroad in 1881 opened up the entire region to logging throughout the year. Logs were transported by 13 railroad routes run by lumber companies before the last route was shut down in 1944.

Lumbering has remained a major enterprise in the county. Large areas of forest land, including that owned by the county, are now managed for cordwood production (fig. 2). The pulpwood, mostly aspen and birch, is cut and hauled to paper mills by many private logging companies. Most sawlogs are hauled to local sawmills. Langlade County is one of the major producers of sawlogs and veneer logs in the state.

Many owners of conifer plantations prune and harvest Christmas trees, mostly balsam fir, white spruce, and red pine. The trees are sold locally and are also hauled to southern markets. Conifer boughs, mostly balsam fir, are harvested by private individuals from plantations and native stands for use as Christmas trimmings. Many are sold in southern markets.

Sugar maple sap collection and syrup production are also important forestry enterprises. 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.

The amount of hardwood poletimber used for firewood has increased rapidly in recent years because of the rising cost of other types of fuel. In 1982, about 20 percent of the hardwood poletimber cut from county-owned forests was marketed as firewood.

Most of the forest land in the county was commercial forest in 1968. The forest land is owned mostly by forest industries, corporations, and county and municipal governments and partly by private individuals and state and

Figure 2.—Pulpwood harvest on an Antigo soil. Many areas of forest in the county are managed for even-aged stands of aspen and birch for pulpwood.

federal governments. The trend is toward less public and more private ownership (*10, 18*).

Transportation Facilities and Industry

Langlade County has a good system of highways. U.S. Highway 45 and State Highways 47, 52, and 64 provide easy access to the county. About two-thirds of the county roads are paved, but many remote areas have few good motor roads. Examples are the western part of Ackley Township and the moraine areas in the northern part of the county. Many of these remote areas have old logging roads that permit access by specialized vehicles.

The county also is served by two railroads, an airport, four motor freight carriers, and one bus line. One railroad provides access to Antigo from the north and south, and the other provides access to the eastern part of the county from the north and south. Major commercial air transportation is available at the airport near Wausau, in Marathon County. Smaller aircraft can use the Langlade County Airport, which is near Antigo.

Industry and retail trade businesses are important parts of the economy in Langlade County. They surpassed the farming industry as leading employers about 1970. Sales in the retail trade businesses are higher than the state average.

Most industry is related to processing forest and agricultural products. Four sawmills currently produce lumber. Other industry produces maple syrup, bowling pins, hardwood flooring, pallets, and parts for brooms and folding chairs. Many logging companies also operate in the county. Agriculture-related industry currently produces cheese, dried cheese powder, dried whey powder, butter, ice cream, milk for marketing, and canned snap beans.

Some industry produces shell cases for ammunition, shoes, babbitt bearings, gears and related products, steel products, and fishing tackle. Other industry is involved in construction and printing. One industry wires transformers and car coils.

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 biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the 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 considerable 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, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were 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 were 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 state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

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

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several 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

Figure 3.—A wet spot included in an area of the well drained Kennan soils. Generally, such contrasting inclusions are indicated on the soil maps by a special symbol.

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. 3). 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 broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in 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 map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The general soil map units in Langlade County join with similar map units that may have different names in adjacent counties. These differences result from variations in the extent or pattern of the soils in the counties. The differences do not significantly affect the use of the maps for general planning.

1. Kennan-Keweenaw

Well drained, undulating to very steep, stony, loamy and silty soils on moraines and drumlins

This map unit consists mostly of soils on terminal and recessional end moraines and partly of soils on ground moraines and drumlins. Large stones are common on the surface of most areas (fig. 4). The end moraines have the highest elevations and the roughest terrain in the county. The knolls, 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. The ground moraines have little local relief. The linear or oval drumlins have crests that are higher than the surrounding landscape. Slopes are mostly short and complex.

This map unit makes up about 33 percent of the land area in the county. It is about 49 percent Kennan soils, 33 percent Keweenaw soils, and 18 percent soils of minor extent.

Kennan soils are undulating and rolling. They are on knolls, swells, hills, ridges, and drumlins. Typically, the surface layer is black loam about 2 inches thick. The next layer is brown and dark brown loam about 17 inches thick. The subsoil is about 27 inches thick. It is dark brown, friable loam in the upper part and reddish brown, very friable sandy loam in the lower part. The substratum to a depth of about 60 inches is brown loamy sand.

Keweenaw soils are hilly to very steep. They are on hills and ridges and on the sides of drumlins. Typically, the surface layer is black sandy loam about 2 inches thick. The subsurface layer is brown loamy sand about 3 inches thick. The subsoil is about 11 inches thick. It is dark reddish brown, very friable gravelly loamy sand in the upper part and dark brown, very friable loamy sand in the lower part. The next layer is about 37 inches thick. It is a mixture of brown loamy sand and reddish brown sandy loam. The substratum to a depth of about 60 inches is brown gravelly loamy sand.

The minor soils include Crystal Lake, Hatley, Loxley, Menominee, and Seelyeville. The moderately well drained Crystal Lake and Menominee soils are in lake basins. The somewhat poorly drained Hatley soils are on small swells or knolls within low areas. The organic Loxley and Seelyeville soils are in kettles and lake basins.

Most of the acreage is woodland, including a few small, wooded swamps. The upland woods are mostly areas of stony, rolling to very steep soils. The main concerns in managing woodland are the restricted use of machinery, erosion, seedling survival, and competing plants that interfere with tree regeneration.

In some areas the soils are used for farming. Dairying is the main farm enterprise. The major crops are oats, alfalfa, and corn. They are grown mostly on the less sloping soils. Stones that interfere with tillage are removed from the cropland. Some areas are used as permanent pasture. The main concerns in managing cropland are soil blowing and low fertility on the Keweenaw soils and water erosion and stoniness on both of the major soils. Applications of lime are needed for most crops.

Many farmsteads, rural homes, and cottages and a few villages and landfills are in areas of this map unit. Sanitary facilities and building site development are generally limited by large stones and slope. Local roads and streets on the Kennan soils may be damaged by frost heave. This map unit has more good sites for landfills than the other map units in the county.

Figure 4.—Large stones on the surface in an area of the Kennan-Keweenaw map unit.

2. Antigo-Pence

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

This map unit consists mostly of soils on rather flat outwash plains that are pitted with kettles and interspersed with hills and ridges of outwash deposits. Some of the hills and ridges are kames and eskers. Many streams and lakes are in areas of this unit. Basins, drainageways, and valleys are on the outwash plains. The kettles are generally small and are very numerous in some areas. Many contain lakes, ponds, bogs, or swamps. Some of the outwash areas are made up of knolls, swells, hills, and ridges and are characterized by undulating to hilly topography.

This map unit makes up about 38 percent of the land area in the county. It is about 41 percent Antigo soils, 24 percent Pence soils, and 35 percent soils of minor extent.

Antigo soils are nearly level to rolling. They are on knolls, swells, hills, ridges, and upland flats and on the sides of drainageways, valleys, kettles, and basins. Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The next layer is dark yellowish brown and brown silt loam about 7 inches thick. The subsoil is about 14 inches thick. It is dark yellowish brown, friable silt loam in the upper part and dark yellowish brown, friable loam and dark brown, very friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is brown, stratified sand and gravel.

Pence soils are nearly level to very steep. They are on knolls, swells, hills, ridges, and upland flats and on the sides of drainageways, valleys, kettles, and basins. Typically, the surface layer is black 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 reddish brown, very friable gravelly sandy loam in the upper part and dark brown gravelly loamy sand and gravelly sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel.

The minor soils include Au Gres, Cathro, Fordum, Loxley, Markey, Oesterle, Seelyeville, and Vilas. The somewhat poorly drained Au Gres and Oesterle soils are on low flats and in upland swales and drainageways. The organic Cathro, Loxley, Markey, and Seelyeville soils are in drainageways, kettles, and basins. The alluvial Fordum soils are on flood plains and in drainageways. The sandy Vilas soils are on knolls, swells, ridges, and upland flats and on the sides of drainageways, valleys, kettles, and basins.

Most of the acreage is woodland, including some wooded swamps. The upland woods are mostly areas of sloping or rolling to very steep soils. The main concerns in managing woodland are the restricted use of machinery, erosion, seedling survival, and competing plants that interfere with tree regeneration.

In some areas the soils are used for farming. Dairying and potato farming are the main farm enterprises. The major crops are oats, alfalfa, corn, red clover, and potatoes. Most of the acreage used for potatoes is irrigated. The crops are grown mostly on the less sloping soils. Some areas are used as permanent pasture. The main concerns in managing cropland are soil blowing and low fertility on the Pence soils, water erosion on both of the major soils, and crusting of the surface layer in the Antigo soils. Applications of lime are needed for most crops. Coarse gravel and cobbles in the surface layer interfere with potato harvesting.

Many farmsteads, rural homes, and cottages and a few villages and landfills are in areas of this map unit. Generally, the soils have few limitations for 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 and streets on the Antigo soils may be damaged by frost heave. The substratum of both the major soils is a probable source of sand and gravel.

3. Magnor-Cable

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

This map unit consists mostly of soils on ground moraines that have little local relief and few prominent features. The landscape is one of broad swells with long side slopes interspersed with long drainageways that broaden into large basins in places. Small swells or knolls are within some of the basins. The drainageways are frequently ponded during wet periods. Many streams and a few hills and manmade impoundments are in areas of this unit. Slopes are mostly long and smooth.

This map unit makes up about 10 percent of the land area in the county. It is about 77 percent Magnor soils, 15 percent Cable soils, and 8 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 4 inches thick. The subsurface layer is dark grayish brown, mottled silt loam about 2 inches thick. The next layer is brown, yellowish brown, and dark brown, mottled silt loam about 14 inches thick. The subsoil is dark brown and reddish brown, mottled sandy loam about 10 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, firm, very compact sandy loam.

Cable soils are very poorly drained and are nearly level. They are in drainageways, basins, and upland swales. Typically, the surface layer is about 7 inches thick. It is very dark brown and black muck in the upper part and very dark gray, mottled silt loam in the lower part. The subsoil is about 31 inches thick. It is dark grayish brown and grayish brown, mottled, friable silt loam in the upper part; grayish brown, mottled, friable loam in the next part; and brown and reddish brown, mottled, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled sandy loam.

The minor soils include the well drained Amery soils on the sides of valleys and basins and on the sides of the highest swells and hills and the organic Cathro and Seelyeville soils in drainageways and basins.

Most of the acreage is woodland, including many wooded swamps. Large woodlots are common. The main concerns in managing woodland are the restricted use of machinery, windthrow, seedling survival, and competing plants that interfere with tree regeneration. Most of the logging trails are rutted because of wetness.

In some areas the soils are used for farming. Dairying is the main farm enterprise. The major crops are oats, red clover, and forage grasses. They are grown mostly on soils that have good surface drainage. Some areas are used as permanent pasture. The main concerns in managing cropland are wetness, water erosion, and crusting of the surface layer. Applications of lime are needed for most crops.

Many farmsteads and a few villages, rural homes, cottages, and landfills are in areas of this map unit. Sanitary facilities, building site development, and roadways are generally limited by wetness or ponding. Also, restricted permeability limits the use of the soils for sanitary facilities, and frost heave may damage local roads and streets.

4. Oesterle-Minocqua-Scott Lake

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

This map unit is on outwash plains where most of the soils have a seasonal high water table. The landscape is one of 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 and a few lakes are in areas of this unit. Slopes are mostly long and smooth.

This map unit makes up about 9 percent of the land area in the county. It is about 33 percent Oesterle soils, 22 percent Minocqua soils, 16 percent Scott Lake soils, and 29 percent soils of minor extent.

Oesterle soils are somewhat poorly drained. 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 also is silt loam about 4 inches thick. It is grayish brown and mottled. The next layer is brown and dark brown, mottled silt loam about 16 inches thick. The subsoil is about 8 inches thick. It is dark brown, mottled, friable loam in the upper part and dark brown, mottled, very friable gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is brown, stratified sand and gravel.

Minocqua soils are very poorly drained. 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 subsoil is about 31 inches thick. It is gray, dark gray, and grayish brown, mottled silt loam in the upper part; grayish brown, mottled, friable loam in the next part; and grayish brown, mottled, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is brown, stratified sand and gravel.

Scott Lake soils are moderately well drained. They are on rather 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 5 inches thick. The next layer is dark yellowish brown and brown silt loam about 14 inches thick. The subsoil is about 20 inches thick. It is dark yellowish brown, mottled, friable silt loam and loam in the upper part and dark brown, mottled, very friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel.

The minor soils include the well drained Antigo soils on upland flats, the organic Cathro and Seelyeville soils in drainageways and basins, and the alluvial Fordum soils in drainageways adjacent to streams.

Most of the acreage is woodland, including many wooded swamps. Large woodlots are common. The main concerns in managing woodland are the restricted use of machinery, windthrow, seedling survival, and competing plants that interfere with tree regeneration. Most of the logging trails are rutted because of wetness.

In some areas the soils are used for farming. Dairying is the main farm enterprise. The major crops are oats, red clover, potatoes, and forage grasses. Most of the acreage used for potatoes is irrigated. The crops are grown mostly on the higher lying soils. Some areas are used as permanent pasture. The main concerns in managing cropland are wetness and crusting of the surface layer. Applications of lime are needed for most crops. Coarse gravel and cobbles in the surface layer interfere with potato harvesting.

Many farmsteads and a few villages, rural homes, and cottages are in areas of this map unit. Sanitary facilities, building site development, and roadways are generally limited 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 and streets may be damaged by frost heave.

5. Antigo-Langlade

Well drained, nearly level and gently sloping, silty soils on outwash plains

This map unit is part of a large, roughly triangular outwash plain that is called the Antigo Flats. Areas are broad and are rather flat, except for a few knolls, swells, swales, the foot slopes bordering terminal moraines, drainageways, and valleys. The one major valley, which is along Spring Brook, is very long, flat floored, and frequently flooded during wet periods. Secondary valleys or drainageways carry runoff to Spring Brook. Slopes are mostly long and smooth.

This map unit makes up about 8 percent of the land area in the county. It is about 57 percent Antigo soils, 27 percent Langlade soils, and 16 percent soils of minor extent.

Antigo soils are on broad upland flats and on the sides of drainageways. Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The next layer is dark yellowish brown and brown silt loam about 7 inches thick. The subsoil is about 14 inches thick. It is dark yellowish brown, friable silt loam in the upper part and dark yellowish brown, friable loam and dark brown, very friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is brown, stratified sand and gravel.

Langlade soils are on broad upland flats and on the foot slopes bordering terminal moraines. Typically, the surface layer is dark grayish brown silt loam about 12 inches thick. The subsurface layer is brown silt loam about 2 inches thick. The next layer is dark yellowish brown and brown silt loam about 8 inches thick. The subsoil is about 31 inches thick. It is dark yellowish brown, friable silt loam and loam in the upper part and dark yellowish brown, friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel.

The minor soils include the alluvial Fordum soils in the valley adjacent to Spring Brook; the somewhat poorly drained Oesterle soils in upland swales and drainageways; and the droughty Pence soils on shoulder slopes of upland flats, on knolls and swells, and on the sides of drainageways and valleys.

Some of the acreage is woodland, including a few small, wooded swamps. The upland woods are mostly areas of sloping soils and soils bordering terminal moraines. Some small woodlots are on broad flats. The main concern in managing woodland is controlling competing plants that interfere with tree regeneration.

In most areas the soils are used for farming. They are the most intensively farmed soils in the county. Dairying and potato farming are the main enterprises. The major crops are oats, alfalfa, red clover, potatoes, and corn. Most of the acreage used for potatoes is irrigated. Some areas are used as permanent pasture. The main concerns in managing cropland are water erosion and crusting of the surface layer. Applications of lime are needed for most crops. Coarse gravel and cobbles in the surface layer interfere with potato harvesting.

Many farmsteads and rural homes, a city, and a few villages and landfills are in areas of this map unit. Generally, the soils have few limitations for sanitary facilities or building site development. The effluent from waste disposal facilities, however, can pollute ground water because of the poor filtering capacity of the substratum. Also, local roads and streets may be damaged by frost heave. The substratum of the soils is a probable source of sand and gravel.

6. Milladore-Sherry-Mylrea

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

This map unit consists of soils on ground moraines that have little local relief and few prominent features. Granite bedrock is close to the surface. The landscape is one of broad swells with long side slopes interspersed with long drainageways that broaden into large basins in places. The drainageways are frequently ponded during wet periods. A few streams and manmade impoundments are in areas of this unit. Slopes are mostly long and smooth.

This map unit makes up about 2 percent of the land area in the county. It is about 32 percent Milladore soils, 31 percent Sherry soils, 27 percent Mylrea soils, and 10 percent soils of minor extent.

Milladore soils are somewhat poorly drained and are nearly level and gently sloping. They are on broad swells and on small swells on knolls within depressional areas. Typically, the surface layer is black silt loam about 3 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 8 inches thick. Below this is grayish brown and brown, mottled loam about 4 inches thick. The subsoil is about 25 inches thick. It is dark brown, mottled, very friable loamy sand in the upper part; gray, mottled, firm, very compact clay loam in the next part; and reddish brown, mottled, firm, very compact sandy clay loam in the lower part. The substratum to a depth of about 60 inches is yellowish red and olive, mottled, firm, very compact sandy loam.

Sherry soils are very poorly drained and are nearly level. They are in drainageways, basins, and upland swales. Typically, the surface layer is about 8 inches thick. It is black muck in the upper part and very dark gray, mottled silt loam in the lower part. The subsoil is about 35 inches thick. It is dark gray and gray, mottled silt loam and loam in the upper part and olive gray, mottled, firm, very compact sandy loam in the lower part. The substratum to a depth of about 60 inches is olive gray, mottled, firm, very compact sandy clay loam and sandy loam.

Mylrea soils are somewhat poorly drained and are nearly level and gently sloping. They are on broad swells and on small swells or knolls within depressional areas. Typically, the surface layer is black silt loam about 3 inches thick. The subsurface layer is dark grayish brown and brown silt loam about 8 inches thick. The next layer is brown and dark yellowish brown, mottled silt loam about 4 inches thick. The subsoil is about 33 inches thick. In descending sequence, it is grayish brown, mottled, friable silt loam; dark brown, mottled, friable sandy loam; dark brown, mottled, firm loam and gravelly loam; and brown, mottled, friable very gravelly sandy loam. The substratum to a depth of about 60 inches is pale brown, mottled very gravelly sandy loam.

The minor soils include the organic Cathro and Seelyeville soils in drainageways and basins.

This map unit is not used for farming because the land is mostly in public ownership. Most of the acreage is woodland, including many wooded swamps. Large woodlots are common. The main concerns in managing woodland include the restricted use of machinery, windthrow, seedling survival, and competing plants that interfere with tree regeneration. Most of the logging trails are rutted because of wetness.

A few farmsteads and rural homes are in areas of this map unit. Sanitary facilities, building site development, and roadways are generally limited by wetness or ponding. Restricted permeability limits the use of Milladore and Sherry soils for sanitary facilities. Granite bedrock can restrict excavations. Local roads and streets may be damaged by frost heave. This map unit is a more likely source of nearly impervious soil material for lining lagoons and landfills than the other map units in the county.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, 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, 0 to 2 percent slopes, is one of several phases in the Antigo series.

Some map units are made up of two or more major soils. These map units are called undifferentiated groups. 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. Seelyeville, Cathro, and Markey mucks 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.

The detailed soil map units in Langlade County join with similar map units that may have different names in adjacent counties. These differences result partly from variations in the extent and pattern of the soils in the counties. Some of the names are different because the map units in Langlade County were designed primarily for woodland use and those in some adjacent counties were designed mostly for another land use, such as farming. None of the differences significantly affect the use of the detailed 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

AmC—Amery loam, 6 to 15 percent slopes. This sloping, well drained soil is on the sides of valleys and basins and on the sides of the highest swells and hills. Slopes are short and smooth. Areas are long and narrow and range from about 5 to 80 acres.

Typically, the surface layer is very dark gray loam about 3 inches thick. The subsurface layer is dark grayish brown loam about 1 inch thick. The next layer is dark yellowish brown and brown loam about 14 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark yellowish brown, friable gravelly sandy loam. The lower part is dark brown and strong brown, friable loamy sand that has thin layers of sand and sandy loam. In places the upper layers are silt loam. In some small areas the slope is less than 6 percent. In places the subsoil is very gravelly.

Included with this soil in mapping are small areas of the moderately well drained Freeon soils on the less sloping parts of the landscape. Also included are small gravel pits. Included areas make up less than 5 percent of the map unit.

Permeability is moderate in the Amery soil. Runoff is medium. The available water capacity is moderate. The subsoil is slightly acid to very strongly acid. Organic matter content 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.

Most areas are used as woodland. Some are used as cropland or pasture.

This soil is suited to trees. The timber stands are mostly sugar maple, but American elm, aspen, American basswood, white ash, yellow birch, and black cherry are in most stands. Northern red oak, paper birch, white spruce, eastern white pine, balsam fir, and eastern hemlock are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mainly of aspen and birch. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated, it is subject to erosion. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, diversions, and grassed waterways 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, help to prevent excessive erosion, improve fertility, and conserve the water available for good plant growth.

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

This soil is only moderately suited to septic tank absorption fields and dwellings, mainly because of the slope. It is only moderately suited to local roads because of the slope and the danger of frost damage. Lateral seepage and 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. Also, 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 textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIIe. The woodland ordination symbol is 2a.

AoA—Antigo silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is on broad flats and on small flats within depressional areas. It is pitted in places. Areas are irregularly shaped and range from about 10 to 5,000 acres.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The next layer is brown and dark yellowish brown silt loam about 7 inches thick. The subsoil is about 14 inches thick. It is dark yellowish brown, friable silt loam in the upper part and dark yellowish brown, friable loam and dark brown, very friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is brown, stratified sand and gravel. The surface layer is loam in some areas. In some places the substratum is at a depth of more than 40 inches, and in other places it has thin layers of loamy material.

Included with this soil in mapping are small areas of Oesterle, Pence, and Scott Lake soils. The somewhat poorly drained Oesterle soils and the moderately well drained Scott Lake soils are in swales and drainageways. Pence soils are in landscape positions similar to those of the Antigo soil. They are droughty and have a sandy loam surface soil that is subject to soil blowing. Also included are areas where the soils are underlain by stratified sand and gravel within a depth of 20 inches, small ponds, stony areas, depressions, wet spots, gravel pits, areas that have been cut or filled, and some small erosive areas where the slope is more than 3 percent. Included areas make up less than 10 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. The available water capacity is moderate. The subsoil is slightly acid to very strongly acid. 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. The rooting depth for some plants is limited by the sand and gravel substratum.

Most areas are used as cropland. Some are used as pasture or woodland. The cropland commonly is irrigated if the crop is potatoes or snap beans. The substratum is a probable source of sand and gravel (fig. 5).

This soil is suited to trees. The timber stands are mostly sugar maple, but American elm, aspen, eastern white pine, white ash, black cherry, yellow birch, and American basswood are in most stands. Balsam fir, paper birch, white spruce, eastern hemlock, and northern red oak are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mainly of aspen and birch. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to corn, vegetable crops, and small grain and to grasses and legumes for hay and pasture. Irrigation commonly is needed in areas used for potatoes and snap beans. If the soil is irrigated, the infiltration rate may decrease because the surface layer puddles and forms a crust as it dries, and water may pond in swales and furrows. The infiltration rate is also reduced when heavy harvesting machinery compacts the soil. Land smoothing helps to prevent the crop damage caused by ponding. Chisel plowing helps to loosen compacted soil. Field windbreaks and vegetative row barriers, which help to deflect the force of the wind, permit sprinkler irrigation systems to apply water evenly and efficiently and reduce water loss by evaporation.

Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching increase the infil-

Figure 5.—An area of Antigo silt loam, 0 to 2 percent slopes, used as a source of sand and gravel. Most of the gravel pits in the county are in areas of Antigo soils.

tration 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 good plant growth. Separating the coarse gravel and cobbles in the surface layer from potatoes is difficult during harvest (fig. 6).

This soil is suited to pasture. Overgrazing or grazing when the soil is wet results in surface compaction, loss of plant cover, and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform 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 can result in the pollution of ground water. The soil is suited to dwellings, but the substratum may cave if excavated. The soil is poorly suited to local roads because of the danger of frost damage. This damage can be prevented, however, by replacing the upper part of the soil with coarse textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIs in nonirrigated areas and I in irrigated areas. The woodland ordination symbol is 1a.

AoB—Antigo silt loam, 2 to 6 percent slopes. This gently sloping or undulating, well drained soil is on small swells or knolls and on the sides of drainageways, kettles, and basins. It is pitted in places. Slopes are long and smooth or short and complex. Areas are elongated or irregularly shaped and range from about 10 to 800 acres.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is grayish brown silt loam about 2 inches thick. The next layer is dark yellowish brown and brown silt loam and loam about 22 inches thick. The subsoil is about 12 inches thick. It is dark yellowish brown, friable loam in the upper part and dark brown sandy loam and gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel. In some areas the surface layer is loam. In other areas the slope is less than 2 percent. In some places

Figure 6.—Coarse gravel and cobbles on the surface of Antigo silt loam, 0 to 2 percent slopes.

the substratum has thin layers of loamy material. In other places it is below a depth of 40 inches.

Included with this soil in mapping are small areas of Oesterle, Pence, and Scott Lake soils. The somewhat poorly drained Oesterle and moderately well drained Scott Lake soils are in swales and drainageways. Pence soils are in positions on the landscape similar to those of the Antigo soil. They are droughty and have a sandy loam surface soil that is subject to soil blowing. Also included are areas where the soils are underlain by stratified sand and gravel within a depth of 20 inches, small depressions, stony areas, wet spots, ponds, gravel pits, areas that have been cut or filled, and some small areas where the slope is more than 6 percent. 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 subsoil is slightly acid to very strongly acid. 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. The rooting depth for some plants is limited by the sand and gravel substratum.

Most areas are used as woodland. Some areas are used as cropland or pasture. The cropland commonly is irrigated if the crop is potatoes or snap beans. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The timber stands are mostly sugar maple, but American elm, aspen, white ash, black cherry, yellow birch, and American basswood are in most stands. Balsam fir, paper birch, white spruce, eastern white pine, eastern hemlock, northern red oak, red pine, and jack pine are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mainly of aspen and birch. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to corn, vegetable crops, and small grain and to grasses and legumes for hay and pasture. If cultivated, it is subject to erosion. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, diversions, and grassed waterways help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. The sand and gravel substratum is droughty and may be difficult to vegetate if exposed during the construction of diversions, grassed waterways, or terraces. Irrigation commonly is needed in areas used for potatoes and snap beans. Because of the slope, however, obtaining an even distribution of water, fertilizer, and herbicide through the irrigation system is difficult. If the soil is irrigated, the infiltration rate may decrease because the surface layer puddles and forms a crust as it dries, and water may pond in swales. The decreased infiltration rate increases the runoff rate and the susceptibility to erosion. The infiltration rate is also reduced when heavy harvesting machinery compacts the soil. Chisel plowing helps to loosen compacted soil. Field windbreaks and vegetative row barriers, which help to deflect the force of the wind, permit sprinkler irrigation systems to apply water evenly and efficiently and reduce water loss by evaporation.

Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching help to prevent excessive water erosion, improve fertility, conserve the water available for good plant growth, 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. Separating the coarse gravel and cobbles in the surface layer from potatoes is difficult during harvest.

This soil is suited to pasture. A cover of pasture plants is effective in controlling water erosion. Overgrazing or grazing when the soil is wet results in surface compaction, loss of plant cover, and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform 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 can result in the pollution of ground water. The soil is suited to dwellings, but the substratum may cave if excavated. The soil is poorly suited to local roads because of the danger of frost damage. This damage can be prevented, however, by replacing the upper part of the soil with coarse textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. The woodland ordination symbol is 1a.

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 basins. Slopes are short and are smooth or complex. Areas are elongated or irregularly shaped and range from about 10 to 800 acres.

Typically, the surface layer is black 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, yellowish brown, brown, and dark brown silt loam about 12 inches thick. The subsoil is about 21 inches thick. It is dominantly dark brown loam, sandy loam, and gravelly loamy sand but has thin layers of sand in the lower part. The substratum to a depth of about 60 inches is brown, stratified sand and gravel. In some areas the surface layer is loam. In other areas the slope is less than 6 percent. In some places the substratum has thin layers of loamy material. In other places it is below a depth of 40 inches.

Included with this soil in mapping are small areas of Oesterle, Pence, and Scott Lake soils. The somewhat poorly drained Oesterle soils and the moderately well drained Scott Lake soils are in swales and drainageways. Pence soils are in landscape positions similar to those of the Antigo soil. They are droughty and have a sandy loam surface layer that is subject to soil blowing. Also included are areas where the soils are underlain by stratified sand and gravel within a depth of 20 inches, wet spots, stony areas, springs, ponds, gravel pits, areas that have been cut or filled, and some small areas where the slope is more than 15 percent. 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 subsoil is slightly acid to very strongly acid. 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. The rooting depth for some plants is limited by the sand and gravel substratum.

Most areas are used as woodland. Some areas are used as cropland or pasture. The cropland commonly is irrigated if the crop is potatoes or snap beans. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The timber stands are mostly sugar maple, but American elm, aspen, white ash, black cherry, yellow birch, and American basswood are in most stands. Balsam fir, paper birch, white spruce, eastern white pine, eastern hemlock, northern red oak, red pine, and jack pine are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mainly of aspen and birch. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

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

Irrigation commonly is needed in areas used for potatoes and snap beans. In some areas, however, obtaining an even distribution of water, fertilizer, and herbicide through the irrigation system is difficult because of the slope. If the soil is irrigated, the infiltration rate may decrease because the surface layer puddles and forms a crust as it dries, and water may pond in swales. The decreased infiltration rate increases the runoff rate and the susceptibility to erosion. The infiltration rate is also reduced when heavy harvesting machinery compacts the soil. Chisel plowing helps to loosen compacted soil. Field windbreaks and vegetative row barriers, which help to deflect the force of the wind, permit sprinkler irrigation systems to apply water evenly and efficiently and reduce water loss by evaporation.

Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, regular additions of manure, and mulching help to prevent excessive water erosion, improve fertility, conserve the water available for good plant growth, 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. Separating the coarse gravel and cobbles in the surface layer from potatoes is difficult during harvest.

This soil is suited to pasture. A cover of pasture plants is effective in controlling water erosion. Overgrazing or grazing when the soil is wet results in surface compaction, loss of plant cover, and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform 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 can result in the pollution of ground water. The soil is only moderately suited to dwellings because of the slope. This limitation can be overcome by land shaping or by designing the dwellings so that they conform to the natural slope of the land. The substratum may cave if excavated. It is droughty and difficult to vegetate if exposed by land shaping. The soil is poorly suited to local roads and streets because of the danger of frost damage. This damage can be controlled by replacing the upper part of the soil with coarse textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIIe. The woodland ordination symbol is 1a.

As—Au Gres loamy sand. This nearly level, somewhat poorly drained soil is on low flats within or bordering lower depressional areas and in swales and drainageways on the higher parts of the landscape. Areas are elongated or irregularly shaped and range from about 5 to 300 acres.

Typically, the surface layer is very dark gray loamy sand about 2 inches thick. The subsurface layer is dark grayish brown, mottled sand about 4 inches thick. The subsoil is about 35 inches thick. It is dark reddish brown, mottled, very friable loamy sand in the upper part and reddish brown and brown, mottled sand in the lower part. The substratum to a depth of about 60 inches is brown sand. In some places the surface layer is sand. In other places the slope is 2 to 4 percent.

Included with this soil in mapping are small areas of the moderately well drained Croswell and excessively drained Vilas soils on the higher parts of the landscape. Also included are wet spots, ponds, and fill areas and some areas where the soil has layers of loamy material or where the sand fraction is fine or very fine. 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 is low. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is low to moderate. The potential for frost action is moderate. 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 1.5 feet. It limits the rooting depth for some plants.

Most areas are used as woodland. A few areas are used as cropland or pasture. Most of the cropland is drained.

This soil is suited to trees. The timber stands are mostly aspen and balsam fir, but red maple and paper birch are in most stands. Yellow birch, eastern hemlock, black cherry, northern red oak, eastern white pine, red pine, jack pine, and northern pin oak are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young stands consisting mostly of aspen and balsam fir. The soil is easily rutted by wheeled vehicles during wet periods because of the seasonal high water table. If the ruts are deep, tree roots can be damaged. Equipment should be used only during dry periods or when the ground is frozen.

Some trees are shallow rooted because of the seasonal high water table and can be blown down by strong winds during wet periods. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. Windthrow of trees and plant competition can be minimized by a selective harvest that maintains most of the tree canopy. Plant competition can also be controlled by establishing the new forest soon after harvesting or by removing the undesirable plants with herbicides or machinery.

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 kind of crop that can be grown. 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 sand from clogging the drains. The field ditches can be used as outlets for tile drains where a suitable drainage outlet is not available.

This soil is subject to soil blowing during dry periods if it is drained and cultivated. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, field borders, field windbreaks, and vegetative row barriers help to prevent excessive soil blowing. 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 improve fertility. These practices conserve moisture in areas where the soil is droughty because it has been drained.

This soil is suited to pasture. Forage stands are difficult to establish and maintain, however, because of low natural fertility, a high water table during wet periods, and droughtiness during dry periods. A cover of pasture plants is effective in controlling soil blowing. Overgrazing or grazing when the soil is dry results in loss of plant cover and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform 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. Because this limitation is difficult to overcome, a better site should be selected. The soil is poorly suited to local roads because of the seasonal high water table. The roads should be constructed on raised, well compacted, coarse textured fill material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IVw. The woodland ordination symbol is 2w.

Co—Comstock silt loam. This nearly level, somewhat poorly drained soil is on low terraces within or bordering lower depressional areas and in swales within glacial lake basins. Areas are rounded, elongated, or irregularly shaped and range from about 5 to 150 acres.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The next layer is grayish brown and dark brown silt loam about 4 inches thick. Below this is brown and dark brown, mottled silt loam about 18 inches thick. The subsoil is about 32 inches thick. It is dark brown, mottled silt loam that has thin layers of very fine sandy loam. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam that has thin layers of very fine sandy loam. In some small areas the substratum is coarser textured. In places the upper layers are loam.

Included with this soil in mapping are small areas of well drained soils and the moderately well drained Crystal Lake soils on the higher parts of the landscape. Also included are some areas where the upper layers are sandy loam and the soil is subject to soil blowing; wet spots, springs, and ponds; areas that have been filled; and some small erosive areas where the slope is more than 3 percent. 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 very high. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is moderate. The shrink-swell potential is moderate in the subsoil. 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. It limits the rooting depth for some plants.

Most areas are used as woodland. A few small areas are used as cropland or pasture. Most of the cropland is drained.

This soil is suited to trees. The timber stands are mostly red maple, sugar maple, balsam fir, and aspen, but American elm, paper birch, and yellow birch are in most stands. White spruce, eastern white pine, eastern hemlock, white ash, black cherry, northern red oak, and American basswood are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. The soil is easily rutted by wheeled vehicles during wet periods because of the seasonal high water table. If the ruts are deep, tree roots can be damaged, soil structure can be altered, and lateral drainage can be restricted. Equipment should be used only during dry periods or when the ground is frozen.

Some trees are shallow rooted because of the seasonal high water table and can be blown down by strong winds during wet periods. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. Windthrow of trees and plant competition can be minimized by a selective harvest that maintains most of the tree canopy. Plant competition can also be controlled by establishing the new forest soon after harvesting or by removing the undesirable plants with herbicides or machinery.

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 kind of crop that can be grown. Field ditches, land smoothing, land grading, or a combination of these can remove excess surface water, which accumulates during spring runoff and after heavy rains. Diversions on adjoining uplands or field ditches at the base of the adjoining uplands help to 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 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 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.

This soil is suited to pasture. Alfalfa stands are difficult to establish and maintain, however, 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, loss of plant cover, and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of high-quality forage.

This soil is generally unsuited to septic tank absorption fields and dwellings, mainly because of the seasonal high water table. Because this limitation is difficult to overcome, a better site should be selected. The soil is poorly suited to local roads because of the low strength and the danger of frost damage. The roads should be constructed on raised, well compacted, coarse textured fill material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. The woodland ordination symbol is 2w.

Cs—Croswell loamy sand. This nearly level, moderately well drained soil is on rather low flats within or bordering lower depressional areas and in swales and drainageways on the higher parts of the landscape. Areas are elongated or irregularly shaped and range from about 5 to 300 acres.

Typically, the surface layer is black loamy sand about 2 inches thick. The subsurface layer is brown sand about 2 inches thick. The subsoil is about 41 inches thick. It is dark reddish brown and reddish brown, very friable loamy sand and 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 yellowish brown, mottled sand. In some places the surface layer is sand. In other places the slope is 2 to 4 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres soils in swales and drainageways and the excessively drained Vilas soils on the higher parts of the landscape. Also included are wet spots and ponds and some areas where the soil has layers of loamy material or where the sand fraction is fine or very fine. Included areas make up less than 5 percent of the map unit.

Permeability is rapid in the Croswell soil. Runoff is very slow. The available water capacity is low. The subsoil is slightly acid to very strongly acid. Organic matter content 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 to 3 feet. It limits the rooting depth for some plants.

Most areas are used as woodland. A few areas are used as cropland or pasture.

This soil is suited to trees. The timber stands are mostly aspen, balsam fir, eastern white pine, jack pine, red pine, and northern pin oak, but paper birch and red maple are in most stands. Yellow birch, eastern hemlock, black cherry, and northern red oak are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young stands consisting mostly of aspen and balsam fir. Seedling survival in dry periods can be improved by planting containerized seedlings or large, vigorous nursery stock when the soil is moist and by furrowing or bedding, which conserves moisture. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated, it is subject to soil blowing during dry periods. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, field borders, field windbreaks, and vegetative row barriers help to prevent excessive 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 moisture. Additions of plant nutrients are needed because of low natural fertility.

This soil is suited to pasture. It is seasonally 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 loss of plant cover and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of forage. The response of shallow rooted forage species to additions of plant nutrients is limited, however, by the low available water content during dry periods.

Because of a poor filtering capacity and the seasonal high water table, this soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water. Both of the limitations can be overcome by mounding the absorption field site with suitable fill material. Otherwise, in some areas the effluent can be pumped to a higher, better suited site. Because of the seasonal high water table, the 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 coarse textured fill material. The basement floor of dwellings with partially exposed basements can be constructed above the level of wetness. The soil may cave if excavated.

Because of the seasonal high water table, this soil is only moderately suited to local roads. This limitation can be overcome by constructing the roads on raised, well compacted, coarse textured fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IVs. The woodland ordination symbol is 2s.

CyB—Crystal Lake silt loam, 0 to 6 percent slopes. This nearly level and gently sloping, moderately well drained soil is in glacial lake basins on uplands and on rather low terraces within or bordering lower depressional areas. Slopes are long and smooth. Areas are rounded or irregularly shaped and range from about 5 to 300 acres.

Typically, the surface layer is black silt loam about 4 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The next layer is brown and dark yellowish brown silt loam about 18 inches thick. The subsoil is about 23 inches thick. It is dark brown, mottled silt loam that has thin layers of very fine sandy loam in the lower part. The substratum to a depth of about 60 inches is dark brown, mottled silt loam that has thin layers of very fine sand. In places the upper layers are loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Comstock soils in swales and the well drained Kennan soils on the higher parts of the landscape. Kennan soils have a loamy sand or sandy loam substratum. Also included are areas where the upper layers are sandy loam and the soil is subject to soil blowing; wet spots, stony areas, depressions, and ponds; and some small areas where the slope is more than 6 percent. 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 very high. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is moderate. The shrink-swell potential is moderate in the subsoil. 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 perched seasonal high water table is at a depth of 2.5 to 6.0 feet. It limits the rooting depth for some plants.

Most areas are used as woodland. Some areas are used as cropland or pasture.

This soil is suited to trees. The timber stands are mostly sugar maple, but American elm, aspen, white ash, black cherry, yellow birch, and American basswood are in most stands. Balsam fir, paper birch, white spruce, eastern white pine, red maple, eastern hemlock, and northern red oak are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mainly of aspen and birch. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated, it is subject to erosion in areas where the slope is more than 2 percent. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, contour farming, contour stripcropping, diversions, grassed waterways, and terraces help to prevent excessive soil loss. In nearly level areas land smoothing helps 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 moisture. They also help to prevent excessive water erosion on slopes of more than 2 percent.

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

Because of the perched seasonal high water table and the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. Both of the limitations can be overcome by mounding the absorption field site with suitable fill material. Otherwise, in some areas the effluent can be pumped to a higher, better suited site. Because of the shrink-swell potential, the soil is only moderately suited to dwellings without basements. Excavating the subsoil and replacing it with coarse textured fill material help to prevent the structural damage caused by shrinking and swelling. The soil is only moderately suited to dwellings with basements because of the perched seasonal high water table. The basement floor of dwellings with partially exposed basements can be constructed above the level of wetness after the subsoil is excavated and replaced with coarse textured fill material.

Because of low strength and the danger of frost damage, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing the upper part of the soil with coarse textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. The woodland ordination symbol is 2a.

Fm—Fordum mucky silt loam. This nearly level, poorly drained or very poorly drained soil is on flood plains and in drainageways. In some places it is pitted and marked by old stream channels. In other places it is in a parallel series of swales separated by slight rises. It is frequently flooded and subject to ponding (fig. 7). Long and narrow areas range from 10 to 200 acres.

Typically, the surface layer is very dark grayish brown, mottled mucky silt loam about 6 inches thick. The upper part of the substratum is very dark grayish brown, mottled mucky loam that has thin layers of fine sand, very fine sand, and muck. The next part is very dark grayish

Figure 7.—Flooding in an area of Fordum mucky silt loam.

brown and black, mottled mucky silt loam that has thin layers of fine sand, very fine sandy loam, and muck. The lower part to a depth of about 60 inches is grayish brown, stratified sand and gravel. In some places the depth to sand and gravel is more than 40 inches. In other places the upper part of the soil is muck.

Included with this soil in mapping are small areas of somewhat poorly drained to well drained soils on the higher parts of the landscape. Also included are small ponds, stony areas, springs, and fill areas. 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 surface layer and the upper part of the substratum are neutral to very strongly acid. 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 for some plants is limited by the sand and gravel substratum and the seasonal high water table.

Most of the acreage supports wetland vegetation, such as tag alder, dogwood, willow, sedges, reeds, cattails, mosses, and wetland grasses and forbs. Some areas are used as woodland.

This soil is suited to trees. Some timber stands are mostly northern white-cedar, black spruce, tamarack, and balsam fir. Other stands have only a few of these trees and are mostly silver maple, red maple, aspen, paper birch, American elm, white spruce, and yellow birch. White ash, black ash, and eastern hemlock are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor hardwood species, but northern white-cedar can be favored for posts and piles or balsam fir can be favored for pulpwood. Because of the wetness, the use of equipment generally is limited to the winter months, when the ground is frozen. Reforestation is restricted to natural regeneration or hand planting. Seedling mortality resulting from soil wetness can be reduced by planting large, vigorous nursery stock on cradle knolls or prepared ridges.

Trees are shallow rooted because of the high water table and can be blown down by strong winds. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent the natural regeneration of the desired native trees and hinder the establishment of planted trees. Sites harvested by clearcutting commonly regenerate to tag alder. Windthrow of trees and plant competition can be minimized by a harvest method, such as a shelterwood cut or a strip cut, that maintains most of the tree canopy. Herbicides can also be used to control undesirable plants.

This soil is generally not suited to farming because of the wetness, the frequent flooding, 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 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. As a result, a better site should be selected.

The land capability classification is Vw in undrained areas. The woodland ordination symbol is 3w.

FoB—Freeon silt loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on the crests of swells and on the sides of drainageways, basins, and the highest swells. Slopes are smooth and are long to short. Areas are oval or elongated and range from about 5 to 150 acres.

Typically, the surface layer is very dark gray silt loam about 2 inches thick. The subsurface layer is brown silt loam about 2 inches thick. The next layer is dark reddish brown, dark brown, and brown silt loam about 16 inches thick. The subsoil is about 20 inches thick. It is dark yellowish brown, mottled, friable loam in the upper part and dark brown and reddish brown, mottled, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled, firm, very compact sandy loam. In some areas the upper layers are loam. In other areas the slope is less than 2 percent. In places the substratum is sandy clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Magnor soils on the nearly level parts of the landscape and the well drained Amery soils on the more sloping parts. Also included are wet spots and gravel pits and some small areas where the slope is more than 6 percent. Included areas make up less than 5 percent of the map unit.

Permeability is moderate or moderately slow in the upper part of the Freeon soil and moderately slow in the lower part. Runoff is medium. The available water capacity is high. The subsoil is slightly acid to very strongly acid. 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. It tends to crust or puddle, however, after rainfall. A perched seasonal high water table is at a depth of 2 to 3 feet. The rooting depth for some plants is limited by the perched seasonal high water table and the very compact substratum.

Most areas are used as woodland. Some are used as cropland or pasture.

This soil is suited to trees. The timber stands are mostly sugar maple, but American elm, aspen, American basswood, white ash, yellow birch, and black cherry are in most stands. Northern red oak, paper birch, white spruce, eastern white pine, red maple, balsam fir, and eastern hemlock are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mainly of aspen and birch. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated, it is subject to erosion. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, diversions, and grassed waterways help to prevent excessive soil loss. Some areas have long, smooth slopes that can be terraced and farmed on the contour. 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, help to prevent excessive erosion, improve fertility, help to prevent crusting and puddling of the surface layer, and conserve the water available for good plant growth.

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

Because of the perched seasonal high water table and the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. Both of these limitations can be overcome by mounding the absorption field site with suitable fill material. Because of the perched seasonal high water table, the 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 coarse textured fill material. The basement floor of dwellings with partially exposed basements can be constructed above the level of wetness.

Because of the perched seasonal high water table and the danger of frost damage, this soil is only moderately suited to local roads. These limitations can be overcome by replacing the upper part of the soil with coarse textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. The woodland ordination symbol is 2a.

HyB—Hatley silt loam, 2 to 6 percent slopes, stony. This undulating, somewhat poorly drained soil is on small swells and knolls in low areas. Slopes are short and complex. The soil has surface stones that commonly are 10 to 24 inches in diameter and 30 to 100 feet apart. Areas are elongated or irregularly shaped and range from about 5 to 300 acres.

Typically, the surface layer is black silt loam about 5 inches thick. The subsurface layer is brown, mottled silt loam about 5 inches thick. The next layer is brown and dark yellowish brown, mottled silt loam and loam about 26 inches thick. The subsoil is about 20 inches thick. It is dark brown, mottled, friable loam in the upper part and dark brown, mottled, very friable sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled loamy sand. In places the surface layer is loam or sandy loam. In some small areas the slope is less than 2 percent. Other small areas are extremely stony.

Included with this soil in mapping are small areas of moderately well drained soils and the well drained Kennan soils on the higher parts of the landscape. Also included are cultivated areas where nearly all of the surface stones have been removed; wet spots, ponds, and springs; areas that have been cut or filled; and some small nonerosive areas where the slope is more than 6 percent. Included areas make up less than 10 percent of the map unit.

Permeability is moderate in the upper part of the Hatley soil and moderate or moderately rapid in the lower part. Runoff is medium. The available water capacity is high. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is moderate or high. The potential for frost action is high. If the stones are removed, 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. It limits the rooting depth for some plants.

Most areas are used as woodland. Some have been cleared of stones and are used as cropland. Some are pastured.

This soil is suited to trees. The timber stands are mostly red maple, sugar maple, balsam fir, and aspen, but American elm, paper birch, and yellow birch are in most stands. White spruce, eastern white pine, eastern hemlock, white ash, black cherry, northern red oak, and American basswood are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. Trees should be planted by hand and yarded with a cable in areas where stones limit the use of equipment. The soil is easily rutted by wheeled vehicles during wet periods because of the seasonal high water table. If the ruts are deep, tree roots can be damaged, soil structure can be altered, and lateral drainage can be restricted. Equipment should be used only during dry periods or when the ground is frozen.

Some trees are shallow rooted because of the seasonal high water table and can be blown down by strong winds during wet periods. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. Windthrow of trees and plant competition can be minimized by a selective harvest that maintains most of the tree canopy. Plant competition can also be controlled by establishing the new forest soon after harvesting or by removing the undesirable plants with herbicides.

Most areas of this soil are unsuitable for cultivation because of the surface stones, which interfere with tillage. Tile drains cannot be used to lower the water table because the stones restrict excavation.

This soil is suited to pasture. It should be managed for bluegrass in areas where stones prevent the use of machinery. A cover of pasture plants is effective in controlling water erosion. Excess water during wet periods may damage the forage. Overgrazing or grazing when the soil is wet results in surface compaction, loss of plant cover, and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation in areas where the stones have been removed, and restricted use during wet periods help to keep the pasture and the soil in good condition. In areas where the stones have been removed, clipping or mowing the pasture controls weeds and brush and encourages uniform regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of high-quality forage.

Mainly because of the seasonal high water table, this soil is generally unsuited to septic tank absorption fields and dwellings. Overcoming this limitation is difficult. As a result, a better site should be selected. The soil is poorly suited to local roads because of the danger of frost damage. The roads should be constructed on raised, well compacted, coarse textured fill material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is VIs in stony areas. The woodland ordination symbol is 2x.

Ig—Ingalls loamy sand. This nearly level, somewhat poorly drained soil is on low terraces within or bordering lower depressional areas and in upland swales within glacial lake basins. Areas are rounded, elongated, or irregularly shaped and range from about 5 to 150 acres.

Typically, the surface layer is black loamy sand about 2 inches thick. The subsurface layer is brown, mottled sand and loamy sand about 4 inches thick. The subsoil is about 26 inches thick. It is dark reddish brown, dark brown, and dark yellowish brown, mottled, very friable loamy sand in the upper part and yellowish red, mottled, very friable sand in the lower part. The upper 6 inches of the substratum is brown, mottled sand. The lower part to a depth of about 60 inches is pale brown and reddish brown, mottled silt loam that has thin layers of very fine sand and silt. In some places the upper layers are sandy loam or the sand fraction is fine or very fine. In other places the sandy deposits are more than 40 or less than 20 inches thick. In some areas the surface layer is sand. In some small areas the lower part of the substratum is coarser textured. In places the slope is 2 to 4 percent.

Included with this soil in mapping are small areas of well drained soils and the moderately well drained Menominee soils on the higher parts of the landscape. Also included are wet spots, ponds, and springs. Included areas make up less than 15 percent of the map unit.

Permeability is rapid in the upper part of the Ingalls soil and moderately slow in the lower part. Runoff is very slow. The available water capacity is moderate. Reaction is neutral to strongly acid in the sandy layers and strongly acid to mildly alkaline in the silty lower layers. The content of organic matter in the surface layer is low to moderate. The potential for frost action is moderate. 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 1.5 feet. It limits the rooting depth for some plants.

Most areas are used as woodland. A few small areas are used as cropland or pasture. Most of the cropland is drained.

This soil is suited to trees. The timber stands are mostly aspen and balsam fir, but red maple and paper birch are in most stands. Yellow birch, northern red oak, black cherry, eastern white pine, eastern hemlock, red pine, jack pine, and northern pin oak are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. The soil is easily rutted by wheeled vehicles during wet periods because of the seasonal high water table. If the ruts are deep, tree roots can be damaged. Equipment should be used only during dry periods or when the ground is frozen.

Some trees are shallow rooted because of the seasonal high water table and can be blown down by strong winds during wet periods. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. Windthrow of trees and plant competition can be minimized by a selective harvest that maintains most of the tree canopy. Plant competition can also be controlled by establishing the new forest soon after harvesting or by removing the undesirable plants with herbicides or machinery.

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 kind of crop that can be grown. Field ditches and tile drains can lower the water table. Field ditches or interception tile drains at the base of the adjoining uplands can intercept seepage. 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. The field ditches can be used as outlets for tile drains where a suitable drainage outlet is not available.

This soil is subject to soil blowing during dry periods if it is drained and cultivated. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, field borders, field windbreaks, and vegetative row barriers help to prevent excessive soil blowing. 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 improve fertility. These practices conserve moisture in areas where the soil is droughty because it has been drained.

This soil is suited to pasture. A cover of pasture plants is effective in controlling water erosion. Alfalfa stands are difficult to establish and maintain, however, unless the soil is drained. The sandy material is droughty during dry periods. Overgrazing or grazing when the soil is dry results in loss of plant cover and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform 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. Overcoming this limitation is difficult. As a result, a better site should be selected. The soil is poorly suited to local roads because of the seasonal high water table. The roads should be constructed on raised, well compacted, coarse textured fill material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIIw. The woodland ordination symbol is 3w.

KnC—Kennan loam, 6 to 15 percent slopes, stony. This rolling, well drained soil is on swells, hills, and ridges and on the sides of drumlins. Slopes are short and complex (fig. 8). The soil has surface stones that commonly are 10 to 24 inches in diameter and 30 to 100 feet apart. Areas are irregularly shaped and range from about 10 to 3,000 acres.

Typically, the surface layer is black loam about 2 inches thick. The next layer is brown and dark brown loam about 17 inches thick. The subsoil is about 27 inches thick. It is dark brown, friable loam in the upper part and reddish brown, very friable sandy loam in the lower part. The substratum to a depth of about 60 inches is brown loamy sand. In places the surface layer is silt loam or sandy loam. In some areas the slope is less than 6 percent. Some small areas are extremely stony.

Included with this soil in mapping are small areas of the somewhat poorly drained Hatley soils on the lower lying knolls and some small areas of moderately well drained soils in swales, drainageways, and lake basins. Also included are cultivated areas where nearly all of the surface stones have been removed; some small areas where the slope is more than 15 percent; and wet spots, gravel pits, springs, and ponds. Included areas make up less than 10 percent of the map unit.

Permeability is moderate in the upper part of the Kennan soil and moderate or moderately rapid in the lower part. Runoff is medium. The available water capacity is moderate. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is moderate or high. The potential for frost action is moderate. If the stones are removed, the surface layer can be easily tilled throughout a wide range in moisture content.

Most areas are used as woodland. Some have been cleared of stones and are used as cropland. Some are pastured.

This soil is suited to trees. The timber stands are mostly sugar maple, but American elm, aspen, white ash, black cherry, yellow birch, and American basswood are in most stands. Balsam fir, paper birch, white spruce, northern red oak, eastern white pine, eastern hemlock, red pine, northern pin oak, and jack pine are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. Trees should be planted by hand and yarded with a

Figure 8.—A typical area of Kennan loam, 6 to 15 percent slopes, stony.

cable in areas where stones limit the use of equipment. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides.

Most areas of this soil are unsuitable for cultivation because of the surface stones, which interfere with tillage. If the stones are removed, however, the soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated, it is subject to erosion. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, diversions, and grassed waterways 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, and regular additions of manure help to prevent excessive erosion, improve fertility, and conserve the water available for good plant growth.

This soil is suited to pasture. It should be managed for bluegrass in areas where stones prevent the use of machinery. A cover of pasture plants is effective in controlling water erosion. Overgrazing or grazing when the soil is wet results in surface compaction, loss of plant cover, and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation in areas where the stones have been removed, and restricted use during wet periods help to keep the pasture and the soil in good condition. In areas where the stones have been removed, clipping or mowing the pasture controls weeds and brush and encourages uniform regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of high-quality forage.

Mainly because of the slope and large stones, this soil is only moderately suited to septic tank absorption fields and dwellings. It is only moderately suited to local roads because of the slope, the danger of frost damage, and large stones. Machinery can be used to remove the large stones. Lateral seepage and surfacing of septic tank effluent in downslope areas can be controlled by installing a trench absorption system on the contour. The slope can be overcome by land shaping. Also, dwellings can be designed so that they conform to the natural slope of the land. The substratum may cave if excavated. Frost damage to local roads can be prevented by replacing the upper part of the soil with coarse textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is VIs in stony areas. The woodland ordination symbol is 1x.

KoB—Kennan silt loam, 2 to 6 percent slopes, stony. This undulating, well drained soil is on small swells or knolls and on the crests of drumlins. Slopes are short and complex. The soil has surface stones that commonly are 10 to 24 inches in diameter and 30 to 100 feet apart. Areas are irregularly shaped and range from about 10 to 2,000 acres.

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 18 inches thick. The subsoil is about 25 inches thick. It is dark yellowish brown, friable loam and sandy loam in the upper part and brown, friable loamy sand in the lower part. The substratum to a depth of about 60 inches is dark brown loamy sand. In places the surface layer is loam or sandy loam. In some areas the slope is less than 2 percent. Some small areas are extremely stony.

Included with this soil in mapping are small areas of the somewhat poorly drained Hatley soils on the lower lying knolls and some small areas of moderately well drained soils in swales and drainageways. Also included are cultivated areas where nearly all of the surface stones have been removed; wet spots, ponds, and gravel pits; areas that have been cut or filled; and some small areas where the slope is more than 6 percent. Included areas make up less than 10 percent of the map unit.

Permeability is moderate in the upper part of the Kennan soil and moderate or moderately rapid in the lower part. Runoff is medium. The available water capacity is high. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is moderate or high. The potential for frost action is moderate. If the stones are removed, the surface layer can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after rainfall.

Most areas are used as woodland. Some areas have been cleared of stones and are used as cropland. Some are pastured.

This soil is suited to trees. The timber stands are mostly sugar maple, but American elm, aspen, white ash, black cherry, yellow birch, and American basswood are in most stands. Balsam fir, paper birch, white spruce, eastern white pine, eastern hemlock, and northern red oak are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. Trees should be planted by hand and yarded with a cable in areas where stones limit the use of equipment. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides.

Most areas of this soil are unsuitable for cultivation because of the surface stones, which interfere with tillage. If the stones are removed, however, the soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated, it is subject to erosion. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, diversions, and grassed waterways help to prevent excessive soil loss. 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, help to prevent excessive erosion, improve fertility, help to prevent crusting and puddling of the surface layer, and conserve the water available for good plant growth.

This soil is suited to pasture. It should be managed for bluegrass in areas where stones prevent the use of machinery. A cover of pasture plants is effective in controlling water erosion. Overgrazing or grazing when the soil is wet results in surface compaction, loss of plant cover, and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation in areas where the stones have been removed, and restricted use during wet periods help to keep the pasture and the soil in good condition. In areas where the stones have been removed, clipping or mowing the pasture controls weeds and brush and encourages uniform regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of high-quality forage.

Mainly because of the large stones, this soil is only moderately suited to septic tank absorption fields and dwellings. It is only moderately suited to local roads because of the large stones and the danger of frost damage. Machinery can be used to remove the large stones. The substratum may cave if excavated. Frost damage to local roads can be prevented by replacing the upper part of the soil with coarse textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is VIs in stony areas. The woodland ordination symbol is 1x.

KwD—Keweenaw sandy loam, 15 to 45 percent slopes, stony. This hilly to very steep, well drained soil is on hills and ridges and on the sides of drumlins. Slopes are short and complex. The soil has surface stones that commonly are 10 to 24 inches in diameter and 30 to 100 feet apart. Areas are elongated or irregularly shaped and range from about 10 to 12,000 acres.

Typically, the surface layer is black sandy loam about 2 inches thick. The subsurface layer is brown loamy sand about 3 inches thick. The subsoil is about 11 inches thick. It is dark reddish brown, very friable gravelly loamy sand in the upper part and dark brown, very friable loamy sand in the lower part. The next layer is brown loamy sand and reddish brown sandy loam about 37 inches thick. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In some places the slope is more than 45 percent. In other places the surface layer is loamy sand. Some areas are extremely stony.

Included with this soil in mapping are small areas of the somewhat poorly drained Hatley soils on the lower lying knolls and some small areas of moderately well drained soils in drainageways and lake basins. Also included are some small areas where the slope is less than 15 percent; wet spots, ponds, gravel pits, and springs; and areas that have been cut or filled. Included areas make up less than 10 percent of the map unit.

Permeability is moderate and moderately rapid in the Keweenaw soil. Runoff is rapid. The available water capacity is low. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is moderately low.

Most areas are used as woodland. Some are used as pasture or cropland.

This soil is suited to trees. The timber stands are mostly sugar maple, but balsam fir, aspen, northern red oak, and yellow birch are in most stands. Paper birch, white ash, American elm, black cherry, American basswood, eastern white pine, eastern hemlock, red pine, northern pin oak, and jack pine are in some stands. The timber stands on north-facing slopes are mostly aspen and balsam fir.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. Erosion is a hazard following site preparation or cutting if the soil is exposed along roads, skid trails, or fire lanes or on landings. Erosion also is a hazard in burned or overgrazed areas. It can be controlled by logging, planting trees, and building roads on the contour; yarding uphill with a cable; and removing water with water bars, out-sloping road surfaces, culverts, and drop structures. Exposed areas should be seeded after the trees are logged.

Trees should be planted by hand and yarded with a cable in areas where the steeper slopes or the stones limit the use of equipment. Roads can be built on the contour or in less sloping areas. Seedling survival in dry periods, especially on hot and dry sites facing south or west, can be improved by planting containerized seedlings or large, vigorous nursery stock when the soil is moist and by furrowing or bedding, which conserves moisture. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides. Skidding may expose enough soil for adequate regeneration.

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

This soil is suited to pasture. It should be managed for bluegrass in areas where the slopes or stones prevent the use of machinery. A cover of pasture plants is effective in controlling water erosion and soil blowing. Overgrazing or grazing when the soil is dry results in loss of plant cover and growth of undesirable plant species. Proper stocking rates, pasture renovation in areas where machinery can be used, rotation grazing, and restricted use during dry periods help to keep the pasture and the soil in good condition. In areas where machinery can be used, clipping or mowing the pasture controls weeds and brush and encourages uniform regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of high-quality forage.

Mainly because of the slope, this soil is generally unsuited to septic tank absorption fields and dwellings. Overcoming this limitation is difficult. As a result, a better site, such as a small included area of a less sloping soil, should be selected. The soil is poorly suited to local roads because of the slope. Land shaping helps to overcome this limitation. The substratum may cave if excavated.

The land capability classification is VIIs in stony areas. The woodland ordination symbol is 2r.

LgA—Langlade silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is on broad flats. Areas are irregularly shaped and commonly range from about 1,600 to 5,400 acres.

Typically, the surface layer is dark grayish brown silt loam about 12 inches thick. The subsurface layer is brown silt loam about 2 inches thick. The next layer is dark yellowish brown and brown silt loam about 8 inches thick. The subsoil is about 31 inches thick. It is dark yellowish brown, friable silt loam and loam in the upper part and dark yellowish brown, friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel. In some places the upper layers are loam. In other places the substratum has thin layers of loamy material.

Included with this soil in mapping are small areas of moderately well drained and somewhat poorly drained soils in swales and drainageways. Also included are small ponds, stony areas, and wet spots and some small erosive areas where the slope is more than 3 percent. Included areas make up less than 5 percent of the map unit.

Permeability is moderate in the upper part of the Langlade soil and rapid or very rapid in the lower part. Runoff is slow. The available water capacity is high. The subsoil is slightly acid to strongly acid. 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. It tends to crust or puddle, however, after rainfall.

Most areas are used as cropland. Some are used as pasture or woodland. The cropland commonly is irrigated if the crop is potatoes or snap beans. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The timber stands are mostly sugar maple, but American elm, aspen, eastern white pine, white ash, black cherry, yellow birch, and American basswood are in most stands. Balsam fir, paper birch, white spruce, eastern hemlock, and northern red oak are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting of aspen and birch. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to corn, vegetable crops, and small grain and to grasses and legumes for hay and pasture. Irrigation commonly is needed in areas used for potatoes (fig. 9) and snap beans. If the soil is irrigated, the infiltration rate may decrease because the surface layer puddles and forms a crust as it dries, and water may pond in swales and furrows. The infiltration rate is also reduced when heavy harvesting machinery compacts the soil. Land smoothing helps to prevent the crop damage caused by ponding. Chisel plowing helps to loosen compacted soil. Field windbreaks and vegetative row barriers, which help to deflect the force of the wind, permit sprinkler irrigation systems to apply water evenly and efficiently and reduce water loss by evaporation.

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 good plant growth. Separating the coarse gravel and cobbles in the surface layer from potatoes is difficult during harvest.

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

This soil is suited to septic tank absorption fields and dwellings, but the substratum may cave if excavated. The soil is poorly suited to local roads and streets because of the danger of frost damage. This damage can be prevented, however, by replacing the upper part of the soil with coarse textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is I. The woodland ordination symbol is 1a.

LgB—Langlade silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on foot slopes bordering terminal moraines. Slopes are long and smooth. Areas are elongated and range from about 40 to 400 acres.

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 12 inches thick. The subsoil is about 42 inches thick. It is dark yellowish brown, friable silt loam in the upper part; dark brown, friable loam in the next part; and dark brown, very friable gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In some places the substratum is at a depth of more than 60 inches, and in other places it has thin layers of loamy material. In some areas the slope is less than 2 percent. In other areas the upper layers are loam.

Included with this soil in mapping are small areas of moderately well drained soils in swales and drainageways. Also included are wet spots and stony areas

Figure 9.—Sprinkler irrigation in an area of Langlade silt loam, 0 to 2 percent slopes, used for potatoes.

and some small areas where the slope is more than 6 percent. Included areas make up less than 5 percent of the map unit.

Permeability is moderate in the upper part of the Langlade soil and rapid or very rapid in the lower part. Runoff is medium. The available water capacity is high. The subsoil is slightly acid to strongly acid. 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. It tends to crust or puddle, however, after rainfall.

Most areas are used as woodland. Some areas are used as cropland or pasture. The cropland commonly is irrigated if the crop is potatoes or snap beans. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The timber stands are mostly sugar maple, but American elm, aspen, eastern white pine, white ash, black cherry, yellow birch, and American basswood are in most stands. Balsam fir, paper birch, white spruce, eastern hemlock, and northern red oak are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to corn, vegetable crops, and small grain and to grasses and legumes for hay and pasture. If cultivated, it is subject to erosion. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, contour farming, contour stripcropping, diversions, grassed waterways, and terraces help to prevent excessive soil loss. The sand and gravel substratum is droughty and may be difficult to vegetate if exposed during the construction of diversions, grassed waterways, or terraces.

Irrigation commonly is needed in areas used for potatoes and snap beans. Because of the slope, however, obtaining an even distribution of water, fertilizer, and herbicide through the irrigation system is difficult. If the soil is irrigated, the infiltration rate may decrease because the surface layer puddles and forms a crust as it dries, and water may pond in swales. The infiltration rate is also reduced when heavy harvesting machinery compacts the soil. Chisel plowing helps to loosen compacted soil. Field windbreaks and vegetative row barriers, which help to deflect the force of the wind, permit sprinkler irrigation systems to apply water evenly and efficiently and reduce water loss by evaporation.

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 good plant growth, and help to prevent excessive water erosion. Separating the coarse gravel and cobbles in the surface layer from potatoes is difficult during harvest.

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

This soil is suited to septic tank absorption fields and dwellings, but the substratum may cave if excavated. The soil is poorly suited to local roads and streets because of the danger of frost damage. This damage can be prevented, however, by replacing the upper part of the soil with coarse textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. The woodland ordination symbol is 1a.

Lx—Loxley peat. This nearly level, very poorly drained soil is in kettles and basins. It commonly has a hummocky surface. It is subject to ponding. Areas are rounded or irregularly shaped and range from about 5 to 700 acres.

Typically, the upper layer is olive brown peat about 3 inches thick. The next layer is very dark grayish brown mucky peat about 9 inches thick. Below this to a depth of about 60 inches is dark brown muck. In places the organic material is mostly mucky peat. In some small areas mineral soil deposits are at a depth of 16 to 50 inches.

Included with this soil in mapping are small ponds, bogs, and fill areas. Also included are small areas of somewhat poorly drained to excessively drained soils on the higher parts of the landscape; some areas where the soils are less acid and support trees of merchantable size and quality; and, adjacent to lakes, some areas that are inundated throughout most of the year. Included areas make up less than 5 percent of the map unit.

Permeability is moderately rapid in the Loxley soil. Runoff is very slow or ponded. The available water capacity is very high. Reaction is extremely acid. The content of organic matter in the surface layer 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 for some plants.

Most of the acreage supports wetland vegetation, such as leatherleaf, mosses, sedges, and wetland grasses and forbs.

This soil is generally not suited to trees. It does not support trees of merchantable size or quality because of the extremely acid soil conditions (fig. 10). Where timber stands occur, they are mostly widely spaced and stunted black spruce and tamarack.

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

This soil is generally unsuited to septic tank absorption fields, dwellings, and local roads, mainly because of subsidence, ponding, and the danger of frost damage to local roads. Overcoming these limitations is difficult. As a result, a better site should be selected.

The land capability classification is VIIw in undrained areas. This soil is not assigned a woodland ordination symbol.

MgB—Magnor silt loam, 0 to 4 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on broad swells and on small swells or knolls within depressional areas. Slopes are mostly smooth and long. Areas are irregularly shaped and range from about 10 to 6,000 acres.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is dark grayish brown, mottled silt loam about 2 inches thick. The next layer is brown, yellowish brown, and dark brown, mottled silt loam about 14 inches thick. The subsoil is dark brown and reddish brown, mottled sandy loam about 10 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, firm, very compact sandy loam. In places the substratum and the lower part of the subsoil are sandy clay loam. In some small areas the slope is 4 to 6 percent.

Figure 10.—An area of Loxley peat. This soil does not support merchantable trees.

Included with this soil in mapping are small areas of the moderately well drained Freeon soils on the crests of swells. Also included are wet spots, ponds, and gravel pits. Included areas make up less than 10 percent of the map unit.

Permeability is moderate in the upper part of the Magnor soil and moderately slow in the lower part. Runoff is slow or medium. The available water capacity is high. The subsoil is medium acid to very strongly acid. 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. A perched seasonal high water table is at a depth of 0.5 foot to 3.0 feet unless the soil is drained. The rooting depth for some plants is limited by the perched seasonal high water table and the very compact substratum.

Most areas are used as woodland. Some areas are used as cropland or pasture. Some of the cropland is drained.

This soil is suited to trees. The timber stands are mostly red maple, balsam fir, aspen, and sugar maple, but American elm, yellow birch, and white ash are in most stands. Paper birch, white spruce, eastern hemlock, American basswood, black cherry, northern red oak, and eastern white pine are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. The soil is easily rutted by wheeled vehicles during wet periods because of the perched seasonal high water table. If the ruts are deep, tree roots can be damaged, soil structure can be altered, and lateral drainage can be restricted. Equipment should be used only during dry periods or when the ground is frozen.

Some trees are shallow rooted because of the perched seasonal high water table and can be blown down by strong winds during wet periods. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. Windthrow of trees and plant competition can be minimized by a selective harvest that maintains most of the tree canopy. Plant competition can also be controlled by establishing the new forest soon after harvesting or by removing the undesirable plants with herbicides or machinery.

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 kind of crop that can be grown. In nearly level areas field ditches, land smoothing, land grading, or a combination of these can remove excess surface water, which accumulates during spring runoff and after heavy rains. Diversions on adjoining uplands or field ditches at the base of the adjoining uplands help to control runoff on this soil. Tile drains and field ditches are not practical because the movement of water through the soil is too slow. The best alternative is to minimize the amount of water that infiltrates the soil by removing surface water.

This soil is subject to erosion in cultivated areas where the slope is more than 2 percent. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, contour farming, contour stripcropping, grassed waterways, and terraces help to prevent excessive soil loss. In areas where contour farming and contour stripcropping 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 increase the infiltration rate and the movement of air and water through the soil, help to prevent excessive erosion on slopes of more than 2 percent, improve fertility, and help to prevent crusting and puddling of the surface layer.

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

This soil is generally unsuited to septic tank absorption fields and dwellings with basements, mainly because of the perched seasonal high water table. Because this limitation is difficult to overcome, a better site should be selected. The soil is poorly suited to dwellings without basements and to local roads because of the perched seasonal high water table and the danger of frost damage to roads. Sites for dwellings without basements can be raised by adding coarse textured fill material. The roads should be constructed on raised, well compacted, coarse textured fill material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. The woodland ordination symbol is 2w.

MhB—Marathon loam, bedrock substratum, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on the crests of broad swells and on small swells or knolls. It is on the highest parts of the landscape. Slopes are smooth and vary greatly in length. Most areas are oval and range from about 5 to 30 acres.

Typically, the surface layer is very dark gray loam about 4 inches thick. The subsurface layer is dark grayish brown loam about 1 inch thick. The next layer is dark yellowish brown, brown, and dark brown loam about 14 inches thick. The subsoil is about 38 inches thick. It is dark brown, very friable sandy loam in the upper part; dark brown, mottled, very friable loamy sand in the next part; and dark brown, mottled, firm, very compact gravelly sandy loam in the lower part. Granite bedrock is at a depth of about 57 inches. In some areas the upper layers are sandy loam or silt loam. In other areas the slope is less than 2 percent. In some places the underlying bedrock is schist or gneiss. In other places the subsoil is sandy clay loam.

Included with this soil in mapping are small areas where the depth to hard granite bedrock is less than 40 inches. Also included are small areas of somewhat poorly drained soils in swales and upland drainageways and some small areas where the slope is more than 6 percent. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the Marathon soil. Runoff is medium. The available water capacity is moderate. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is moderate. The potential for frost action is moderate. A seasonal high water table is at a depth of 2.5 to 4.5 feet. The rooting depth for some plants is limited by the seasonal high water table and the underlying granite bedrock.

Most areas are used as woodland. A few areas were formerly used as cropland but are now idle.

This soil is suited to trees. The timber stands are mostly sugar maple and American basswood, but white ash, aspen, American elm, yellow birch, and black cherry are in most stands. Red maple, northern red oak, paper birch, white spruce, eastern white pine, balsam fir, and eastern hemlock are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to farming. Almost all of the acreage, however, is county-owned woodland that is not likely to be cleared and farmed.

Because of the seasonal high water table, this soil is poorly suited to septic tank absorption fields. This limitation can be overcome by mounding the absorption field site with suitable fill material. The soil is suited to dwellings without basements. It is only moderately suited to dwellings with basements because of the seasonal high water table and the depth to hard bedrock. The basement floor of dwellings with partially exposed basements can be constructed above the level of wetness and the bedrock. The soil is only moderately suited to local roads because of the danger of frost damage. This damage can be prevented, however, by replacing the upper part of the soil with coarse textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIe. The woodland ordination symbol is 2a.

MnB—Menominee loamy sand, 0 to 6 percent slopes. This nearly level, gently sloping, or undulating, moderately well drained soil is in glacial lake basins on uplands and on rather low terraces within or bordering lower depressional areas. Slopes are long and smooth or short and complex. Areas are rounded, elongated, or irregularly shaped and range from about 5 to 300 acres.

Typically, the surface layer is black loamy sand about 3 inches thick. The subsurface layer is brown, very friable loamy sand about 2 inches thick. The next layer is about 35 inches thick. It is dark reddish brown and reddish brown gravelly loamy sand in the upper part and mostly dark brown and yellowish brown sand in the lower part. The subsoil is about 19 inches thick. It is mostly grayish brown, mottled, friable silt loam that has thin layers of loam. The substratum to a depth of about 60 inches is grayish brown, mottled silt loam that has thin layers of very fine sandy loam. In some places, the upper layers are sandy loam or the sand fraction is fine or very fine. In other places the sandy deposits are more than 40 or less than 20 inches thick. In some areas the surface layer is sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Ingalls soils in swales and the well drained Pence soils on the higher parts of the landscape. Pence soils have a stratified sand and gravel substratum at a depth of 20 to 36 inches. Also included are wet spots, stony areas, ponds, depressions, and springs; areas that have been cut or filled; and some small areas where the slope is more than 6 percent. Included areas make up less than 15 percent of the map unit.

Permeability is rapid in the upper layers of the Menominee soil and moderately slow in the subsoil and substratum. Runoff is very slow. The available water capacity is moderate. Reaction is slightly acid to strongly acid in the sandy layers and strongly acid to neutral in the silty lower layers. The content of organic matter in the surface layer is low to moderate. The shrink-swell potential is moderate in the silty lower layers. 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 4.0 feet. It limits the rooting depth for some plants.

Most areas are used as woodland. Some areas are used as cropland or pasture.

This soil is suited to trees. The timber stands are mostly sugar maple, but balsam fir, aspen, northern red oak, and yellow birch are in most stands. Paper birch, American elm, white ash, American basswood, eastern hemlock, black cherry, eastern white pine, red pine, northern pin oak, and jack pine are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. Seedling survival in dry periods can be improved by planting containerized seedlings or large, vigorous nursery stock when the soil is moist and by furrowing or bedding, which conserves moisture. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated, it is subject to soil blowing. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, field borders, field windbreaks, and vegetative row barriers help to prevent excessive 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 good plant growth.

This soil is suited to pasture. A cover of pasture plants is effective in controlling soil blowing. The sandy material is droughty during dry periods. Overgrazing or grazing when the soil is dry results in loss of plant cover and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform 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, the moderately slow permeability in the substratum, and a poor filtering capacity in the sandy layers. These limitations can be overcome by mounding the absorption field site with suitable fill material. Otherwise, in some areas the effluent can be pumped to a higher, better suited site. The soil is suited to dwellings without basements and to local roads. It is only moderately suited to dwellings with basements because of the perched seasonal high water table. The basement floor of dwellings with partially exposed basements can be constructed above the level of wetness. The sandy material may cave if excavated.

The land capability classification is IIIs. The woodland ordination symbol is 2s.

MoB—Milladore silt loam, 0 to 4 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on broad swells and on small swells or knolls within depressional areas. Slopes are smooth and long. Areas are irregularly shaped and range from about 10 to 600 acres.

Typically, the surface layer is black silt loam about 3 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 8 inches thick. The next layer is grayish brown and brown, mottled loam about 4 inches thick. The subsoil is about 25 inches thick. It is dark brown, mottled, very friable loamy sand in the upper part; gray, mottled, firm, very compact clay loam in the next part; and reddish brown, mottled, firm, very compact sandy clay loam in the lower part. The substratum to a depth of about 60 inches is yellowish red and olive, mottled, firm, very compact sandy loam. In some small areas the slope is 4 to 6 percent. In places the substratum is silty clay loam or very gravelly granite residuum.

Included with this soil in mapping are small areas of moderately well drained soils on the crests of swells. Also included are wet spots and some areas where hard bedrock is within a depth of 60 inches. Included areas make up less than 15 percent of the map unit.

Permeability is moderately slow in the Milladore soil. Runoff is slow or medium. The available water capacity is high. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is moderate. The shrink-swell potential is moderate in the subsoil. The potential for frost action is high. A perched seasonal high water table is at a depth of 1.0 to 2.5 feet. The rooting depth for some plants is limited by the perched seasonal high water table and, in places, by the very compact substratum.

Most areas are used as woodland. A few small areas were formerly used as cropland but are now idle. Of all the soils in the county, this soil is the most likely source of nearly impervious soil material for lining lagoons and landfills.

This soil is suited to trees. The timber stands are mostly red maple, aspen, and sugar maple, but American elm, paper birch, and white ash are in most stands. Yellow birch, white spruce, eastern hemlock, American basswood, black cherry, northern red oak, balsam fir, and eastern white pine are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. The soil is easily rutted by wheeled vehicles during wet periods because of the perched seasonal high water table. If the ruts are deep, tree roots can be damaged, soil structure can be altered, and lateral drainage can be restricted. Equipment should be used only during dry periods or when the ground is frozen.

Some trees are shallow rooted because of the perched seasonal high water table and can be blown down by strong winds during wet periods. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. Windthrow of trees and plant competition can be minimized by a selective harvest that maintains most of the tree canopy. Plant competition can also be controlled by establishing the new forest soon after harvesting or by removing the undesirable plants with herbicides or machinery.

If drained, this soil is suited to farming. Almost all of the acreage, however, is county-owned woodland that is not likely to be cleared, drained, and farmed. Subsurface drains are not practical because the movement of water through the soil is too slow.

This soil is generally unsuited to septic tank absorption fields and dwellings, mainly because of the perched seasonal high water table. Because this limitation is difficult to overcome, a better site should be selected. The soil is poorly suited to local roads because of the danger of frost damage. The roads should be constructed on raised, well compacted, coarse textured fill material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. The woodland ordination symbol is 2w.

Ms—Minocqua, Cable, and Sherry mucks. These nearly level, very poorly drained soils are in kettles, basins, drainageways, and upland swales. They are subject to ponding. Areas are elongated or irregularly shaped and range from about 5 to 2,500 acres. The acreage of this map unit is about 50 percent Minocqua soil, 35 percent Cable soil, and 15 percent Sherry soil. A single mapped area may contain one or more of the soils. These soils have similar behavior characteristics for present or anticipated uses in the survey area, and it was not considered practical or necessary to map them separately.

Typically, the surface layer of the Minocqua soil is black muck about 4 inches thick. The subsoil is about 31 inches thick. It is gray, dark gray, and grayish brown, mottled silt loam in the upper part; grayish brown, mottled, friable loam in the next part; and grayish brown, mottled, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is brown, stratified sand and gravel. In places the surface layer is mostly mineral soil. In some small areas somewhat poorly drained soils are on slight rises. In other areas the organic surface layer is more than 6 inches thick.

Typically, the surface layer of the Cable soil is about 7 inches thick. It is very dark brown and black muck in the upper part and very dark gray, mottled silt loam in the lower part. The subsoil is about 31 inches thick. It is dark grayish brown and grayish brown, mottled, friable silt loam in the upper part; grayish brown, mottled, friable loam in the next part; and brown and reddish brown, mottled, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled sandy loam. In places the surface layer is mostly mineral soil. In some small areas somewhat poorly drained soils are on slight rises. In other areas the organic part of the surface layer is more than 6 inches thick.

Typically, the surface layer of the Sherry soil is about 8 inches thick. It is black muck in the upper part and very dark gray, mottled silt loam in the lower part. The subsoil is about 35 inches thick. It is dark gray and gray, mottled silt loam and loam in the upper part and olive gray, mottled, firm, very compact sandy loam in the lower part. The substratum to a depth of about 60 inches is olive gray, mottled, firm, very compact sandy clay loam and sandy loam. In places the surface layer is mostly mineral soil. In some areas the organic part of the surface layer is more than 6 inches thick. In other areas the substratum is silty clay loam or very gravelly granite residuum.

Included with these soils in mapping are small areas of somewhat poorly drained to well drained soils on the higher parts of the landscape and some areas where hard bedrock is within a depth of 60 inches. Also included are small ponds, springs, stony areas, and, adjacent to lakes, some areas that are inundated throughout most of the year. Included areas make up less than 5 percent of the map unit.

Permeability is moderate in the upper part of the Minocqua soil and rapid or very rapid in the lower part. It is moderate and moderately slow in the Cable and Sherry soils. Runoff is very slow or ponded on the three soils. The available water capacity is moderate in the Minocqua soil, high in the Cable soil, and very high in the Sherry soil. The subsoil of the Minocqua soil is very strongly acid to mildly alkaline. The subsoil of the Cable and Sherry soils is very strongly acid to neutral. The content of organic matter in the surface layer of all three soils is very high. The shrink-swell potential is moderate in the subsoil of the Sherry soil. The potential for frost action is high in all three soils. A seasonal high water table is above the surface or within a depth of 1 foot. It limits the rooting depth for some plants. The rooting depth is also limited by the sand and gravel substratum in the Minocqua soil and, in places, by the very compact substratum in the Cable and Sherry soils.

Most of the acreage is used as woodland or supports wetland vegetation, such as tag alder, dogwood, willow, sedges, reeds, cattails, mosses, and wetland grasses and forbs.

These soils are suited to trees. Some timber stands are mostly northern white-cedar, black spruce, tamarack, and balsam fir. Other stands have only a few of these trees and are mostly red maple, aspen, paper birch, American elm, white spruce, and yellow birch. Some stands are mostly aspen. White ash, black ash, and eastern hemlock are in other stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor hardwood species, but northern white-cedar can be favored for posts and piles or balsam fir can be favored for pulpwood. Because of the wetness, the use of equipment generally is limited to winter months, when the ground is frozen. Reforestation is restricted to natural regeneration or hand planting. Seedling mortality resulting from soil wetness and from the organic surface layer can be reduced by planting large, vigorous nursery stock on cradle knolls or prepared ridges.

Trees are shallow rooted because of the high water table and can be blown down by strong winds. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. Sites harvested by clear cutting commonly regenerate to tag alder. Windthrow of trees and plant competition can be minimized by a harvest method, such as shelterwood cut or strip cut, that maintains most of the tree canopy. Herbicides can also be used to control undesirable plants.

These soils are generally not suited to farming because of the wetness, 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. In all areas of the Sherry soil and most areas of the Cable soil, subsurface drains are not practical because the movement of water through the soils is too slow.

These soils are generally unsuited to septic tank absorption fields and dwellings, mainly because of the ponding. Overcoming this limitation is difficult. As a result, a better site should be selected. The soils are poorly suited to local roads because of the ponding and the danger of frost damage. These limitations can be overcome by constructing the roads on raised, well compacted, coarse textured fill material and by installing a good drainage system of adequate side ditches and culverts. The drainage system can remove surface water and equalize the water level on each side of the road.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 3w.

MyB—Mylrea silt loam, 0 to 4 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on broad swells and on small swells or knolls within depressional areas. Slopes are smooth and long. Areas are irregularly shaped and range from about 10 to 800 acres.

Typically, the surface layer is black silt loam about 3 inches thick. The subsurface layer is dark grayish brown and brown silt loam about 8 inches thick. The next layer is brown and dark yellowish brown, mottled silt loam about 4 inches thick. The subsoil is about 33 inches thick. In sequence downward, it is grayish brown, mottled, friable silt loam; dark brown, mottled, friable sandy loam; dark brown, mottled, firm loam and gravelly loam; and brown, mottled, friable very gravelly sandy loam. The substratum to a depth of about 60 inches is pale brown, mottled very gravelly sandy loam. In places the substratum is sandy clay loam or very gravelly loam. In some small areas the slope is 4 to 6 percent.

Included with this soil in mapping are small areas of Matherton and other moderately well drained soils on the crests of swells. Marathon soils have hard granite bedrock at a depth of 40 to 60 inches. Also included are wet spots. Included areas make up less than 15 percent of the map unit.

Permeability is moderate in the upper part of the Mylrea soil and moderately rapid or rapid in the lower part. Runoff is slow or medium. The available water capacity is moderate. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is moderate. The potential for frost action is high. A seasonal high water table is at a depth of 1 to 3 feet. It limits the rooting depth for some plants.

Most of the acreage is woodland. This soil is suited to trees. The timber stands are mostly red maple, aspen, and sugar maple, but American elm, paper birch, and white ash are in most stands. Yellow birch, white spruce, eastern hemlock, American basswood, black cherry, northern red oak, balsam fir, and eastern white pine are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. The soil is easily rutted by wheeled vehicles during wet periods because of the seasonal high water table. If the ruts are deep, tree roots can be damaged, soil structure can be altered, and lateral drainage can be restricted. Equipment should be used only during dry periods or when the ground is frozen.

Some trees are shallow rooted because of the seasonal high water table and can be blown down by strong winds during wet periods. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. Windthrow of trees and plant competition can be minimized by a selective harvest that maintains most of the tree canopy. Plant competition can also be controlled by establishing the new forest soon after harvesting or by removing the undesirable plants with herbicides or machinery.

If drained, this soil is suited to farming. All of the acreage is, however, county-owned woodland that is not likely to be cleared, drained, and farmed.

This soil generally is unsuited to septic tank absorption fields and dwellings, mainly because of the seasonal high water table. Because this limitation is difficult to overcome, a better site should be selected. The soil is poorly suited to local roads because of the danger of frost damage and the seasonal high water table. The roads should be constructed on raised, well compacted, coarse textured fill material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. The woodland ordination symbol is 2w.

Os—Oesterle silt loam. This nearly level, somewhat poorly drained soil is on low flats within or bordering lower depressional areas and in swales and drainageways on the higher parts of the landscape. Areas are elongated or irregularly shaped and range from about 5 to 1,000 acres.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is grayish brown, mottled silt loam about 4 inches thick. The next layer is brown and dark brown, mottled silt loam about 16 inches thick. The subsoil is about 8 inches thick. It is dark brown, mottled, friable loam in the upper part and dark brown, mottled, very friable gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is brown, stratified sand and gravel. In some areas the surface layer is loam. In some places the substratum is at a depth of more than 40 inches, and in other places it has thin layers of loamy material.

Included with this soil in mapping are small areas of the well drained Antigo soils and the moderately well drained Scott Lake soils on the higher parts of the landscape. Also included are small ponds, springs, and wet spots; areas that have been cut or filled; areas that are underlain by stratified sand and gravel within a depth of 20 inches; some small erosive areas where the slope is more than 3 percent; and some areas where the upper layers are sandy loam or fine sandy loam and the soil is subject to soil blowing. Included areas make up less than 10 percent of the map unit.

Permeability is moderate in the upper part of the Oesterle soil and rapid or very rapid in the lower part. Runoff is slow. The available water capacity is moderate. The subsoil is slightly acid to very strongly acid. 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. 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 for some plants is limited by the sand and gravel substratum and the seasonal high water table.

Most areas are used as woodland. Some areas are used as cropland or pasture. Some of the cropland is drained.

This soil is suited to trees. The timber stands are mostly red maple, sugar maple, balsam fir, and aspen, but American elm, paper birch, and yellow birch are in most stands. White spruce, eastern white pine, eastern hemlock, white ash, black cherry, northern red oak, and American basswood are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. The soil is easily rutted by wheeled vehicles during wet periods because of the seasonal high water table. If the ruts are deep, tree roots can be damaged, soil structure can be altered, and lateral drainage can be restricted. Equipment should be used only during dry periods or when the ground is frozen.

Some trees are shallow rooted because of the seasonal high water table and can be blown down by strong winds during wet periods. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. Windthrow of trees and plant competition can be minimized by a selective harvest that maintains most of the tree canopy. Plant competition can also be controlled by establishing the new forest soon after harvesting or by removing the undesirable plants with herbicides or machinery.

If drained, this soil is suited to corn, small grain, and vegetable crops and to grasses and legumes for hay and pasture. The wetness in undrained areas limits yields and the kind of crop that can be grown. Field ditches, land smoothing, land grading, or a combination of these can remove excess surface water, which accumulates during spring runoff and after heavy rains. Diversions on adjoining uplands or field ditches at the base of the adjoining uplands help to 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 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. Separating the coarse gravel and cobbles in the surface layer from potatoes is difficult during harvest.

This soil is suited to pasture (fig. 11). Alfalfa stands are difficult to establish and maintain, however, 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, loss of plant cover, and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during wet periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform regrowth and grazing. Topdressing with fertilizer helps to maintain a productive stand of high-quality forage.

This soil is generally unsuited to septic tank absorption fields and dwellings, mainly because of the seasonal high water table. Because this limitation is difficult to overcome, a better site should be selected. The soil is poorly suited to local roads and streets because of the

Figure 11.—A pastured area of Oesterle silt loam.

danger of frost damage. The roads should be constructed on raised, well compacted, coarse textured fill material. A good subsurface drainage system of adequate side ditches and culverts is needed.

The land capability classification is IIw. The woodland ordination symbol is 2w.

PsB—Pence sandy loam, 0 to 6 percent slopes. This nearly level, gently sloping or undulating, well drained soil is on upland flats, on small swells or knolls, and on the sides of drainageways, kettles, and basins. It is pitted in places. Slopes are long and smooth or short and complex. Areas are elongated or irregularly shaped and range from about 10 to 500 acres.

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 reddish brown, very friable gravelly sandy loam in the upper part; dark reddish brown and reddish brown, very friable gravelly loamy sand in the next part; and dark brown, loose gravelly sand in the lower part. The substratum to a depth of about 60 inches is brown, stratified sand and gravel. In some places the surface layer is gravelly sandy loam. In other places the substratum has thin layers of loamy material.

Included with this soil in mapping are small areas of Antigo, Oesterle, and Scott Lake soils, which have silty upper layers. Antigo soils are in positions on the landscape similar to those of the Pence soil. The somewhat poorly drained Oesterle soils and the moderately well drained Scott Lake soils are in swales and drainageways. Also included are areas where the soils are underlain by stratified sand and gravel within a depth of 12 inches; small ponds, stony areas, depressions, wet spots, and gravel pits; areas that have been cut or filled; some areas where the upper layers are loamy sand and the soils are droughtier than the Pence soil; and some small areas where the slope is more than 6 percent. 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 rapid or very rapid in the lower part. Runoff is slow or medium. The available water capacity is very low. The subsoil is slightly acid to very strongly acid. 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. The rooting depth for some plants is limited by the sand and gravel substratum.

Most areas are used as woodland. Some are used as cropland or pasture. The cropland commonly is irrigated if the crop is potatoes or snap beans. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The timber stands on the droughtiest sites are mostly aspen, balsam fir, and paper birch. Other stands are mostly sugar maple, but American basswood, paper birch, yellow birch, black cherry, white ash, eastern white pine, aspen, American elm, and balsam fir are in most of these stands. Red pine, jack pine, northern pin oak, eastern hemlock, and northern red oak are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young stands consisting mostly of aspen, birch, and balsam fir. Seedling survival in dry periods can be improved by planting containerized seedlings or large, vigorous nursery stock when the soil is moist and by furrowing or bedding, which conserves moisture. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

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

This soil is subject to soil blowing during dry periods if it is cultivated. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve available water (fig. 12). Irrigation commonly is needed in areas used for potatoes and snap beans. In some areas, however, obtaining an even distribution of water, fertilizer, and herbicide through the irrigation system is difficult because of the slope. Field windbreaks and vegetative row barriers, which help to deflect the force of the wind, permit sprinkler irrigation systems to apply water evenly and efficiently and reduce water loss by evaporation. Separating the coarse gravel and cobbles in the surface layer from potatoes is difficult during harvest. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure improve fertility, conserve the water available for good plant growth, and help to control soil blowing. They also help to prevent excessive water erosion on slopes of more than 2 percent.

This soil is suited to pasture, but it is droughty. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soil is dry results in loss of plant cover and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform 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 very low available water content during dry periods.

This soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity of the substratum can result in the pollution of ground water. The soil is suited to dwellings and local roads. The substratum may cave if excavated.

The land capability classification is IIIe in nonirrigated areas and IIe in irrigated areas. The woodland ordination symbol is 2s.

PsC—Pence sandy 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 basins. Slopes are short and are smooth or complex. Areas are elongated or irregularly shaped and range from about 10 to 600 acres.

Typically, the surface layer is black sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is about 29 inches thick. It is dark reddish brown, very friable gravelly sandy loam in the upper part and dark brown, very friable gravelly loamy sand and gravelly sand in the lower part. The substratum to a depth of about 60 inches is dark yellowish brown, stratified sand and gravel. In some places the surface layer is gravelly sandy loam. In other places the slope is less than 6 percent. In some areas the substratum has thin layers of loamy material.

Included with this soil in mapping are small areas of Antigo, Oesterle, and Scott Lake soils, which have silty upper layers. Antigo soils are in positions on the landscape similar to those of the Pence soil. The somewhat poorly drained Oesterle soils and the moderately well drained Scott Lake soils are in swales and drainageways. Also included are droughty areas where the upper layers are loamy sand; areas where the soils are underlain by stratified sand and gravel within a depth of 12 inches; small ponds, stony areas, wet spots, gravel pits, and springs; areas that have been cut or filled; and some small areas where the slope is more than 15

Figure 12.—A field windbreak of red pine on Pence sandy loam, 0 to 6 percent slopes.

percent. 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 rapid or very rapid in the lower part. Runoff is medium. The available water capacity is very low. The subsoil is slightly acid to very strongly acid. 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. The rooting depth for some plants is limited by the sand and gravel substratum.

Most areas are used as woodland. Some areas are used as cropland or pasture. The cropland commonly is irrigated if the crop is potatoes or snap beans. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The timber stands on the droughtiest sites are mostly aspen, balsam fir, and paper birch. Other stands are mostly sugar maple, but American basswood, paper birch, yellow birch, black cherry, white ash, eastern white pine, aspen, American elm, and balsam fir are in most of these stands. Red pine, jack pine, northern pin oak, eastern hemlock, and northern red oak are in some stands.

Woodlad management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young stands consisting mostly of aspen, birch, and balsam fir. Seedling survival in dry periods can be improved by planting containerized seedlings or large, vigorous nursery stock when the soil is moist and by furrowing or bedding, which conserves moisture. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to corn, vegetable crops, and small grain and to grasses and legumes for hay and pasture. If cultivated, it is subject to soil blowing and water erosion. A conservation tillage system, such as chisel planting, that leaves all or part of the crop residue on the surface, diversions, and grassed waterways help to prevent excessive water erosion. Critical area planting helps to stabilize highly erodible areas where vegetation is difficult to establish. The sand and gravel substratum is droughty and may be difficult to vegetate if exposed during the construction of diversions or grassed waterways. Conservation tillage, field borders, field windbreaks, and vegetative row barriers help to control soil blowing and conserve available water.

Irrigation commonly is needed in areas used for potatoes and snap beans. In some areas, however, obtaining an even distribution of water, fertilizer, and herbicide through the irrigation system is difficult because of the slope. Field windbreaks, which help to deflect the force of the wind, permit sprinkler irrigation systems to apply water evenly and efficiently and reduce water loss by evaporation. Separating the coarse gravel and cobbles in the surface layer from potatoes is difficult during harvest. Cover crops, green manure crops, crop residue management, grasses and legumes in the crop rotation, and regular additions of manure help to prevent excessive water erosion, improve fertility, conserve the water available for good plant growth, and help to control soil blowing.

This soil is suited to pasture, but it is droughty. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soil is dry results in loss of plant cover and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform 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 very low available water content during dry periods.

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

The land capability classification is IVe in nonirrigated areas and IIIe in irrigated areas. The woodland ordination symbol is 2s.

PsD—Pence sandy loam, 15 to 45 percent slopes. This hilly to very steep, well drained soil is on hills and ridges and on the sides of valleys, kettles, and basins. Slopes are short and complex. Areas are elongated or irregularly shaped and range from about 10 to 1,000 acres.

Typically, the surface layer is black 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 reddish brown, very friable gravelly sandy loam in the upper part and dark brown gravelly loamy sand and gravelly sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel. In some places the surface layer is gravelly sandy loam. In other places the slope is more than 45 percent. In some areas the substratum has thin layers of loamy material.

Included with this soil in mapping are small areas of Antigo, Oesterle, and Scott Lake soils, which are silty in the upper part. Antigo soils are in positions on the landscape similar to those of the Pence soil. The somewhat poorly drained Oesterle and moderately well drained Scott Lake soils are in drainageways. Also included are some areas that are underlain by stratified sand and gravel within a depth of 12 inches; small ponds, wet spots, springs, stony areas, and gravel pits; areas that have been cut and filled; some small areas where the slope is less than 15 percent; and some areas where the upper layers are loamy sand and the soil is droughtier than the Pence soil. 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 rapid or very rapid in the lower part. Runoff is rapid. The available water capacity is very low. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is moderately low or moderate. The rooting depth for some plants is limited by the sand and gravel substratum.

Most areas are used as woodland. Some areas are used as pasture or cropland. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The timber stands on the droughtiest sites and on the north-facing slopes are mostly aspen, balsam fir, and paper birch. Other stands are mostly sugar maple, but American basswood, paper birch, yellow birch, black cherry, white ash, eastern white pine, aspen, American elm, and balsam fir are in most of these stands. Red pine, jack pine, northern pin oak, eastern hemlock, and northern red oak are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young stands consisting mostly of aspen, birch, and balsam fir. Erosion is a hazard following site preparation or cutting if the soil is exposed along roads, skid trails, or fire lanes or on landings. Erosion also is a hazard in burned or overgrazed areas. It can be controlled by logging, planting trees, and building roads on the contour; yarding uphill with a cable; and removing water with water bars, out-sloping road surfaces, culverts, and drop structures. Exposed areas should be seeded after the trees are logged.

Trees should be planted by hand and yarded with a cable in areas where the steeper slopes limit the use of equipment. Roads can be built on the contour or in less sloping areas. Seedling survival in dry periods, especially on hot and dry sites facing south or west, can be improved by planting containerized seedlings or large, vigorous nursery stock when the soil is moist and by furrowing or bedding, which conserves moisture. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent the natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery. Skidding may expose enough soil for adequate regeneration.

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

This soil is suited to pasture, but it is droughty. 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 or grazing when the soil is dry results in loss of plant cover and 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 and the soil in good condition. In areas where machinery can be used, clipping or mowing the pasture controls weeds and brush and encourages uniform 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 very low available water content during dry periods.

Mainly because of the slope, this soil is generally unsuited to septic tank absorption fields and dwellings. Overcoming this limitation is difficult. As a result, a better site, such as a small included area of a less sloping soil, should be selected. The soil is poorly suited to local roads because of the slope. The slope can be reduced by land shaping. The substratum may cave if excavated. It is droughty and is difficult to vegetate if exposed by land shaping.

The land capability classification is VIIe. The woodland ordination symbol is 2r.

Pt—Pits, gravel. This map unit consists of open excavations from which sand and gravel have been removed. It is on moraines, outwash plains, eskers, or kames. Slope ranges from 0 to 6 percent on the pit floors and from 15 to 90 percent on the sidewalls. Areas are linear or irregularly shaped and range from about 5 to 50 acres.

Typically, the floors and sides of the pits are stratified sand and gravel in which the content of cobbles is as much as 5 percent. In some places the floors and sides are gravelly loamy sand that contains stones, and in other places they are sand.

Included with this unit 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 crush and some ponds. Included areas make up less than 5 percent of the map unit.

Soil properties, such as depth to a seasonal high water table, vary. They should be determined by onsite investigation.

Most of the pits are actively mined for sand and gravel. Some are abandoned because all of the suitable material has been removed. Others are abandoned because of a seasonal high water table, which makes further excavation impractical.

These pits are generally not suited to farming or woodland. The main management concern is reclamation of the pits after excavation. In most of the pits, land shaping and the addition of suitable topsoil are needed before a plant cover can be established. Vegetation can be established if the piles of finer textured material 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.

The suitability of these pits for septic tank absorption fields, dwellings, and local roads should be determined by onsite investigation.

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

Sc—Scott Lake silt loam. This nearly level, moderately well drained soil is on rather low flats within or bordering lower depressional areas and in swales and drainageways on the higher parts of the landscape. Areas are elongated or irregularly shaped and range from about 10 to 1,000 acres.

Typically, the surface layer is very dark gray silt loam about 5 inches thick. The next layer is dark yellowish brown and brown silt loam about 14 inches thick. The subsoil is about 20 inches thick. It is dark yellowish brown, mottled, friable silt loam and loam in the upper part and dark brown, mottled, very friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel. In some areas the surface layer is loam. In some places the substratum has thin layers of loamy material, and in other places it is at a depth of more than 45 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Oesterle soils in swales and drainageways and the well drained Antigo soils on the higher parts of the landscape. Also included are some areas that are underlain by stratified sand and gravel within a depth of 20 inches; some areas where the upper layers are sandy loam and the soil is subject to soil blowing; small ponds, wet spots, and springs; and some small erosive areas where the slope is more than 3 percent. Included areas make up less than 15 percent of the map unit.

Permeability is moderate or moderately rapid in the upper part of the Scott Lake soil and rapid or very rapid in the lower part. Runoff is slow. The available water capacity is moderate. The subsoil is slightly acid to very strongly acid. 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. It tends to crust or puddle, however, after rainfall. A seasonal high water table is at a depth of 2.5 to 6.0 feet. The rooting depth for some plants is limited by the sand and gravel substratum and the seasonal high water table.

Most areas are used as woodland. Some areas are used as cropland or pasture. The cropland commonly is irrigated if the crop is potatoes or snap beans.

This soil is suited to trees. The timber stands are mostly sugar maple, but American elm, aspen, eastern white pine, white ash, black cherry, yellow birch, and American basswood are in most stands. Balsam fir, paper birch, white spruce, red maple, eastern hemlock, and northern red oak are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor northern red oak and eastern white pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition can be minimized by a selective harvest that maintains the tree canopy, by establishing the new forest soon after harvesting, or by removing the undesirable plants with herbicides or machinery.

This soil is suited to corn, vegetable crops, and small grain and to grasses and legumes for hay and pasture. Irrigation commonly is needed in areas used for potatoes and snap beans. If the soil is irrigated, the infiltration rate may decrease because the surface layer puddles and forms a crust as it dries, and water may pond in swales and furrows. The infiltration rate is also reduced when heavy harvesting machinery compacts the soil. Land smoothing helps to prevent the crop damage caused by ponding. Chisel plowing helps to loosen compacted soil. Field windbreaks and vegetative row barriers, which help to deflect the force of the wind, permit sprinkler irrigation systems to apply water evenly and efficiently and reduce water loss by evaporation.

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 good plant growth. Separating the coarse gravel and cobbles in the surface layer from potatoes is difficult during harvest.

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

Because of the seasonal high water table and the poor filtering capacity of the substratum, this soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water. Both of these limitations can be overcome by mounding the absorption field site with suitable fill material. Otherwise, in some areas the effluent can be pumped to a higher, better suited site. The soil is suited to dwellings without basements. Because of the seasonal higher water table, it is only moderately suited to dwellings with basements. The basement floor of dwellings with partially exposed basements can be constructed above the level of wetness. The substratum may cave if excavated.

Because of the danger of frost damage, this soil is only moderately suited to local roads. This damage can be prevented, however, by replacing the upper part of the soil with coarse textured, well compacted fill material and by installing a good subsurface drainage system of adequate side ditches and culverts.

The land capability classification is IIs in nonirrigated areas and I in irrigated areas. The woodland ordination symbol is 2a.

Sy—Seelyeville, Cathro, and Markey mucks. These nearly level, very poorly drained soils are in drainageways and in kettles and basins. They are subject to ponding. Areas are rounded, elongated, or irregularly shaped and range from about 5 to 2,000 acres. The acreage of this map unit is about 50 percent Seelyeville soil, 35 percent Cathro soil, and 15 percent Markey soil. A single mapped area may contain one or more of the soils. These soils have similar behavior characteristics for present or anticipated uses in the survey area, and it was not considered practical or necessary to map them separately.

Typically, the Seelyeville soil has an upper layer of black muck about 29 inches thick. The next layer to a depth of about 60 inches is dark reddish brown muck. 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 40 inches thick. The substratum to a depth of about 60 inches is gray, mottled silt loam. In some places the organic material is mostly peat, and in other places it is less than 16 inches thick.

Typically, the Markey soil has an upper layer of black, very dark gray, and dark reddish brown muck about 41 inches thick. The substratum to a depth of about 60 inches is dark gray sand. In some places the organic material is mostly mucky peat, and in other places it is less than 16 inches thick.

Included with these soils in mapping are small areas of somewhat poorly drained to excessively drained soils in the higher landscape positions. Also included are small springs, fill areas, and ponds; some areas where the soils are extremely acid and do not support trees of merchantable size or quality; and, adjacent to lakes, some areas that are inundated throughout most of the year. Included areas make up less than 5 percent of the map unit.

Permeability is moderately rapid in the organic part of the Seelyeville, 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 all three soils. The available water capacity is very high. The organic layers are medium acid to mildly alkaline. The content of organic matter in the surface layer 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 for some plants.

Most of the acreage is woodland or supports wetland vegetation, such as tag alder, dogwood, willow, sedges, reeds, cattails, mosses, and wetland grasses and forbs.

These soils are suited to trees. Some timber stands are mostly northern white-cedar, black spruce, tamarack, and balsam fir. Other stands have only a few of these trees and are mostly red maple, aspen, paper birch, American elm, white spruce, and yellow birch. White ash, black ash, and eastern hemlock are in some stands.

Woodland management is governed by the species in the stand and landowner objectives. It should favor hardwood species, but northern white-cedar can be favored for posts and piles or balsam fir can be favored for pulpwood. Because of the wetness, the use of equipment generally is limited to the winter months, when the ground is frozen. Reforestation is restricted to natural regeneration or hand planting. Seedling mortality resulting from soil wetness and from the organic surface layer can be reduced by planting large, vigorous nursery stock on cradle knolls or prepared ridges.

Trees are shallow rooted because of the high water table and can be blown down by strong winds. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. Sites harvested by clear cutting commonly regenerate to tag alder. Windthrow of trees and plant competition can be minimized by a harvest method, such as a shelterwood cut or strip cut, that maintains most of the tree canopy. Herbicides can also be used to control undesirable plants.

These soils are generally not suited to farming because of the wetness, low natural fertility, 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.

These soils are generally unsuited to septic tank absorption fields, dwellings, and local roads, mainly because of subsidence, ponding, and the danger of frost damage to local roads. Overcoming these limitations is difficult. As a result, a better site should be selected.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 3w.

VsB—Vilas loamy sand, 0 to 6 percent slopes. This nearly level, gently sloping, or undulating, excessively drained soil is on upland flats, on small swells or knolls, and on the sides of drainageways, kettles, and basins. It is pitted in places. Slopes are long and smooth or short and complex. Areas are elongated or irregularly shaped and range from about 10 to 1,100 acres.

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 25 inches thick. It is dark reddish brown and dark brown, very friable loamy sand in the upper part and brown, loose sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand. In places the surface layer is sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres soils and the moderately well drained Croswell soils in swales and drainageways. Also included are wet spots, sand pits, and depressions; some small areas where the slope is more than 6 percent; and some areas where the soil has layers of loamy material or where the sand fraction is fine or very fine. Included areas make up less than 5 percent of the map unit.

Permeability is rapid in the Vilas soil. Runoff is very slow. The available water capacity is low. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is low or very low. The surface layer can be easily tilled throughout a wide range in moisture content.

Most areas are used as woodland. Some areas are used as cropland or pasture. The cropland commonly is irrigated if the crop is potatoes or snap beans. This soil is a probable source of sand.

This soil is suited to trees. The timber stands are mostly aspen, balsam fir, eastern white pine, jack pine, red pine, and northern pin oak. Paper birch and northern red oak are in some stands. Management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young stands consisting mostly of aspen and balsam fir. Seedling survival in dry periods can be improved by planting containerized seedlings or large, vigorous nursery stock when the soil is moist and by furrowing or bedding, which conserves moisture.

This soil is suited to corn, vegetable crops, and small grain and to grasses and legumes for hay and pasture. Field borders, field windbreaks, and vegetative row barriers help to prevent excessive soil blowing and conserve moisture. Irrigation commonly is needed in areas used for potatoes and snap beans. Because of the slope, however, obtaining an even distribution of water, fertilizer, and herbicide through the irrigation system is difficult in some areas. Field windbreaks, which help to deflect the force of the wind, permit sprinkler irrigation systems to apply water evenly and efficiently and reduce water loss by evaporation. 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 good plant growth. Additions of plant nutrients are needed because of 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 loss of plant cover and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform 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 readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water. The soil is suited to dwellings and to local roads. It may cave if excavated.

The land capability classification is IVs in nonirrigated areas and IIIe in irrigated areas. The woodland ordination symbol is 3s.

VsC—Vilas loamy sand, 6 to 15 percent slopes. This sloping or rolling, excessively drained soil is on swells, hills, and ridges and on the sides of valleys, kettles, and basins. Slopes are short and are smooth or complex. Areas are elongated or irregularly shaped and range from about 5 to 100 acres.

Typically, the surface layer is black loamy sand about 2 inches thick. The subsurface layer is brown sand about 3 inches thick. The subsoil is about 22 inches thick. It is dark reddish brown and reddish brown, very friable 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 places the surface layer is sand. In other places the slope is less than 6 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres and moderately well drained Croswell soils in swales and drainageways. Also included are wet spots, some small areas where the slope is more than 15 percent, and some areas where the soil has layers of loamy material or where the sand fraction is fine or very fine. Included areas make up less than 5 percent of the map unit.

Permeability is rapid in the Vilas soil. Runoff is slow. The available water capacity is low. The subsoil is slightly acid to very strongly acid. The content of organic matter in the surface layer is low or very low.

Most areas are used as woodland. A few small areas are used as cropland or pasture. This soil is a probable source of sand.

This soil is suited to trees. The timber stands are mostly aspen, balsam fir, eastern white pine, jack pine, red pine, and northern pin oak. Paper birch and northern red oak are in some stands. Management is governed by the species in the stand and landowner objectives. It should favor northern red oak and pine. Harvest by selective cutting benefits some hardwood species but does not favor oak or pine. Clear-cut areas commonly regenerate to young stands consisting mostly of aspen and balsam fir. Seedling survival in dry periods can be improved by planting containerized seedlings or large, vigorous nursery stock when the soil is moist and by furrowing or bedding, which conserves moisture.

Because of the low available water capacity and the low natural fertility, this soil is generally not suited to farm crops. It is suited to pasture, but the droughtiness and the natural low fertility are limitations. A cover of pasture plants is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soil is dry results in loss of plant cover and growth of undesirable plant species. Proper stocking rates, rotation grazing, pasture renovation, and restricted use during dry periods help to keep the pasture and the soil in good condition. Clipping or mowing the pasture controls weeds and brush and encourages uniform 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 readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water. Because of the slope, the soil is only moderately suited to dwellings and local roads. The slope can be reduced by land shaping. Also, dwellings can be designed so that they conform to the natural slope of the land. The soil may cave if excavated.

The land capability classification is VIs. The woodland ordination symbol is 3s.

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 and 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 inputs of energy and economic resources, and farming it results in the least damage to the environment.

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

Langlade County has about 192,740 acres of prime farmland, but only 42 percent of this land is currently farmed. An additional acreage of prime farmland occurs as areas of Hatley and Kennan soils where the removal of surface stones has facilitated cultivation.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed at the end of this section. The nonstony areas of Hatley and Kennan soils are not included on the list. 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 for 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 on the following list. Onsite evaluation is needed to determine whether or not the limitation has been overcome by corrective measures.

AoA	Antigo silt loam, 0 to 2 percent slopes
AoB	Antigo silt loam, 2 to 6 percent slopes
Co	Comstock silt loam (where drained)
CyB	Crystal Lake silt loam, 0 to 6 percent slopes
FoB	Freeon silt loam, 2 to 6 percent slopes
LgA	Langlade silt loam, 0 to 2 percent slopes
LgB	Langlade silt loam, 2 to 6 percent slopes
MgB	Magnor silt loam, 0 to 4 percent slopes (where drained)
MhB	Marathon loam, bedrock substratum, 2 to 6 percent slopes
MoB	Milladore silt loam, 0 to 4 percent slopes (where drained)
MyB	Mylrea silt loam, 0 to 4 percent slopes (where drained)
Os	Oesterle silt loam (where drained)
Sc	Scott Lake silt loam

Use and Management of the Soils

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

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

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

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

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

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

Woodland Management and Productivity

Most of Langlade County was forested prior to settlement. The forests were a mixture of pine, northern hardwoods, hemlock, lowland hardwoods, and swamp conifers. Logging, fires, and agricultural activities have altered the original forests. Currently, about 355,795 acres is used as forest, which is the most extensive land use in the county. The forested acreage includes about 39,600 acres of wooded swamps. The rest is upland woods (*10*).

The wooded swamps commonly have stands of balsam fir, black spruce, northern white-cedar, tamarack, red maple, aspen, paper birch, American elm, white spruce, and yellow birch. Some stands are mostly aspen or swamp conifers. Black ash, white ash, and eastern hemlock are in some stands.

The upland woods in areas of fertile soils commonly have stands of sugar maple, American basswood, black cherry, white ash, yellow birch, American elm, and aspen. Balsam fir, paper birch, white spruce, eastern hemlock, northern red oak, and eastern white pine are in some stands. Young, even-aged stands are mostly aspen and birch. Red maple, aspen, and balsam fir generally are the major components of stands on somewhat poorly drained soils. Stands of aspen, balsam fir, and paper birch are on droughty soils, on steep, north-facing slopes, and on fertile soils that are managed for these species. Red pine, jack pine, and northern pin oak predominate on some droughty soils.

In 1968, the composition of forest land, by stand-size class, was 17 percent sawtimber, 49 percent poletimber, 33 percent seedlings and saplings, and 1 percent nonstocked areas (*10*). The sawtimber was mostly maple, followed by elm, aspen, spruce, balsam fir, pine, basswood, birch, oak, ash, and other species. About 45 percent of the forest land owned by the county is managed for the production of sawtimber. The poletimber, seedlings, and saplings were mostly maple and aspen, followed by spruce, balsam fir, basswood, elm, birch, pine, ash, oak, and other species. The trend is toward more sawtimber and poletimber and fewer seedlings and saplings.

Composition of the forest land by forest type in 1968 was 5 percent pine; 20 percent spruce, fir, and other conifers; 4 percent oak; 7 percent elm, ash, and other lowland hardwoods; 30 percent maple, basswood, birch, and other upland hardwoods; 33 percent aspen and birch; and 1 percent nonstocked areas.

Growing stock produced a volume of 3,633,900 cords in 1968; sawtimber, a volume of 500,221,000 board feet; and cull trees, a volume of 219,300 cords. The volume of growing stock and sawtimber has increased since 1956, and the volume of cull trees has decreased.

In 1968, Langlade County had about 6,290 acres of conifer plantations more than 5 acres in size. Most of these plantations are red pine, but some are eastern white pine, jack pine, white spruce, balsam fir, and other species (fig. 13). Many were planted in the 1930's, when reforestation was at its peak. About 125 acres is planted annually to conifers, mostly red pine.

Management for wood crops on the soils in Langlade County varies according to the species in the stand and landowner objectives. It should favor any hardwood trees, especially northern red oak and pine. Harvest by selective cutting benefits most hardwood species but does not favor northern red oak and pine. Clear-cut areas commonly regenerate to young, even-aged stands consisting mostly of aspen and birch on fertile upland soils; to young stands consisting mostly of aspen, birch, and balsam fir on droughty upland soils; and to mostly tag alder on very poorly drained soils. Management on the wetter soils can favor northern white-cedar for posts and piles or balsam fir for pulpwood.

Management should include controlling erosion, overcoming soil-related equipment limitations, improving seedling survival, minimizing the windthrow of trees, controlling the growth of the vegetation that competes with tree regeneration, planting trees where natural regeneration is unreliable, timely harvesting, controlling damage by insects and diseases, removing cull trees and undesirable species, maintaining the most productive basal area, preventing woodland fires, and excluding livestock. Management of public lands for maximum timber production is generally tempered by considerations of wildlife management, including the kinds of trees that are best suited to habitat for wildlife.

Soil erosion generally is a hazard on forest land if the slope is 15 percent or more. It can occur following site preparation and cutting if the soil is exposed along roads, skid trails, and fire lanes and on landings. Burned or overgrazed areas are also subject to erosion. About 22 percent of the forest land in the county, including Keweenaw soils and some areas of Pence soils, is sus-

Figure 13.—Plantation of pruned balsam fir on an Antigo soil.

ceptible to erosion. Excessive soil loss can be prevented by logging, planting trees, and building roads on the contour; yarding uphill with a cable; removing water with water bars, out-sloping road surfaces, culverts, and drop structures; preventing fires; and excluding livestock from the woodland.

Soil wetness can result in seedling mortality, limit the use of equipment, increase the extent of the vegetation that competes with tree regeneration, and increase the windthrow hazard. Wetness results from flooding, ponding, or a water table at or near the surface. The seedling mortality rate can be reduced by planting large, vigorous nursery stock on cradle knolls or prepared ridges. Where mechanical tree planters cannot operate because of wetness, hand planting of trees is necessary if natural tree regeneration is unreliable. The use of equipment on poorly drained and very poorly drained soils is generally limited to the winter, when the ground is frozen. Somewhat poorly drained soils, especially the silty ones, are easily rutted by wheeled vehicles during wet periods. If the ruts are deep, tree roots can be damaged, soil structure can be altered, and lateral drainage can be restricted. Equipment should be used only during dry periods or when the ground is frozen.

Trees are shallow rooted where the water table is near the surface and can be blown down by strong winds. The invasion or growth of undesirable plants that follows removal of the tree canopy during a harvest can prevent natural regeneration of the desired native trees and hinder the establishment of planted trees. This plant competition is a problem on most of the soils in the county. It is more severe on the wetter soils than on other soils. Windthrow of trees and plant competition can be minimized by a harvest method that maintains most of the tree canopy. Plant competition can also be controlled by establishing the new forest soon after harvesting or by removing the undesirable plants with herbicides. In areas where equipment can operate, the unwanted plants can be removed by machinery. Skidding may expose enough soil for adequate regeneration.

Slope and *stoniness* can limit the use of forestry equipment. Slope is a problem in areas where it is 15 percent or more. Stones on and in the Hatley, Kennan, and Keweenaw soils also interfere with the use of equipment. Trees should be planted by hand and yarded with a cable in areas where the slope or stones prohibit the use of equipment. Roads can be built on the contour or in the less sloping areas.

Soil droughtiness can cause seedling mortality. Steep slopes facing south or west are especially droughty because of high temperatures and high evaporation rates. Croswell, Keweenaw, Pence, Vilas, and other soils that formed in sandy deposits or are underlain by sandy and gravelly deposits are droughty. Menominee soils are droughty in the sandy upper part. The seedling survival rate during dry periods can be increased by planting containerized seedlings or vigorous nursery stock when the soil is moist and by furrowing or bedding, which conserves moisture. Reinforcement planting may be needed on very dry sites.

Table 5 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each suitable soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. It is based on the site index of the species listed first in the *common trees* column. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *r* indicates steep slopes; *x*, stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted rooting depth; *c*, clay in the upper part of the soil; *s*, sandy texture; and *f*, high content of coarse fragments in the soil profile. The letter *a* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: r, x, w, t, d, c, s, and f.

In table 5, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

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

Trees to plant are those that are suited to the soils and to commercial wood production.

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

Crops and Pasture

James L. Enlow, conservation agronomist, Soil Conservation Service, helped prepare this section.

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

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

About 94,173 acres in Langlade County was used for crops and pasture in 1978 (*15*). Of this total, about 15,334 acres was pasture, including 5,843 acres of permanent pasture. An additional 11,977 acres was grazed woodland. In 1979, about 3,200 acres was used for corn harvested for grain and 4,500 acres was used for corn silage. Also, about 12,200 acres was used for oats, 90 acres for barley, 200 acres for wheat, 150 acres for soybeans, 11,300 acres for alfalfa hay, 24,600 acres for other hay, 9,400 acres for potatoes, 300 acres for peas, and 3,400 acres for snap beans (*17*). In 1981, small acreages were used for rye, sudangrass, sunflowers, sweet corn, raspberries, strawberries, apples, and nursery plants.

A large part of the cropland is used for the production of alfalfa, oats, and corn to support the dairy industry. The hay crop is commonly a mixture of bromegrass and alfalfa. In the western part of the county, however, it is mostly red clover because the soils are generally too wet to support good stands of alfalfa. Red clover also is grown in rotation with potatoes and oats because it can tolerate the acid soil conditions that are maintained for the potato crop. The acreage used for hay has remained relatively stable in recent years. The acreage cropped to corn has increased. The acreage used for oats has decreased dramatically. The acreage used for potatoes has remained stable. The small acreage used for wheat, barley, rye, and soybeans also has remained stable. The acreage used for peas has decreased sharply because a local cannery now processes snap beans instead of peas.

The soils in Langlade County vary in their suitability for specialty crops. Special management commonly is needed if specialty crops are grown. Also, the management is more intensive than that used for the commonly grown crops. Management for potato production is an example. It includes not only the basic management techniques used for the commonly grown crops but also irrigation and extensive applications of herbicide, fungicide, and insecticide. Nearly level, well drained, fertile soils that have a high available water capacity, such as most of the soils in Langlade County, are especially well suited to potatoes, sweet corn, snap beans, peas, soybeans, and sunflowers. Sandy soils and other soils in which tilth is good but available water capacity is low are suited to strawberries. Most of the well drained soils in the county are suited to small fruits, tree fruits, and nursery plants. Soils in low positions where frost is frequent and air drainage is poor are poorly suited to vegetables, small fruits, and tree fruits. The organic soils in low positions, however, may have potential for mint, cranberries, and sod for lawns.

The latest information about growing specialty crops can be obtained from the local office of the Cooperative Extension Service.

The soils in Langlade County have good potential for increased production of farm crops. If proper conservation measures are applied, about 244,000 acres of forested land, including some prime farmland, can be converted to cropland. Some soils would be suitable as cropland if surface stones were removed. In the western part of the county, forage production can be increased if the wet soils are drained and used for alfalfa instead for forage grasses or red clover. Food production also can be increased considerably by applying the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

Management varies on the different kinds of soil in Langlade County. Basic management, however, is needed on practically all of the soils. It should include controlling erosion, providing an adequate drainage system, maintaining fertility, maintaining or improving tilth, liming, preparing a good seedbed, and timely harvesting. Basic management of pasture should include proper stocking rates; rotation grazing; pasture renovation; clipping or mowing, which removes weeds and brush and encourages uniform regrowth and grazing; and restricted use during periods when the soil can be damaged by grazing. Crop yields and the kinds of crop that can be grown are limited by the frost hazard, a short growing season, and cool temperatures.

Water erosion is generally a hazard if the slope of the soil is more than 2 percent. About 64 percent of the acreage in Langlade County is wholly or partly susceptible to erosion. Most of this acreage, however, currently has a protective cover of vegetation. Erosion is a problem in areas where the erodible soils are used for row crops.

Erosion is damaging for three reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a layer in or below the subsoil that limits the depth of the root zone. Such a layer includes the strata of gravel in Antigo soils, the bedrock in Marathon soils, and the very compact strata in Freeon soils. Vilas and other sandy soils are damaged when erosion exposes infertile sand. Second, erosion adversely affects tilth and the infiltration of water. Eroded soils are generally more difficult to till than uneroded soils because the clay content of the plow layer usually increases when part of the subsoil is incorporated into the plow layer. Third, erosion results in sediment entering lakes and streams. Control of erosion helps to prevent this sedimentation and improves the quality of water for municipal use, recreation, and fish and other wildlife.

Erosion-control measures provide a protective cover, reduce the runoff rate, increase the rate of water infiltration, and divert runoff from critical areas. A cropping system that keeps a plant cover on the soil for extended periods can hold erosion to a level that does not reduce the productive capacity of the soil. Including grasses and legumes in the cropping sequence helps to control erosion and improves tilth. The legumes also provide nitrogen for the following crop.

Slopes are so short or irregular that contour farming or terracing is not practical on Amery soils, in nonstony areas of Kennan soils, and in some areas of Antigo, Freeon, and Pence soils. On these soils a cropping system that provides an adequate plant cover is needed to control erosion.

A conservation tillage system, such as chisel planting, that leaves a protective amount of crop residue on the surface, cover crops, green manure crops, crop residue management, grasses and legumes in the cropping sequence, regular additions of manure, and mulching increase the rate of water infiltration and reduce the runoff rate and the susceptibility to erosion. They are suited to all erodible soils in the county. Plowing in the spring instead of the fall also is effective in controlling erosion. Fall plowing leaves the surface layer exposed to the erosion damage caused by spring runoff.

Terraces and diversions reduce the length of slopes and direct runoff away from critical areas, thus reducing the amount of runoff and erosion. They are most practical on deep, well drained soils that have long and uniform slopes. Many of the soils in the county are generally not suited to terraces and diversions because of short slopes, irregular slopes, excessive wetness in channels, stoniness, or infertile sand and gravel, which would be exposed in the channels. Diversions help to protect low lying areas from the runoff from higher areas.

Grassed waterways remove excess surface water and reduce the risk of erosion on erodible slopes along natural drainageways. They are most practical on deep, well drained soils. They are common in the county. Some are tiled. Tiling reduces wetness in channels. As a result, farm machinery can more easily cross the channels and a plant cover can be more easily established. Establishing grassed waterways is difficult on many soils because of excessive wetness in channels, stoniness, or infertile sand and gravel, which would be exposed in the channels.

Contour farming and contour stripcropping help to control erosion on soils that have long and uniform slopes. They allow for more intensive cropping of erodible soils by reducing the runoff rate and the risk of erosion. If they are used on the wetter soils, such as Magnor, establishing a slight grade towards grassed waterways helps to remove excess surface water.

Critical area planting helps to stabilize areas of highly erodible soils where vegetation is difficult to establish.

Soil blowing is a hazard on soils that have a loamy sand, sandy loam, or muck surface layer. Most areas of these soils, however, currently have a protective cover of vegetation, including trees. Soil blowing can damage the soils in a short time if winds are strong and the soils are dry and bare of vegetation. Field borders, field windbreaks, and vegetative row barriers help to prevent the damage to soils and crops caused by soil blowing. Conservation tillage, cover crops, green manure crops, crop residue management, grasses and legumes in the cropping sequence, regular additions of manure, and tillage methods that keep the surface rough also help to control soil blowing.

Information about the design of measures that control erosion and soil blowing on each kind of soil is contained in the Technical Guide, available at the local office of the Soil Conservation Service.

Soil drainage is a problem on some of the acreage used for crops and pasture. Most of the wetter areas are not farmed.

The poorly drained or very poorly drained soils generally are not farmed because of excessive wetness and frequent frost. Cable, Cathro, Fordum, Loxley, Markey, Minocqua, Seelyeville, and Sherry soils are examples.

Most of these soils cannot be drained because suitable drainage outlets are not available.

The somewhat poorly drained soils are mostly or entirely used for nonfarm purposes, primarily woodland. Au Gres, Comstock, Hatley, Ingalls, Magnor, Milladore, Mylrea, and Oesterle soils are examples. A small acreage of Au Gres, Comstock, Hatley, and Ingalls soils and a large acreage of Magnor and Oesterle soils are farmed. The wetness of these soils limits crop yields and the kind of crop that can be grown. A drainage system is needed to remove excess water (fig. 14).

Small areas of wetter soils are included with the moderately well drained Croswell, Crystal Lake, Freeon, Marathon, Menominee, and Scott Lake soils in mapping. A drainage system is needed in some of these included areas to promote uniform drying.

Surface drainage systems provide for an orderly removal of the excess surface water resulting from spring runoff, excessive irrigation, or heavy rains. The systems may consist of field ditches, land smoothing, land grading, or a combination of the three, along with ditches to carry the water to an outlet. On Comstock and Oesterle soils and in nearly level areas of Magnor soils, a surface drainage system is needed to improve the growing conditions for most crops. The sides of ditches in areas of the Comstock and Oesterle soils should be gentle because the substratum of these soils is unstable. Diversions are needed on the adjoining uplands to protect many of the soils from the runoff from those uplands. The runoff or seepage from the adjoining uplands also can be intercepted by field ditches at the base of the upland slopes. Land smoothing helps to prevent the crop damage caused by ponding on Scott Lake soils and in nearly level areas of Antigo, Crystal Lake, and Langlade soils.

Subsurface drainage systems remove free water from below the surface. The drains lower the water table and thus improve growing conditions for most crops. Generally, subsurface tile drains carry the water to specific drainage outlets. Ditches can be used to lower the water table, however, especially in soils that have highly permeable layers, such as Au Gres and Ingalls soils. The

Figure 14.—Excess surface water on an Oesterle soil.

ditches can serve as suitable outlets for tile drains in the areas of Au Gres, Comstock, Ingalls, and Oesterle soils where a natural outlet is not available. The sides of the ditches in these areas should be gentle because they may be unstable. The tile drains should be protected by filters, which keep fine particles of silt and sand from clogging the drains. Frost action in the Comstock and Oesterle soils can cause displacement of the tile drains. Interception tile drains can reduce the wetness in the Ingalls soils by intercepting seepage from the adjoining uplands. Because stones restrict excavation, tile drains are not practical in Hatley soils. They are not practical in Magnor soils because water moves too slowly through the profile.

Information about the design of drainage systems for each kind of soil is contained in the Technical Guide, available at local offices of the Soil Conservation Service.

Soil fertility is naturally low in the sandy Au Gres, Croswell, and Vilas soils and in the organic Cathro, Loxley, Markey, and Seelyeville soils. Fertility also is low in the upper part of the sandy Ingalls and Menominee soils. Some of the most fertile soils in the county are the deep, silty soils, such as some of the Kennan soils and all of the Comstock, Crystal Lake, Freeon, Hatley, Langlade, Magnor, and Milladore soils, which have a high or very high available water capacity.

Fertility can be improved by applying commercial fertilizers. The response to additions of plant nutrients is limited on most of the soils, however, because of acid soil conditions, wetness, or both. Most of the soils have a low supply of potassium. Applications of nitrogen, phosphorus, and potassium generally are needed before crops, especially potatoes, can grow well. Applications of boron generally are needed to help in establishing a good stand of legumes on dairy farms. Applications of sulfur are beneficial on the sandy soils.

Fertility also can be improved by measures that add organic matter to the soil. Examples are applying barnyard manure, mulching, plowing a green manure crop under, and returning crop residue to the soil.

All of the cropped soils in the county are naturally acid. Applications of lime are needed to raise the pH level sufficiently for good growth of alfalfa and other crops that grow best on nearly neutral soils. In areas used for potatoes, however, acid soil conditions are needed to prevent the development of potato scabs.

On all soils additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime needed.

Soil tilth is an important factor in the germination of seeds, the emergence of seedlings, and the infiltration of water into the soil. Soils with good tilth are granular and porous. Tilth generally is good in the soils in Langlade County if the surface layer is high or very high in content of organic matter or is loamy sand, sandy loam, or loam.

Most of the cropped soils in the county have a silt loam surface layer that has a moderate content of organic matter. Intensive rainfall or excessive irrigation on these soils results in puddling and crusting of the surface layer. Crust formation is especially common in eroded areas where organic matter in the surface layer has been lost through erosion. The crust, which is hard when dry, reduces the rate of water infiltration. In most areas it increases the runoff rate. On nearly level soils in swales and furrows, it increases the extent of ponding. The crust also restricts the emergence of seedlings. Cover crops, green manure crops, crop residue management, grasses and legumes in the cropping sequence, regular additions of manure, and mulching improve soil structure and help to prevent crusting.

Excessive tillage, use of heavy farm machinery, overgrazing, and tilling or grazing when the soil is too wet can result in surface compaction and thus in poor tilth. Excessive tillage can be avoided if a system of conservation tillage is applied. Proper stocking rates and rotation grazing can prevent overgrazing. Chisel plowing helps to loosen compacted soil.

Hatley, Kennan, and Keweenaw soils cannot be tilled unless the stones that interfere with tillage are removed. Coarse gravel and cobbles in the surface layer of Antigo, Langlade, Oesterle, Pence, and Scott Lake soils are problems because they are difficult to separate from potatoes during harvest.

Irrigation on some of the Antigo, Langlade, Pence, Scott Lake, and Vilas soils helps to maintain a sufficient amount of available water for specialty crops, such as potatoes and snap beans. About 10,000 acres was irrigated in 1981, mostly by sprinkler systems. In the future the extent of irrigation could be increased considerably in Langlade County because of ample water supplies and large acreages of nearly level soils that are suited to irrigation. The water for irrigation is drawn from wells and ponds. The trend is toward greater use of wells.

Strong winds can prevent a uniform application of water from sprinkler systems. Field windbreaks and vegetative row barriers help to deflect the force of the wind and conserve available water.

Information about the design of irrigation systems for each kind of soil is available in the local office of the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in tables 6 and 7. In any given year, yields may be higher or lower than those indicated in the tables because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the tables.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered (*6*).

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

Yields of irrigated crops are the same for all the irrigated soils. To obtain these yields, the irrigation system should be adapted to the soils and to the crops grown, good quality irrigation water should be uniformly applied as needed, and tillage should be kept to a minimum. Also, management should be more intensive on some soils than on others. For example, more fertilizer is needed on soils that are low in fertility than on the more fertile soils.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 and 7 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (*13*). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

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

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields tables.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service, from the Wisconsin Department of Natural Resources, or from a commercial nursery.

Recreation

Langlade County provides many opportunities for outdoor recreation. Visitors are attracted by the scenic wooded landscape, the many lakes and streams, the large remote areas that retain a wilderness quality, and the many species of wildlife. Recreational facilities are needed to accommodate the local population and the seasonal influx of tourists and vacationers.

Public ownership of recreational resources helps to prevent development for other uses and ensures access. State ownership of frontage along spring ponds, prime trout streams, and the Wolf River is increasing. The state currently owns much of the shoreline along the Wolf River. Entire shorelines of many lakes are publicly owned. Some frontage along many lakes and streams, including many trout streams, is in public ownership.

Fish and other wildlife resources, described under the heading "Wildlife Habitat," are ample and readily available for fishing, hunting, and trapping. Preservation of wildlife habitat is vitally important if the county is to continue providing recreational opportunities. Peters Marsh and Ackley Wildlife Areas are intensively managed for the production of wildlife, especially waterfowl and sharp-tailed grouse. Public forests are managed for increased wildlife populations. Many trails are managed as grouse hunting trails.

Woodland resources, described under the heading "Woodland Management and Productivity," are used for recreational activities, such as snowmobiling, hunting, cross-country skiing, hiking, picnicking, snowshoeing, and horse riding. Many paths and trails meander through the forests. The county has the largest network of snowmobile trails in the state. Hiking is available on many trails, including the scenic Ice Age Trail, and on old logging and tote roads throughout the forests. These roads and trails are also used for snowmobiling and cross-country skiing. Cross-country skiing is practiced on five major trails. Several riding stables also have trails. The county has many miles of marked auto tours. Woodland provides the setting for two golf courses and one downhill ski area.

Water resources, described under the heading "Water Supply," are used for fishing, boating, canoeing, sailing, waterskiing, swimming, trapping, and waterfowl hunting. They also are used for skating and snowmobiling in winter. Some lakes, including Black Oak, Enterprise, Greater Bass, Upper Post, Rolling Stone, and Summit Lakes, are suitable for fast boating, sailing, and waterskiing. The number of trips by rafts, canoes, and inner tubes on the Wolf River has increased greatly in recent years.

Langlade County has many miles of water frontage along lakes and streams. Some of this frontage is developed and used for resorts, organizational camps, campgrounds, cottages, summer homes, and year-round homes. Access to lakes is provided on all of the campgrounds in the county. Many of the county parks and local parks and waysides are on water frontage where recreational facilities, such as swimming areas, bathhouses, and boat ramps, are available. The parks and waysides include playgrounds, picnic areas, ball diamonds, grills, horseshoe courts, and hiking trails.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Langlade County has a large and varied population of wildlife because of the diversity provided by wetland, woodland, cropland, areas of open water, and remote areas. The large remote areas are inhabited by black bear, bobcat, and other wildlife characteristic of wilderness areas.

The many lakes, streams, and spring ponds support many species of fish, including muskellunge, trout, northern pike, walleye, largemouth and smallmouth bass, and panfish, such as perch, sunfish, bluegill, crappie, and pumpkinseed. The county has more spring ponds than any other county in the state. Good fish populations are in the lakes and trout streams (fig. 15).

The areas of poorly drained and very poorly drained Cable, Cathro, Fordum, Loxley, Markey, Minocqua, Seelyeville, and Sherry soils are seasonally used for hunting and trapping. They are suited to habitat for wetland wildlife. The Loxley soils support a bog vegetation of mosses, leatherleaf, and a few stunted black spruce or tamarack trees. The other wet soils occur as an intermixture of brushy areas, freshwater marshes, meadows, and wooded swamps, which provide the habitat diversity needed by many species of wildlife. The adjacent streams and lakes and the small areas of open water included with these soils in mapping provide good habitat for waterfowl and furbearers. The wildlife habitat can be improved by management that favors the areas of open water, preserves den trees, favors production of herbaceous vegetation and shrubs, and provides seedlings and saplings for browse. Constructing dugout ponds and level ditches helps to provide areas of open water. The wetness of the soils, however, commonly limits the use of machinery to periods when the soil is frozen. Cutbanks may cave on all of the soils, except for Cable and Sherry soils. Woodland management that favors a stand of aspen and conifers helps to provide both food and cover for wildlife. Grains and legumes are available on the adjacent uplands. Protection from fire helps to preserve the woodland part of the habitat.

Wildlife habitat on many of the other soils in Langlade County also can be improved by increasing the supply of food and water and the amount of cover. Woodland trails can be planted to white clover. Large stands of upland hardwoods can be improved as wildlife habitat by logging methods that create brushy areas and by planting clumps of conifers near trails and clearings. Creating impoundments in drainageways improves the habitat for waterfowl and furbearers. Some of the management techniques that are needed on the wet soils also are needed on the upland soils.

In the following paragraphs, the six map units described under the heading "General Soil Map Units" are grouped into four wildlife areas. The Magnor-Cable, Oesterele-Minocqua-Scott Lake, and Milladore-Sherry-Mylrea map units have similar wildlife habitat elements and thus are grouped together. The habitat components of wooded swamps and upland woods are further described under the heading "Woodland Management and Productivity." The value of each wildlife area depends on how the soils are interspersed with each other. Generally, a good mixture of soils in an area results in a good mixture of wildlife habitat and thus in a large variety of wildlife species.

Wildlife area 1 is the Kennan-Keweenaw general soil map unit. It is mostly on end moraines and partly on ground moraines and drumlins. The end moraines are characterized by many knolls, swells, hills, and ridges interspersed with many small kettles and a few lake basins and drainageways. Lakes, ponds, bogs, and swamps are in many of the kettles and basins. This area

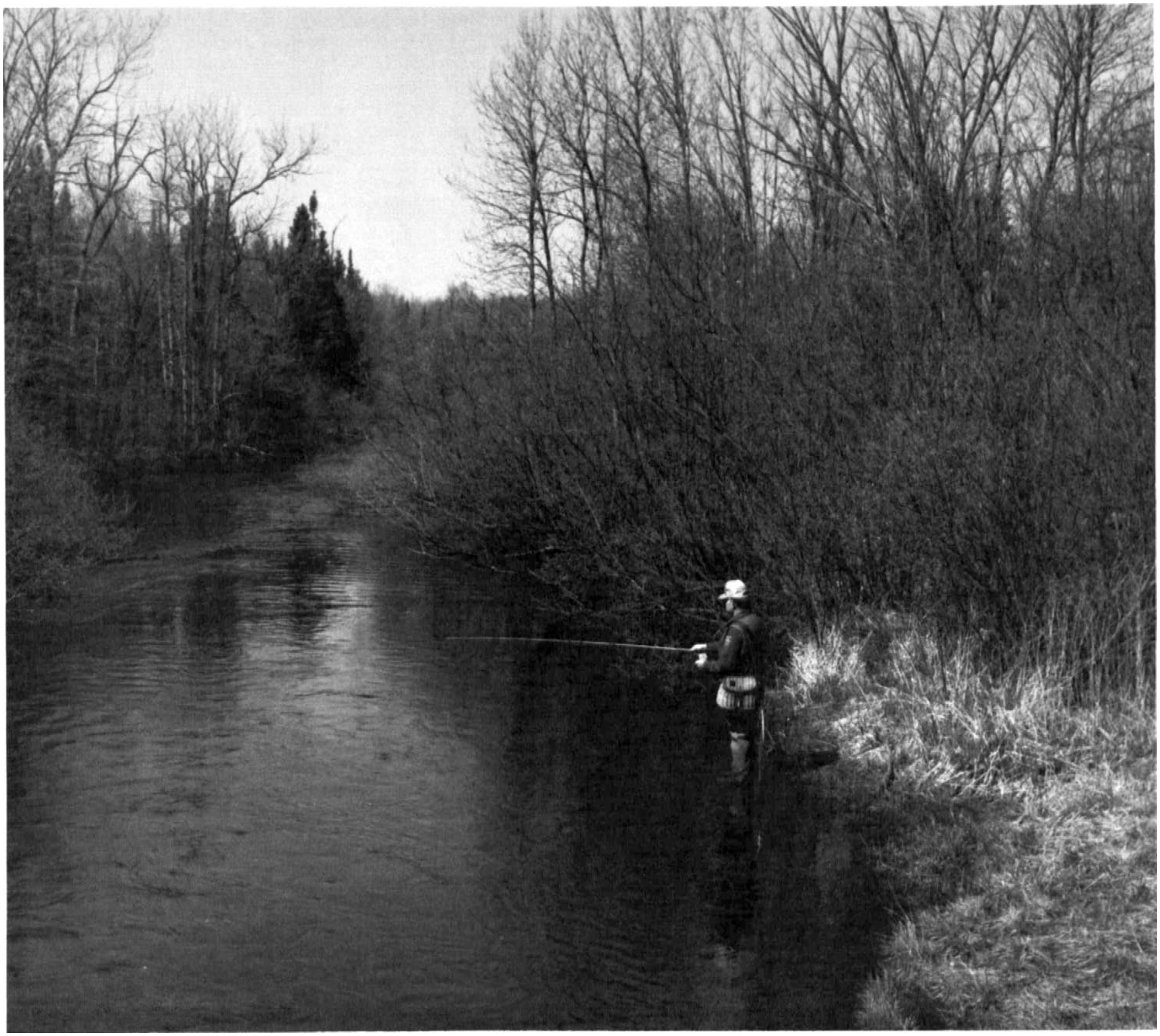


Figure 15.—A trout stream in an area of a Minocqua soil. Tag alder and trees provide protective shore cover and water-cooling shade for trout.

includes large remote areas and only a few streams. Most of the soils are stony and well drained.

This area is mostly upland woods interspersed with a few wetlands. The wetlands are mostly wooded swamps and small, isolated bogs. The bog vegetation is mainly mosses, leatherleaf, and a few stunted spruce and tamarack trees. A large part of the area supports mature upland hardwoods, mainly sugar maple, and provides the essential food and cover for many species of wildlife only along old, brushy logging roads and on logging camp clearings (fig. 16). Some of the tree stands are mostly aspen and birch. Stands of fir, aspen, and birch on steep, north-facing slopes and small stands of hemlock, pine, and oak within the sugar maple stands attract some species of wildlife. The best habitat is where the hardwoods are interspersed with newly logged areas, wet pockets, bogs, wooded swamps, or cropland. Oats, alfalfa, and corn enhance the habitat in this area.

Figure 16.—A mature stand, mainly of sugar maples, in an area of a Kennan soil. This area does not have the essential food and cover for many species of wildlife.

This area has species of wildlife similar to those in wildlife area 3. The population of most species, however, especially waterfowl, furbearers, snowshoe hare, and woodcock, is lower. Also, the population of squirrels, porcupines, chipmunks, woodpeckers, and woodland songbirds is higher. Some fishers inhabit this area.

Wildlife area 2 is the Antigo-Pence general soil map unit. It is mostly on rather flat outwash plains characterized by kettles, drainageways, and basins interspersed with hills and ridges of outwash deposits and a few drumlins, moraine areas, and lake plains. The area has many streams, lakes, and ponds. Many of the ponds are spring ponds. The soils are mostly well drained, but wet soils are in the depressional areas.

This area is mostly upland woods that are commonly interspersed with wetland. The diversity and kinds of habitat elements are similar to those in wildlife area 3, but area 2 has bogs, has more extensive upland woods, and has more lakes and ponds. The upland woods are generally sugar maple or aspen and birch. The wooded swamps are mostly conifers and partly hardwoods. The major crops in the farmed areas are oats, alfalfa, corn, red clover, and potatoes.

This area generally has the same kinds of wildlife as area 3, but it also has some fishers. It has more areas of open water for waterfowl and furbearers.

Wildlife area 3 consists of the Magnor-Cable, Oesterle-Minocqua-Scott Lake, and Milladore-Sherry-Mylrea general soil map units. It encompasses a ground moraine and part of an outwash plain, both of which have little local relief and few prominent features, such as lakes or high hills. Generally, the area has many streams and a few impoundments, small dugout ponds, beaver ponds, and large remote areas. Most of the soils have a seasonal high water table.

This area is mostly upland woods interspersed with many wetlands. The wetlands are mostly shrub swamps and wooded swamps, but some freshwater marshes of cattails and meadows of grasses and rushes are along the drainageways. The shrub swamps are mostly along drainageways. The vegetation in these swamps includes alder, willow, dogwood, and a few aspen. The wooded swamps are mostly conifers and partly hardwoods. The upland woods are generally a mixture of maple, aspen, and conifers or are mostly aspen and birch. The area has some farmland. Oats, red clover, and forage grasses enhance the habitat in this area.

A wide variety of wildlife inhabits this area because of the diversity and intermixture of habitat elements and the many remote areas. The streams, impoundments, and ponds attract not only waterfowl, including wood duck, teal, mallard, and geese, but also furbearers, including muskrat, otter, mink, and beaver. The area also is inhabited by deer, bears, coyotes, foxes, bobcats, squirrels, cottontails, snowshoe hares, raccoons, porcupines, chipmunks, weasels, ruffed grouse, woodcocks, crows, ravens, hawks, owls, woodpeckers, and a wide variety of songbirds.

Wildlife area 4 is the Antigo-Langlade general soil map unit. It is part of a large and rather flat outwash plain that has little local relief, except in the drainage valleys that carry runoff to Spring Brook, which drains the area. The soils are mostly well drained, but a few wet soils are in the depressional areas.

About 90 percent of the area is intensively farmed. Oats, alfalfa, red clover, potatoes, and corn are the major crops. Most of the fence rows do not provide good cover for wildlife. The grass and forb vegetation in the drainage valleys and gravel pits attracts some wildlife. Woodland habitat is scarce, but there are some conifer windbreaks and a few small woodlots consisting mostly of sugar maple. Wetland habitat also is scarce. Spring Brook and a few irrigation ponds are the only areas of open water. Small areas of shrub swamps, wooded swamps, freshwater marshes, and meadows are along Spring Brook.

Few wildlife species inhabit this area. Some squirrels, cottontail rabbits, and chipmunks and a few woodcocks, ruffed grouse, and raccoons inhabit the wooded areas. Crows, hawks, owls, woodpeckers, starlings, doves, and songbirds also inhabit the wooded areas. Redwing blackbirds, sparrows, bobolinks, and meadowlarks are common in the areas of grasses and legumes. A few muskrats and ducks use Spring Brook and the irrigation ponds. Geese and ducks feed on the farm crops during migration periods.

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

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat.

Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are timothy, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are baneberry, goldenrod, wintergreen, foxtail, and bluegrass.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, maple, cherry, hazelnut, apple, aspen, dogwood, birch, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are highbush cranberry, ninebark, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and hemlock.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobolink, killdeer, meadowlark, song sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include snowshoe hare, ruffed grouse, woodcock, bobcat, woodpeckers, squirrels, coyote, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, otter, muskrat, mink, and beaver.

Engineering

Robert E. Wilson, civil engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

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

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

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

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

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity (fig. 17).

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

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site

Figure 17.—Road damage resulting from frost action in a Magnor soil.

features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid or very rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

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

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

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

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

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

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity in the root zone. Availability of drainage outlets is not considered in the ratings.

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

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Robert E. Wilson, civil engineer, Soil Conservation Service, helped prepare this section.

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 18.

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

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

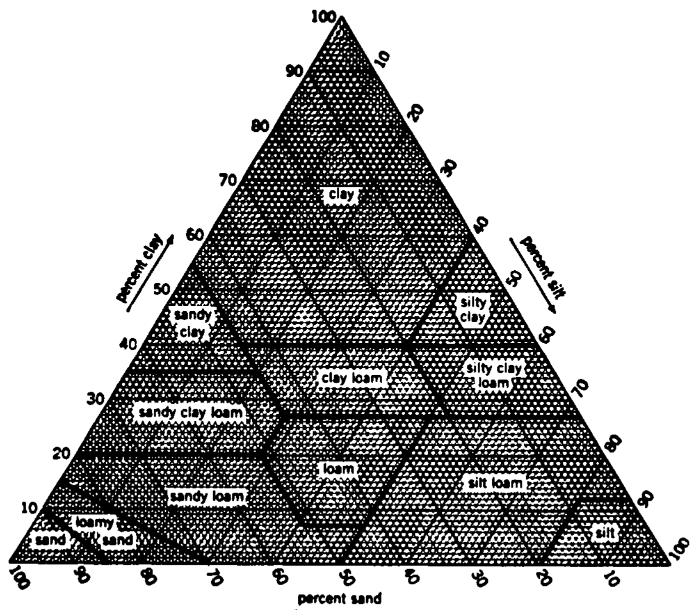


Figure 18.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 18). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

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

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

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range frcm 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 18.

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

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

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

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

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

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

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

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 17 shows the expected total subsidence, which usually is a result of drainage and oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 18 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series or are taxadjuncts to the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Wisconsin Department of Transportation, Division of Highways and Transportation Facilities.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*14*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 19 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Inceptisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquept (*Aqu*, meaning water, plus *ept*, from Inceptisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquepts (*Hapl*, meaning minimal horizonation, plus *aquept*, the suborder of the Inceptisols that have an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquepts.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-loamy, mixed, nonacid, frigid Typic Haplaquepts.

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

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*12*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*14*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

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

Amery Series

The Amery series consists of well drained, moderately permeable soils that formed in loamy deposits and in the underlying loamy and sandy glacial drift. These soils are on moraines. Slope ranges from 6 to 15 percent.

Amery soils are near Freeon soils. Freeon soils are moderately well drained, have more silt in the subsoil than the Amery soils, and are mostly on the crests of swells above the Amery soils.

Typical pedon of Amery loam, 6 to 15 percent slopes, 1,260 feet north and 450 feet west of the southeast corner of sec. 24, T. 32 N., R. 9 E.

A—0 to 3 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; friable; many fine roots; about 9 percent pebbles and 2 percent cobbles; medium acid; abrupt wavy boundary.

E—3 to 4 inches; dark grayish brown (10YR 4/2) loam; weak medium platy structure; very friable; many fine roots; about 9 percent pebbles and 2 percent cobbles; common faint very dark gray (10YR 3/1) wormcasts; medium acid; abrupt broken boundary.

Bs1—4 to 7 inches; dark yellowish brown (10YR 3/4) loam; weak very fine subangular blocky structure; very friable; many fine roots; about 9 percent pebbles and 2 percent cobbles; strongly acid; clear broken boundary.

Bs2—7 to 12 inches; dark yellowish brown (10YR 4/4) loam; weak fine subangular blocky structure; very friable; many fine roots; about 9 percent pebbles and 2 percent cobbles; strongly acid; clear wavy boundary.

E/B—12 to 18 inches; brown (10YR 5/3) loam (E), very pale brown (10YR 7/3) dry; weak medium platy structure; very friable; about 80 percent of the horizon occurring as tongues of E material extending into or completely surrounding isolated remnants of dark yellowish brown (10YR 4/4) loam (Bt); moderate fine subangular blocky structure; friable; discontinuous distinct dark brown (7.5YR 4/4) clay films on faces of peds; common fine roots; about 10 percent pebbles and 2 percent cobbles; strongly acid; clear wavy boundary.

2Bt1—18 to 24 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam; moderate fine and medium subangular blocky structure; friable; few fine roots; about 17 percent pebbles and 2 percent cobbles; discontinuous distinct dark brown (7.5YR 4/4) clay films on faces of peds; strongly acid; clear wavy boundary.

2Bt2—24 to 33 inches; dark brown (7.5YR 4/4) loamy sand; moderate medium subangular blocky structure; friable; tendency to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 14 percent pebbles and 2 percent cobbles; patchy faint dark brown (7.5YR 3/4) clay films on faces of peds; strongly acid; abrupt wavy boundary.

2Bt3—33 to 60 inches; strong brown (7.5YR 4/6) loamy sand; weak medium and coarse subangular blocky structure; friable; tendency to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 12 percent pebbles and 2 percent cobbles; faint dark brown (7.5YR 3/4) clay bridging between most mineral grains; common uncoated sand grains, primarily on vertical faces of peds; few discontinuous layers of brown (7.5YR 5/4) sand; few discontinuous layers of reddish brown (5YR 4/3 and 4/4) sandy loam less than 3 inches thick; strongly acid.

The thickness of the solum ranges from 24 to 65 inches. The content of pebbles ranges from 0 to 15 percent in the upper part of the solum and from 5 to 35 percent in the 2Bt horizon and in the substratum. The content of cobbles ranges from 0 to 3 percent in the upper part of the solum and from 2 to 10 percent in the 2Bt horizon and in the substratum. The solum is very strongly acid to slightly acid. The substratum, if it occurs, is strongly acid to slightly acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 4 inches thick. Some pedons have an Ap horizon. The E/B horizon is loam, sandy loam, or fine sandy loam. The 2Bt horizon is sand, loamy sand, sandy loam, or the gravelly analogs of these textures.

Antigo Series

The Antigo series consists of well drained soils that formed in silty and loamy deposits and in the underlying sand and gravel. These soils are on outwash plains, kames, and eskers. Permeability is moderate in the upper part of the profile and rapid or very rapid in the lower part. Slope ranges from 0 to 15 percent.

These soils average less clay and more fine sand or coarser sand in the upper part of the Bt horizon than is definitive for the Antigo series. This difference, however, does not alter the usefulness or behavior of the soils.

Antigo soils are similar to Langlade and are near Scott Lake soils. Langlade soils are in positions on the outwash plains similar to those of the Antigo soils. Their solum is 40 to 60 inches thick. Scott Lake soils have mottles in the subsoil. They are on the lower lying flats and in swales and drainageways below the Antigo soils.

Typical pedon of Antigo silt loam, 0 to 2 percent slopes, 344 feet north and 1,272 feet west of the southeast corner of sec. 16, T. 31 N., R. 11 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; many fine roots; about 6 percent pebbles and 2 percent cobbles; slightly acid; abrupt smooth boundary.

E—9 to 12 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; weak thin platy structure; very friable; common fine roots; about 2 percent pebbles and cobbles; slightly acid; clear wavy boundary.

B/E—12 to 19 inches; dark yellowish brown (10YR 4/4) silt loam (Bt); moderate very fine angular blocky structure; friable; continuous distinct dark brown (7.5YR 4/4) clay films on faces of peds; about 30 percent of the horizon occurring as tongues of brown (10YR 5/3) silt loam (E), very pale brown

(10YR 7/3) dry; weak thin platy structure; very friable; common fine roots; about 1 percent pebbles and cobbles; very strongly acid; clear irregular boundary.

Bt1—19 to 28 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine angular blocky structure; friable; common fine roots; about 1 percent pebbles and cobbles; discontinuous distinct dark brown (7.5YR 4/4) clay films on faces of peds; common distinct pale brown (10YR 6/3) uncoated silt and very fine sand grains, primarily on vertical faces of peds; very strongly acid; abrupt wavy boundary.

2Bt2—28 to 31 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; friable; common fine roots; about 11 percent pebbles and 2 percent cobbles; patchy distinct dark reddish brown (5YR 3/4) clay films on faces of peds and in pores; common pale brown (10YR 6/3) uncoated silt and sand grains, primarily on vertical faces of peds; very strongly acid; abrupt wavy boundary.

3Bt3—31 to 33 inches; dark brown (7.5YR 4/4) gravelly sandy loam; weak coarse subangular blocky structure; very friable; few fine roots; about 34 percent pebbles and 2 percent cobbles; faint dark reddish brown (5YR 3/4) clay bridging between mineral grains; very strongly acid; abrupt wavy boundary.

3C—33 to 60 inches; brown (7.5YR 5/4) stratified sand and gravel; single grain; loose; about 16 percent pebbles and 2 percent cobbles; strongly acid.

The thickness of the solum ranges from 22 to 40 inches. The silty mantle is as much as 32 inches thick. The content of pebbles ranges from 0 to 5 percent in the silty mantle, from 0 to 15 percent in the 2Bt2 horizon, from 5 to 35 percent in the 3Bt3 horizon, and from 5 to 60 percent in the 3C horizon. The content of cobbles ranges from 0 to 2 percent in the silty mantle and from 0 to 5 percent in the 2Bt2, 3Bt3, and 3C horizons. The substratum is slightly acid to strongly acid.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Some pedons have an A horizon. The 3Bt3 horizon is loamy sand, gravelly loamy sand, sandy loam, gravelly sandy loam, sand, or gravelly sand.

Au Gres Series

The Au Gres series consists of somewhat poorly drained, rapidly permeable soils that formed in sandy deposits. These soils are on outwash plains. Slope ranges from 0 to 2 percent.

Au Gres soils are near Croswell and Vilas soils. Croswell soils are moderately well drained and are mostly on low flats above the Au Gres soils. Vilas soils are excessively drained and are on upland flats, hills, swells, and knolls above the Au Gres soils.

Typical pedon of Au Gres loamy sand, 1,135 feet north and 2,400 feet west of the southeast corner of sec. 7, T. 34 N., R. 12 E.

A—0 to 2 inches; very dark gray (10YR 3/1) loamy sand, dark gray (10YR 4/1) dry; moderate very fine granular structure; very friable; many fine roots; about 2 percent pebbles; few uncoated sand grains; very strongly acid; abrupt wavy boundary.

E—2 to 6 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) sand; few fine faint dark brown (10YR 4/3) and common fine prominent yellowish brown (10YR 5/6) mottles; weak medium platy structure; very friable; many fine roots; about 2 percent pebbles; strongly acid; abrupt broken boundary.

Bhs—6 to 7 inches; dark reddish brown (5YR 3/2) loamy sand; common fine distinct brown (7.5YR 4/4) mottles; weak very fine subangular blocky structure; very friable; many fine roots; about 2 percent pebbles; very strongly acid; abrupt broken boundary.

Bs1—7 to 12 inches; reddish brown (5YR 4/4) sand; few fine distinct yellowish red (5YR 5/6), few fine faint brown (7.5YR 5/3), and common fine prominent dark red (2.5YR 3/6) mottles; weak fine subangular blocky structure; very friable; many fine roots; trace of pebbles; medium acid; clear wavy boundary.

Bs2—12 to 19 inches; brown (7.5YR 5/4) sand; few fine prominent dark reddish brown (2.5YR 2/4), few fine prominent dark red (2.5YR 3/6), common fine prominent yellowish red (5YR 5/8), and common fine faint brown (7.5YR 5/3) mottles; weak medium subangular blocky structure; very friable; common fine roots; about 3 percent pebbles; medium acid; clear wavy boundary.

BC—19 to 41 inches; brown (7.5YR 5/3) sand; common fine prominent dark reddish brown (2.5YR 2/4), common coarse prominent dark reddish brown (2.5YR 3/4), common coarse faint brown (7.5YR 5/4), few coarse faint brown (10YR 5/3), and few medium prominent yellowish red (5YR 5/8) mottles; single grain; loose except for a few thin and medium prominent discontinuous dark reddish brown (2.5YR 2/4 and 3/4) weakly consolidated layers (iron and manganese oxides) in which the content of pebbles is about 7 percent; few fine roots; about 2 percent pebbles in most parts; medium acid; gradual wavy boundary.

C—41 to 60 inches; brown (10YR 5/3) sand; single grain; loose; about 2 percent pebbles; medium acid.

The thickness of the solum ranges from 20 to 45 inches. The content of pebbles ranges from 0 to 10 percent throughout the profile. The solum is slightly acid to very strongly acid, and the substratum is neutral to medium acid.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is 1 to 5 inches thick. Some pedons have an Ap horizon. The E, Bhs, and Bs horizons are sand or loamy sand.

Cable Series

The Cable series consists of very poorly drained soils that formed in silty or loamy deposits and in the underlying loamy or sandy glacial till. These soils are on moraines. Permeability is moderate or moderately slow in the upper part of the profile and moderately slow in the lower part. Slope ranges from 0 to 2 percent.

Cable soils are similar to Minocqua and Sherry soils and are near Hatley and Magnor soils. Hatley soils are somewhat poorly drained and are on small swells and on knolls above the Cable soils. Magnor soils are somewhat poorly drained, have an argillic horizon, and are on knolls and swells above the Cable soils. Minocqua soils have a stratified sand and gravel substratum. Sherry soils have more clay in the subsoil than the Cable soils.

Typical pedon of Cable muck, in an area of Minocqua, Cable, and Sherry mucks, 575 feet east and 1,350 feet south of the northwest corner of sec. 19, T. 31 N., R. 9 E.

Oa1—0 to 2 inches; very dark brown (10YR 2/2), broken face and rubbed, very dark grayish brown (10YR 3/2), pressed, sapric material; about 30 percent fiber, 10 percent rubbed; massive; very friable; tendency to part along horizontal weaknesses in the fibers; many fine roots; primarily herbaceous fibers and some woody ones; about 5 percent dark brown (7.5YR 4/4) wood fragments; about 20 percent mineral material; brown (10YR 5/3) sodium pyrophosphate extract; strongly acid (pH 5.2 by Truog method); abrupt smooth boundary.

Oa2—2 to 6 inches; black (N 2/0), broken face, black (10YR 2/1), rubbed and pressed, sapric material; about 20 percent fiber, 3 percent rubbed; weak fine granular structure; very friable; many fine roots; primarily herbaceous fibers and some woody ones; about 5 percent dark brown (7.5YR 4/4) wood fragments; about 40 percent mineral material; brown (10YR 4/3) sodium pyrophosphate extract; strongly acid (pH 5.3 by Troug method); abrupt smooth boundary.

A—6 to 7 inches; very dark gray (10YR 3/1) silt loam; many fine faint dark brown (7.5YR 3/2) and few fine distinct dark reddish brown (5YR 3/3) mottles; weak very fine subangular blocky structure; very friable; many fine roots; about 2 percent pebbles and cobbles; strongly acid; abrupt wavy boundary.

Bg—7 to 11 inches; dark grayish brown (2.5Y 4/2) silt loam; few fine distinct dark yellowish brown (10YR 4/4), few fine prominent yellowish red (5YR 4/6), and many medium faint gray (5Y 5/1) mottles; weak fine subangular blocky structure; friable; tendency to part along horizontal cleavage planes inherited from the parent material; common fine roots; about 2 percent pebbles and cobbles; few fine prominent dark reddish brown (5YR 2/2) concretions and stains (iron and manganese oxides); strongly acid; clear wavy boundary.

Btg1—11 to 16 inches; grayish brown (2.5Y 5/2) silt loam; common fine prominent yellowish red (5YR 4/6), common medium faint gray (5Y 6/1), and many medium faint brown (10YR 5/3) mottles; weak very fine subangular blocky structure; friable; tendency to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 3 percent pebbles and cobbles; discontinuous distinct gray (10YR 5/1) clay films in pores; common fine prominent dark reddish brown (5YR 2/2) concretions and stains (iron and manganese oxides); strongly acid; clear wavy boundary.

2Btg2—16 to 21 inches; grayish brown (10YR 5/2) loam; common fine faint brown (7.5YR 5/2), common fine prominent yellowish red (5YR 5/8), and many medium prominent yellowish red (5YR 4/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine roots; about 5 percent pebbles and 3 percent cobbles; patchy faint very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films on faces of peds, discontinuous in pores; common fine prominent dark reddish brown (5YR 2/2) concretions and stains (iron and manganese oxides); strongly acid; abrupt wavy boundary.

2Btg3—21 to 28 inches; brown (7.5YR 5/2) sandy loam; common fine faint grayish brown (10YR 5/2), common fine prominent yellowish red (5YR 5/8), and many medium distinct reddish brown (5YR 4/4) mottles; weak coarse prismatic structure; friable; tendency to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 10 percent pebbles and 4 percent cobbles; patchy distinct very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films on faces of peds, continuous in pores; few fine prominent black (5YR 2/1) concretions and stains (iron and manganese oxides); strongly acid; clear wavy boundary.

2Bt—28 to 38 inches; reddish brown (5YR 4/4) sandy loam; common fine distinct red (2.5YR 4/6), many medium distinct brown (7.5YR 5/2), and many medium prominent yellowish red (5YR 5/8) mottles; weak coarse prismatic structure; friable; tendency to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 10 percent pebbles and 4 percent cobbles; patchy distinct dark brown (7.5YR 4/2) and prominent very dark gray (10YR 3/1) clay films on faces of peds, discontinuous in pores; few fine prominent black (N 2/0) concretions and stains (iron and manganese oxides); strongly acid; gradual wavy boundary.

2C—38 to 60 inches; reddish brown (5YR 5/4) sandy loam; common fine distinct yellowish red (5YR 4/6 and 5/6) and brown (7.5YR 5/2) mottles; massive; firm and very compact; about 10 percent pebbles and 4 percent cobbles; few fine prominent black (N 2/0) concretions and stains (iron and manganese oxides); medium acid.

The thickness of the solum ranges from 20 to 40 inches. The silty mantle is as much as 30 inches thick. The content of pebbles ranges from 0 to 15 percent in the upper part of the solum and from 5 to 25 percent in the lower part and in the substratum. The content of cobbles is as much as 15 percent throughout the profile. The solum is very strongly acid to neutral, and the substratum is medium acid to mildly alkaline.

The sapric material has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is 2 to 6 inches thick. The A, Bg, Btg1, and 2Btg horizons are sandy loam, loam, or silt loam. The 2Bt and 2C horizons are loamy sand, gravelly loamy sand, sandy loam, or gravelly sandy loam.

Cathro Series

The Cathro series consists of very poorly drained soils that formed in organic material over silty or loamy deposits. These soils are on outwash plains, in glacial lake basins, and on moraines. Permeability is moderately rapid in the organic material and moderate or moderately slow in the mineral deposits. Slope ranges from 0 to 2 percent.

Cathro soils are similar to Loxley, Markey, and Seelyeville soils. Loxley and Seelyeville soils have organic layers more than 51 inches thick. Also, Loxley soils are more acid than the Cathro soils. Markey soils are underlain by sandy deposits.

Typical pedon of Cathro muck, in an area of Seelyeville, Cathro, and Markey mucks, 2,500 feet west and 1,315 feet south of the northeast corner of sec. 18, T. 32 N., R. 11 E.

Oa1—0 to 12 inches; black (N 2/0), broken face and rubbed, dark reddish brown (5YR 2/2), pressed, sapric material; about 30 percent fiber, 10 percent rubbed; weak medium subangular blocky structure; very friable; many fine roots; primarily herbaceous fibers and some woody ones; about 10 percent dark brown (7.5YR 4/4) wood fragments; about 15 percent mineral material; brown (10YR 5/3) sodium pyrophosphate extract; neutral (pH 6.7 by Truog method); clear smooth boundary.

Oa2—12 to 23 inches; black (5YR 2/1), broken face and rubbed, dark reddish brown (5YR 2/2), pressed, sapric material; about 35 percent fiber, 10 percent rubbed; mostly massive but tends to part along a few horizontal weaknesses in the fibers; very friable; primarily herbaceous fibers and some woody ones; about 10 percent dark brown (7.5YR 4/4) wood fragments; about 15 percent mineral material; pale brown (10YR 6/3) sodium pyrophosphate extract; slightly acid (pH 6.4 by Truog method); clear smooth boundary.

Oa3—23 to 35 inches; dark reddish brown (5YR 3/2), broken face, dark reddish brown (5YR 2/2), rubbed, dark brown (7.5YR 3/2), pressed, sapric material; about 35 percent fiber, 10 percent rubbed; mostly massive but tends to part along a few horizontal weaknesses in the fibers; very friable; primarily herbaceous fibers and some woody ones; about 15 percent dark brown (7.5YR 4/4) wood fragments; about 20 percent mineral material; pale brown (10YR 6/3) sodium pyrophosphate extract; slightly acid (pH 6.4 by Truog method); clear smooth boundary.

Oa4—35 to 40 inches; black (5YR 2/1), broken face and rubbed, dark reddish brown (5YR 2/2), pressed, sapric material; about 20 percent fiber, 5 percent rubbed; massive; very friable; primarily herbaceous fibers; about 25 percent mineral material; dark brown (10YR 3/3) sodium pyrophosphate extract; neutral (pH 6.7 by Truog method); abrupt smooth boundary.

Cg—40 to 60 inches; gray (5Y 5/1) silt loam; many fine prominent olive brown (2.5Y 4/4) mottles; massive; friable; neutral.

The organic material is 16 to 51 inches thick. Many pedons have a surface cover of sphagnum moss as much as 4 inches thick. The content of wood fragments in the organic material is as much as 30 percent. The content of mineral ash also is as much as 30 percent. The organic material is medium acid to mildly alkaline.

The sapric material has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3. Some pedons have a few thin layers of hemic material within the sapric material. The Cg horizon is loam, silt loam, or stratified silt loam and very fine sand. It is neutral or mildly alkaline.

Comstock Series

The Comstock series consists of somewhat poorly drained soils that formed in silty water-laid deposits. These soils are in glacial lake basins. Permeability is moderate in the upper part of the profile and moderately slow in the lower part. Slope ranges from 0 to 2 percent.

Comstock soils are near the moderately well drained Crystal Lake soils, which are on the higher parts of the glacial lake basins.

Typical pedon of Comstock silt loam, 390 feet west and 1,290 feet north of the southeast corner of sec. 16, T. 32 N., R. 12 E.

A—0 to 3 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; many fine roots; strongly acid; abrupt smooth boundary.

E—3 to 4 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; moderate medium platy structure; very friable; many fine roots; few very dark gray (10YR 3/1) wormcasts; medium acid; abrupt broken boundary.

Bs—4 to 7 inches; dark brown (7.5YR 4/4) silt loam; weak medium subangular blocky structure; very friable; many fine roots; medium acid; abrupt broken boundary.

E'—7 to 13 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; few fine faint light brownish gray (10YR 6/2), common fine prominent strong brown (7.5YR 5/6), and few fine prominent yellowish red (5YR 4/6) mottles; weak medium platy structure; very friable; a few vertical cleavage planes through the platy structure; common fine roots; few fine dark reddish brown (5YR 2/2) concretions (iron and manganese oxides) in the lower 4 inches; medium acid; clear wavy boundary.

B/E—13 to 25 inches; dark brown (10YR 4/3) silt loam (Bt); many coarse distinct light brownish gray (10YR 6/2), common medium prominent strong brown (7.5YR 5/6), and common fine prominent yellowish red (5YR 4/6) mottles; moderate fine subangular blocky structure; friable; discontinuous prominent dark reddish brown (5YR 3/4) clay films on faces of peds; about 40 percent of the horizon occurring as tongues of brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; weak medium platy structure; very friable; a few vertical cleavage planes through the platy structure; common fine roots; few fine dark reddish brown (5YR 2/2) concretions (iron and manganese oxides) in the upper 5 inches; very strongly acid; clear wavy boundary.

Bt1—25 to 31 inches; dark brown (10YR 4/3) silt loam; common coarse faint grayish brown (10YR 5/2), many medium prominent strong brown (7.5YR 5/6), and common fine prominent yellowish red (5YR 4/6) mottles; weak coarse prismatic structure parting to moderate fine subangular blocky; friable; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; discontinuous prominent dark reddish brown (5YR 3/4) clay films on faces of peds; faces of prisms are 95 percent grayish brown (10YR 5/2); strongly acid; clear smooth boundary.

Bt2—31 to 38 inches; dark brown (10YR 4/3) silt loam that has a few thin strata of very fine sandy loam; few fine prominent yellowish red (5YR 4/6), common fine prominent strong brown (7.5YR 5/6), and common fine faint grayish brown (10YR 5/2) mottles; weak very coarse prismatic structure parting to moderate medium subangular blocky; friable; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; patchy prominent dark reddish brown (5YR 3/4) clay films on faces of peds, continuous in pores; medium acid; gradual smooth boundary.

BC—38 to 57 inches; dark brown (10YR 4/3) silt loam that has a few thin strata of very fine sandy loam; common fine faint grayish brown (10YR 5/2), common fine prominent strong brown (7.5YR 5/6), and few fine prominent yellowish red (5YR 4/6) mottles; weak very coarse prismatic structure; very friable; tends to part along horizontal cleavage planes inherited from the parent material; dark reddish brown (5YR 3/4) clay films on faces of peds; medium acid; abrupt smooth boundary.

C—57 to 60 inches; yellowish brown (10YR 5/4) silt loam that has a few thin strata of very fine sandy loam; common fine distinct yellowish red (5YR 4/6) and many medium distinct strong brown (7.5YR 5/6) and light brownish gray (2.5Y 6/2) mottles; massive; very friable; tends to part along horizontal cleavage planes inherited from the parent material; medium acid.

The solum ranges from 30 to 60 inches in thickness. It is slightly acid to very strongly acid. The substratum is neutral to strongly acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 5 inches thick. Some pedons have an Ap horizon. The Bt2, BC, and C horizons are dominantly silt loam, but they have thin strata of silt, loam, fine or very fine sandy loam, fine or very fine sand, loamy fine sand, or loamy very fine sand.

Croswell Series

The Croswell series consists of moderately well drained, rapidly permeable soils that formed in sandy deposits. These soils are on outwash plains. Slope ranges from 0 to 2 percent.

Croswell soils are near Au Gres and Vilas soils. Au Gres soils are somewhat poorly drained and are on the lower lying flats and in swales and drainageways below the Croswell soils. Vilas soils are excessively drained and are on upland flats, hills, knolls, swells, and ridges above the Croswell soils.

Typical pedon of Croswell loamy sand, 2,400 feet west and 2,590 feet north of the southeast corner of sec. 13, T. 34 N., R. 11 E.

A—0 to 2 inches; black (N 2/0) loamy sand, black (10YR 2/1) dry; weak fine granular structure; very friable; many fine roots; about 2 percent pebbles; common uncoated sand grains; few charcoal fragments; very strongly acid; abrupt smooth boundary.

E—2 to 4 inches; brown (7.5YR 4/2) sand; weak fine subangular blocky structure; very friable; many fine roots; about 4 percent pebbles; few black (10YR 2/1) wormcasts; strongly acid; abrupt wavy boundary.

Bs1—4 to 9 inches; dark reddish brown (5YR 3/4) loamy sand; weak medium subangular blocky structure; very friable; many fine roots; about 4 percent pebbles; strongly acid; clear wavy boundary.

Bs2—9 to 15 inches; reddish brown (5YR 4/4) sand; weak medium subangular blocky structure; very friable; many fine roots; about 4 percent pebbles; medium acid; clear wavy boundary.

Bs3—15 to 24 inches; dark brown (7.5YR 4/4) sand; few fine distinct yellowish red (5YR 4/6) mottles; weak coarse subangular blocky structure; very friable; common fine roots; about 4 percent pebbles; medium acid; clear wavy boundary.

BC—24 to 45 inches; brown (7.5YR 5/4) sand; common fine distinct red (2.5YR 4/6), many medium faint reddish brown (5YR 4/4), and many coarse prominent yellowish red (5YR 5/8) mottles; single grain; loose; few fine roots; about 3 percent pebbles; slightly acid; gradual wavy boundary.

C—45 to 60 inches; yellowish brown (10YR 5/4) sand; few medium prominent strong brown (7.5YR 5/8) mottles; single grain; loose; few fine roots; about 2 percent pebbles; slightly acid.

The thickness of the solum ranges from 24 to 45 inches. The content of pebbles ranges from 0 to 10 percent throughout the profile. The substratum is medium acid to neutral.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is 1 to 4 inches thick. Some pedons have an Ap horizon. The E and Bs horizons are sand or loamy sand.

Crystal Lake Series

The Crystal Lake series consists of moderately well drained soils that formed in silty water-laid deposits. These soils are in glacial lake basins. Permeability is moderate in the upper part of the profile and moderately slow in the lower part. Slope ranges from 0 to 6 percent.

Crystal Lake soils are near the somewhat poorly drained Comstock soils, which are on the lower parts of the glacial lake basins.

Typical pedon of Crystal Lake silt loam, 0 to 6 percent slopes, 1,020 feet east and 1,940 feet south of the northwest corner of sec. 23, T. 32 N., R. 12 E.

A—0 to 4 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; very friable; many fine roots; slightly acid; abrupt smooth boundary.

E—4 to 8 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; weak medium platy structure; very friable; common fine roots; common black (10YR 2/1) wormcasts; medium acid; clear irregular boundary.

E/B—8 to 16 inches; brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; weak medium platy structure; very friable; about 80 percent of the horizon occurring as tongues of E material extending into or completely surrounding isolated remnants of dark yellowish brown (10YR 4/4) silt loam (Bt); moderate fine subangular blocky structure; friable; patchy prominent dark reddish brown (5YR 3/4) clay films on faces of peds; common fine roots; medium acid; clear wavy boundary.

B/E—16 to 26 inches; dark yellowish brown (10YR 4/4) silt loam (Bt); moderate fine subangular blocky structure; friable; discontinuous prominent dark reddish brown (5YR 3/4) clay films on faces of peds; about 40 percent of the horizon occurring as tongues of brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; weak medium platy structure; very friable; common fine roots; medium acid; clear wavy boundary.

Bt1—26 to 38 inches; dark brown (10YR 4/3) silt loam; common fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; friable; tends to part along horizontal cleavage planes inherited from the parent material; common fine roots; discontinuous prominent dark reddish brown (5YR 3/4) clay films on faces of peds; common distinct pale brown (10YR 6/3) uncoated silt and sand grains, primarily on vertical faces of peds; strongly acid; gradual wavy boundary.

Bt2—38 to 49 inches; dark brown (10YR 4/3) silt loam that has a few strata of dark brown (7.5YR 4/4) very fine sandy loam 1 to 2 millimeters thick; common medium faint grayish brown (10YR 5/2), common medium prominent strong brown (7.5YR 5/6), and few fine prominent dark red (2.5YR 3/6) mottles; moderate medium subangular blocky structure; very friable; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; patchy prominent dark reddish brown (5YR 3/3) clay films on faces of peds, continuous in pores; few fine dark reddish brown (5YR 2/2) concretions (iron and manganese oxides); strongly acid; gradual wavy boundary.

C—49 to 60 inches; dark brown (10YR 4/3) silt loam that has a few strata of dark brown (7.5YR 4/4) very fine sand 1 to 10 millimeters thick; common medium faint grayish brown (10YR 5/2), common fine prominent strong brown (7.5YR 5/6), and few fine prominent dark red (2.5YR 3/6) mottles; massive; very friable; tends to part along horizontal cleavage planes inherited from the parent material; medium acid.

The solum ranges from 30 to 60 inches in thickness. It is slightly acid to very strongly acid. The substratum is neutral to strongly acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 5 inches thick. Some pedons have an Ap horizon. The Bt2 and C horizons are dominantly silt loam but have thin strata of silt, loam, fine or very fine sandy loam, fine or very fine sand, loamy fine sand, or loamy very fine sand.

Fordum Series

The Fordum series consists of poorly drained or very poorly drained soils that formed in loamy alluvial deposits over sand and gravel. These soils are on flood plains. Permeability is moderate or moderately rapid in the upper part of the profile and rapid or very rapid in the lower part. Slope ranges from 0 to 2 percent.

Fordum soils are near Markey and Minocqua soils. The nearby soils are in positions on the landscape similar to those of the Fordum soils. Markey soils formed in organic material 16 to 51 inches deep over sandy deposits. Minocqua soils have a cambic horizon.

Typical pedon of Fordum mucky silt loam, 1,600 feet east and 1,740 feet north of the southwest corner of sec. 34, T. 31 N., R. 10 E.

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) mucky silt loam, grayish brown (10YR 5/2) dry; few fine distinct dark brown (7.5YR 4/4) and many fine faint dark grayish brown (10YR 4/2) mottles; weak fine granular structure; very friable; many fine roots; few thin discontinuous layers of black (N 2/0) sapric material; medium acid; abrupt smooth boundary.

A2—2 to 6 inches; very dark grayish brown (10YR 3/2) mucky silt loam, grayish brown (10YR 5/2) dry; many fine distinct dark reddish brown (5YR 3/4 and 2/2) and prominent yellowish red (5YR 4/6) mottles; weak fine granular structure; very friable; common fine roots; few thin discontinuous layers of black (N 2/0) sapric material; many black (5YR 2/1) concretions (iron and manganese oxides) 1 to 5 millimeters in diameter; few hollow, tubular dark reddish brown (5YR 3/3) concretions (iron and manganese oxides), 1 to 10 millimeters in diameter, adjacent to pores in the lower inch; few black (5YR 2/1) strongly cemented discontinuous layers 1 to 2 millimeters thick; medium acid; abrupt smooth boundary.

C1—6 to 9 inches; very dark grayish brown (2.5Y 3/2) mucky loam that has a few thin discontinuous layers of pale brown (10YR 6/3) fine sand and very fine sand; few fine prominent dark reddish brown (5YR 3/4) and many medium faint very dark gray (5Y 3/1) mottles; massive; very friable; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; few thin discontinuous layers of black (N 2/0) sapric material; few black (5YR 2/1) and dusky red (2.5YR 3/2) concretions (iron and manganese oxides) 1 to 3 millimeters in diameter; few hollow, tubular dark reddish brown (5YR 3/3) concretions (iron and manganese oxides), 1 to 5 millimeters in diameter, adjacent to pores; slightly acid; clear smooth boundary.

C2—9 to 19 inches; very dark grayish brown (2.5Y 3/2) mucky silt loam that has a few thin strata of pale brown (10YR 6/3) fine sand; few fine distinct dark greenish gray (5GY 4/1) mottles adjacent to pores and many medium faint very dark gray (5Y 3/1) mottles; massive; very friable; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 1 percent fine pebbles; few thin discontinuous layers of black (N 2/0) sapric material; medium acid; gradual smooth boundary.

C3—19 to 30 inches; black (5Y 2/2) mucky silt loam that has a few thin strata of dark olive gray (5Y 3/2) very fine sandy loam and grayish brown (10YR 5/2) fine sand; massive; very friable; tends to part along horizontal cleavage planes inherited from the parent material; about 1 percent fine pebbles; few thin discontinuous layers of black (N 2/0) sapric material; medium acid; abrupt smooth boundary.

C4—30 to 60 inches; grayish brown (10YR 5/2) stratified sand and gravel; single grain; loose; about 30 percent pebbles and 2 percent cobbles; medium acid.

The depth to the C4 horizon ranges from 24 to 40 inches. The content of pebbles ranges from 0 to 10 percent in the A, C1, C2, and C3 horizons and from 5 to 60 percent in the C4 horizon. The content of cobbles ranges from 0 to 5 percent in the C4 horizon. The A, C1, C2, and C3 horizons are very strongly acid to neutral, and the C4 horizon is medium acid to mildly alkaline.

The A horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3. The A, C1, C2, and C3 horizons vary in texture and thickness but commonly consist of loamy deposits intermixed with thin layers of sandy deposits and muck.

Freeon Series

The Freeon series consists of moderately well drained soils that formed in silty deposits and in the underlying loamy glacial till. These soils are on moraines. Permeability is moderate or moderately slow in the upper part of the profile and moderately slow in the lower part. Slope ranges from 2 to 6 percent.

Freeon soils are near Amery and Magnor soils. Amery soils are well drained, have less silt in the subsoil than the Freeon soils, and are mostly on the sides of swells and hills below the Freeon soils. Magnor soils are somewhat poorly drained and are mostly on the sides of swells below the Freeon soils.

Typical pedon of Freeon silt loam, 2 to 6 percent slopes, 1,130 feet east and 1,450 feet north of the southwest corner of sec. 26, T. 32 N., R. 9 E.

A—0 to 2 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; many fine roots; about 2 percent pebbles and 4 percent cobbles; medium acid; abrupt wavy boundary.

E—2 to 4 inches; brown (7.5YR 5/2) silt loam; weak thin platy structure; very friable; many fine roots; about 2 percent pebbles and 4 percent cobbles; few distinct very dark gray (10YR 3/1) wormcasts; strongly acid; abrupt wavy boundary.

Bs1—4 to 6 inches; dark reddish brown (5YR 3/4) silt loam; weak very fine subangular blocky structure; very friable; many fine roots; about 2 percent pebbles and 4 percent cobbles; strongly acid; abrupt wavy boundary.

Bs2—6 to 13 inches; dark brown (7.5YR 4/4) silt loam; weak fine subangular blocky structure; very friable; many fine roots; about 2 percent pebbles and 4 percent cobbles; strongly acid; clear wavy boundary.

B/E—13 to 20 inches; dark brown (10YR 4/3) silt loam (Bt); moderate very fine subangular blocky structure; friable; patchy distinct dark brown (7.5YR 3/4) clay films on faces of peds; about 40 percent of the horizon occurring as tongues of brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; weak medium platy structure; very friable; common fine roots; about 2 percent pebbles and 4 percent cobbles; strongly acid; clear wavy boundary.

2Bt1—20 to 24 inches; dark yellowish brown (10YR 4/4) loam; few medium distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; friable; common fine roots; about 5 percent pebbles and 4 percent cobbles; patchy distinct dark brown (7.5YR 3/4) clay films on faces of peds; many faint brown (10YR 5/3) uncoated sand grains, primarily on vertical faces of peds; very strongly acid; clear wavy boundary.

2Bt2—24 to 28 inches; dark brown (7.5YR 4/4) sandy loam; common medium distinct yellowish red (5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; common fine roots; about 10 percent pebbles and 4 percent cobbles; patchy distinct dark reddish brown (5YR 3/4) clay films on faces of peds and clay bridging between most mineral grains; many distinct brown (10YR 5/3) uncoated sand grains, primarily on vertical faces of peds; very strongly acid; clear wavy boundary.

2Bt3—28 to 40 inches; reddish brown (5YR 4/3) sandy loam; few medium faint brown (7.5YR 5/3), few fine prominent dark red (2.5YR 3/6), and few medium prominent yellowish red (5YR 5/6) mottles; weak coarse prismatic structure; friable; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 10 percent pebbles and 4 percent cobbles; patchy faint dark reddish brown (5YR 3/4) clay films on faces of peds and clay bridging between most mineral grains; common distinct brown (7.5YR 5/3) uncoated sand grains, primarily on vertical faces of peds; strongly acid; gradual wavy boundary.

2C—40 to 60 inches; reddish brown (5YR 4/4) sandy loam; few medium distinct yellowish red (5YR 4/6) and reddish gray (5YR 5/2) mottles; massive; firm and very compact; few fine roots; about 10 percent pebbles and 4 percent cobbles; medium acid.

The thickness of the solum ranges from 30 to 50 inches. The silty mantle is 15 to 30 inches thick. The content of pebbles ranges from 0 to 5 in the silty mantle and from 5 to 15 percent in the 2Bt and 2C horizons. The content of cobbles is 0 to 2 percent in the silty mantle and 2 to 10 percent in the 2Bt and 2C horizons. The solum is very strongly acid to slightly acid, and the substratum is strongly acid to slightly acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 5 inches thick. Some pedons have an Ap horizon.

Hatley Series

The Hatley series consists of somewhat poorly drained soils that formed in silty deposits and in the underlying loamy or sandy glacial till. These soils are on moraines and drumlins. Permeability is moderate in the upper part of the profile and moderate or moderately rapid in the lower part. Slope ranges from 2 to 6 percent.

Hatley soils are similar to the Magnor, Mylrea, and Oesterle soils, which are not stony. Magnor soils have a firm and very compact substratum. Mylrea soils have a cambic horizon and a substratum of granite residuum. Oesterle soils have a sand and gravel substratum and a solum that is thinner than that of the Hatley soils.

Typical pedon of Hatley silt loam, 2 to 6 percent slopes, stony, 1,450 feet north and 925 feet west of the southeast corner of sec. 7, T. 33 N., R. 11 E.

A—0 to 5 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; many fine roots; about 2 percent pebbles and 5 percent cobbles; strongly acid; abrupt wavy boundary.

E—5 to 10 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; few fine prominent dark yellowish brown (10YR 4/6) mottles; weak thin platy structure; very friable; common fine roots; about 2 percent pebbles and 5 percent cobbles; strongly acid; clear wavy boundary.

E/B—10 to 22 inches; brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; many fine distinct strong brown (7.5YR 5/6) mottles; weak medium platy structure; very friable; about 80 percent of the horizon occurring as tongues of E material extending into or completely surrounding isolated remnants of dark yellowish brown (10YR 4/4) silt loam (Bt); common fine distinct grayish brown (10YR 5/2) and many fine distinct yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; friable; discontinuous distinct dark brown (7.5YR 4/4) clay films on faces of peds; common fine roots; about 2 percent pebbles and 5 percent cobbles; strongly acid; clear wavy boundary.

2B/E—22 to 36 inches; dark yellowish brown (10YR 4/4) loam (2Bt); common fine distinct yellowish red (5YR 4/6) and common medium distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; friable; discontinuous distinct dark brown (7.5YR 3/4) clay films on faces of peds; about 30 percent of the horizon occurring as tongues of brown (10YR 5/3) loam (2E), very pale brown (10YR 7/3) dry; common fine distinct strong brown (7.5YR 5/6) mottles; weak medium platy structure; very friable; few fine roots; about 5 percent pebbles and 5 percent cobbles; strongly acid; clear wavy boundary.

2Bt1—36 to 48 inches; dark brown (7.5YR 4/4) loam; few medium distinct light brownish gray (10YR 6/2), common fine distinct yellowish red (5YR 4/6), and common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; few fine roots; about 5 percent pebbles and 5 percent cobbles; patchy distinct dark reddish brown (5YR 3/4) clay films on faces of peds; strongly acid; clear wavy boundary.

2Bt2—48 to 56 inches; dark brown (7.5YR 4/4) sandy loam; few coarse distinct light brownish gray (10YR 6/2), common fine distinct yellowish red (5YR 4/6), and common medium distinct strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; very friable; few fine roots; about 10 percent pebbles and 5 percent cobbles; patchy distinct dark reddish brown (5YR 3/4) clay films on faces of peds and clay bridging between most mineral grains; medium acid; gradual wavy boundary.

2C—56 to 60 inches; yellowish brown (10YR 5/4) loamy sand; few medium distinct yellowish brown (10YR 5/6) and few medium faint brown (10YR 5/3) mottles; massive; very friable; about 13 percent pebbles and 5 percent cobbles; slightly acid.

The thickness of the solum ranges from 40 to 60 inches. The silty mantle is as much as 30 inches thick. The content of pebbles ranges from 0 to 15 percent in the upper part of the solum and from 5 to 25 percent in the lower part and in the substratum. The content of cobbles is as much as 15 percent throughout the profile. The solum is very strongly acid to slightly acid, and the substratum is medium acid to neutral.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 5 inches thick. Some pedons have an Ap horizon. The E, E/B, 2B/E, and 2Bt1 horizons are sandy loam, loam, or silt loam. The 2Bt2 and 2C horizons are loamy sand, gravelly loamy sand, sandy loam, or gravelly sandy loam.

Ingalls Series

The Ingalls series consists of somewhat poorly drained soils in glacial lake basins. These soils formed in sandy deposits over silty water-laid deposits. Permeability is rapid in the upper deposits and moderately slow in the lower deposits. Slope ranges from 0 to 2 percent.

Ingalls soils are near Menominee soils. Menominee soils are moderately well drained, have an argillic horizon, and are on the higher parts of the glacial lake basins.

Typical pedon of Ingalls loamy sand, 400 feet east and 2,500 feet south of the northwest corner of sec. 18, T. 34 N., R. 12 E.

A—0 to 2 inches; black (N 2/0) loamy sand, very dark gray (N 3/0) dry; moderate fine granular structure; very friable; many fine roots; about 1 percent pebbles; many uncoated sand grains; strongly acid; abrupt smooth boundary.

E—2 to 6 inches; brown (7.5YR 5/2) sand with brown (7.5YR 4/2) loamy sand in the lower one-half inch; few fine prominent yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; very friable; many fine roots; about 1 percent pebbles; strongly acid; abrupt wavy boundary.

Bs1—6 to 9 inches; dark reddish brown (5YR 3/4) loamy sand; few fine faint dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; very friable; many fine roots; about 1 percent pebbles; medium acid; clear wavy boundary.

Bs2—9 to 15 inches; dark brown (7.5YR 4/4) loamy sand; few fine faint yellowish brown (10YR 5/4) and few fine distinct red (2.5YR 4/6) mottles; weak medium subangular blocky structure; very friable; common fine roots; about 2 percent pebbles; medium acid; clear wavy boundary.

Bs3—15 to 26 inches; dark yellowish brown (10YR 4/4) loamy sand; common coarse distinct grayish brown (10YR 5/2), many medium distinct strong brown (7.5YR 5/6), and common fine prominent dark red (2.5YR 3/6) mottles; weak medium subangular blocky structure; very friable; common fine roots; about 2 percent pebbles; slightly acid; clear wavy boundary.

BC—26 to 32 inches; yellowish red (5YR 5/6) sand; few medium prominent brown (10YR 5/3) and many coarse distinct dark red (10R 3/6) mottles; very weak medium subangular blocky structure; very friable; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 5 percent pebbles; few dark red (10R 3/6) weakly cemented spots; slightly acid; clear broken boundary.

C1—32 to 38 inches; brown (10YR 5/3) sand; many coarse prominent strong brown (7.5YR 5/8) and few fine prominent red (2.5YR 4/6) mottles; single grain; loose; trace of pebbles; slightly acid; abrupt wavy boundary.

2C2—38 to 43 inches; pale brown (10YR 6/3) silt loam that has a few thin strata of very fine sand; many coarse prominent greenish gray (5GY 5/1), common fine prominent yellowish brown (10YR 5/4), and few fine prominent dark red (2.5YR 3/6) mottles; upper inch mostly greenish gray (5GY 5/1); massive; friable; tends to part along horizontal cleavage planes inherited from the parent material; trace of pebbles; slightly acid; abrupt smooth boundary.

2C3—43 to 60 inches; reddish brown (5YR 5/3) silt loam that has a few thin strata of silt; few coarse prominent greenish gray (5GY 6/1) and few medium faint reddish brown (5YR 4/4) mottles; massive; friable; tends to part along horizontal cleavage planes inherited from the parent material; mottles mostly in the upper 12 inches; slightly acid.

The thickness of the solum and of the sandy mantle is 20 to 40 inches. The content of pebbles ranges from 0 to 15 percent in the A and E horizons, from 0 to 25 percent in the Bs, BC, and C1 horizons, and from 0 to 5 percent in the 2C horizon. The content of cobbles ranges from 0 to 5 percent in the sandy mantle. The C1 horizon is strongly acid to neutral, and the 2C horizon is strongly acid to mildly alkaline.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is 1 to 5 inches thick. Some pedons have an Ap horizon. The E horizon is sand or loamy sand. The Bs, BC, and C1 horizons commonly are sand, gravelly sand, loamy sand, or gravelly loamy sand. In some pedons, however, the C1 horizon is stratified sand and gravel. The 2C horizon is dominantly silt loam or silty clay loam, but it has thin strata of silt, loam, fine or very fine sandy loam, fine or very fine sand, loamy fine sand, or loamy very fine sand.

Kennan Series

The Kennan series consists of well drained soils that formed in silty and loamy deposits and in the underlying loamy or sandy glacial till. These soils are on moraines and drumlins. Permeability is moderate in the upper part of the profile and moderate or moderately rapid in the lower part. Slope ranges from 2 to 15 percent.

Kennan soils are near Hatley and Keweenaw soils. Hatley soils are somewhat poorly drained and are on small swells and knolls below the Kennan soils. Keweenaw soils have less clay and more sand in the subsoil than the Kennan soils and are on the more sloping hills and ridges.

Typical pedon of Kennan loam, 6 to 15 percent slopes, stony, 925 feet east and 1,200 feet south of the northwest corner of sec. 25, T. 31 N., R. 11 E.

A—0 to 2 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; very friable; many fine roots; about 5 percent pebbles and cobbles; common uncoated sand grains; slightly acid; abrupt smooth boundary.

E—2 to 5 inches; brown (7.5YR 4/2) loam; moderate thin platy structure; very friable; many fine roots; about 5 percent pebbles and cobbles; medium acid; abrupt broken boundary.

Bs—5 to 9 inches; dark brown (7.5YR 4/4) loam; weak medium subangular blocky structure; very friable; many fine roots; about 5 percent pebbles and cobbles; medium acid; clear wavy boundary.

E'—9 to 13 inches; brown (10YR 5/3) loam, very pale brown (10YR 7/3) dry, moderate thin platy structure; friable; many fine roots; about 5 percent pebbles and cobbles; medium acid; clear wavy boundary.

E/B—13 to 19 inches; brown (10YR 5/3) loam (E), very pale brown (10YR 7/3) dry; moderate thin platy structure; friable; about 60 percent of the horizon occurring as tongues of E material extending into or completely surrounding isolated remnants of dark brown (7.5YR 4/4) loam (Bt); moderate fine subangular blocky structure; friable; discontinuous distinct dark reddish brown (5YR 3/4) clay films on faces of peds; common fine roots; about 5 percent pebbles and cobbles; strongly acid; clear wavy boundary.

Bt1—19 to 30 inches; dark brown (7.5YR 4/4) loam; moderate medium subangular blocky structure; friable; common fine roots; discontinuous distinct dark reddish brown (5YR 3/4) clay films on faces of peds; about 4 percent pebbles and cobbles; common brown (10YR 5/3) uncoated silt and sand grains, primarily on vertical faces of peds; strongly acid; clear wavy boundary.

2Bt2—30 to 46 inches; reddish brown (5YR 4/4) sandy loam; weak medium and coarse subangular blocky structure; very friable; few fine roots; patchy faint dark reddish brown (5YR 3/4) clay films on faces of peds and clay bridging between most mineral grains; about 12 percent pebbles and 5 percent cobbles; medium acid; gradual wavy boundary.

2C—46 to 60 inches; brown (7.5YR 5/4) loamy sand; massive; very friable; few fine roots; about 12 percent pebbles and 10 percent cobbles; medium acid.

The thickness of the solum ranges from 40 to 60 inches. Some pedons have a silty mantle, which is as much as 30 inches thick. The content of pebbles ranges from 0 to 15 percent in the upper part of the solum and from 5 to 25 percent in the lower part and in the substratum. The content of cobbles is as much as 15 percent throughout the profile. The solum is very strongly acid to slightly acid, and the substratum is medium acid to neutral.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 5 inches thick. Some pedons have an Ap horizon. The A horizon is silt loam or loam. The E, Bs, E', E/B, and Bt1 horizons are sandy loam, loam, or silt loam. The 2Bt2 and 2C horizons are loamy sand, gravelly loamy sand, sandy loam, or gravelly sandy loam.

Keweenaw Series

The Keweenaw series consists of well drained, moderately permeable and rapidly permeable soils that formed in loamy and sandy glacial till. These soils are on moraines and drumlins. Slope ranges from 15 to 45 percent.

Keweenaw soils are near Kennan soils. Kennan soils have less sand and more clay in the subsoil than the Keweenaw soils and are on swells and the less sloping hills and ridges.

Typical pedon of Keweenaw sandy loam, 15 to 45 percent slopes, stony, 1,590 feet east and 860 feet south of the northwest corner of sec. 25, T. 31 N., R. 11 E.

A—0 to 2 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many fine roots; about 5 percent pebbles and cobbles; common uncoated sand grains; strongly acid; abrupt smooth boundary.

E—2 to 5 inches; brown (7.5YR 4/2) loamy sand; weak fine subangular blocky structure; very friable; many fine roots; about 10 percent pebbles and 5 percent cobbles; common uncoated sand grains; strongly acid; clear wavy boundary.

Bs1—5 to 9 inches; dark reddish brown (5YR 3/4) gravelly loamy sand; weak medium subangular blocky structure; very friable; many fine roots; about 18 percent pebbles and 5 percent cobbles; strongly acid; clear wavy boundary.

Bs2—9 to 16 inches; dark brown (7.5YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; many fine roots; about 11 percent pebbles and 5 percent cobbles; medium acid; gradual wavy boundary.

E'—16 to 36 inches; brown (7.5YR 5/3) loamy sand, pinkish gray (7.5YR 7/2) dry; weak medium subangular blocky structure; very friable; common fine roots; about 8 percent pebbles and 5 percent cobbles; medium acid; gradual wavy boundary.

E/B—36 to 53 inches; brown (7.5YR 5/3) loamy sand (E), pinkish gray (7.5YR 7/2) dry; weak medium subangular blocky structure; very friable; about 60 percent of the horizon occurring as tongues of E material completely surrounding isolated remnants of reddish brown (5YR 4/4) sandy loam (Bt); moderate medium subangular blocky structure; friable; patchy faint dark reddish brown (5YR 3/4) clay films on faces of peds and clay bridging between most mineral grains; common fine roots; about 12 percent pebbles and 10 percent cobbles; medium acid; gradual wavy boundary.

C—53 to 60 inches; brown (7.5YR 5/4) gravelly loamy sand; massive; very friable; few fine roots; about 18 percent pebbles and 10 percent cobbles; medium acid.

The thickness of the solum ranges from 40 to 75 inches. The content of pebbles ranges from 2 to 15 percent in the A and E horizons, from 2 to 20 percent in the Bs, E', and E/B horizons, and from 7 to 25 percent in the C horizon. The content of cobbles is as much as 15 percent throughout the profile. The solum is very strongly acid to slightly acid, and the substratum is medium acid to neutral.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 1 to 5 inches thick. Some pedons have an Ap horizon. The E horizon is loamy sand or sandy loam. The Bs horizon and the Bt part of the E/B horizon are loamy sand, gravelly loamy sand, sandy loam, or gravelly sandy loam. The E' horizon, the E part of the E/B horizon, and the C horizon are sand, gravelly sand, loamy sand, or gravelly loamy sand.

Langlade Series

The Langlade series consists of well drained soils that formed in silty and loamy deposits and in the underlying sand and gravel. These soils are on outwash plains. Permeability is moderate in the upper part of the profile and rapid or very rapid in the lower part. Slope ranges from 0 to 6 percent.

Langlade soils are similar to Antigo soils and are near Antigo and Scott Lake soils. Antigo and Scott Lake soils have a solum that is 22 to 40 inches thick. Antigo soils are in positions on the outwash plains similar to those of the Langlade soils. Scott Lake soils are in swales and drainageways below the Langlade soils and are moderately well drained.

Typical pedon of Langlade silt loam, 0 to 2 percent slopes, 132 feet north and 2,163 feet east of the southwest corner of sec. 29, T. 32 N., R. 12 E.

Ap—0 to 12 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; common fine roots; about 5 percent pebbles and cobbles; strongly acid; abrupt smooth boundary.

E—12 to 14 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; moderate thin and medium platy structure; very friable; common fine roots; about 5 percent pebbles and cobbles; strongly acid; abrupt wavy boundary.

B/E—14 to 22 inches; dark yellowish brown (10YR 4/4) silt loam (Bt); moderate fine and very fine angular blocky structure; friable; continuous distinct dark brown (7.5YR 4/4) clay films on faces of peds; about 30 percent of the horizon occurring as tongues of brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; weak medium platy structure; very friable; common fine roots; about 4 percent pebbles and cobbles; very strongly acid; gradual wavy boundary

Bt1—22 to 31 inches; dark yellowish brown (10YR 4/4) silt loam; weak coarse prismatic structure parting to moderate fine and very fine angular blocky; friable; common fine roots; about 4 percent pebbles and cobbles; continuous distinct dark brown (7.5YR 4/4) clay films on faces of peds; common distinct pale brown (10YR 6/3) uncoated silt and very fine sand grains, primarily on vertical faces of peds; very strongly acid; gradual wavy boundary.

Bt2—31 to 42 inches; dark yellowish brown (10YR 4/4) silt loam; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; friable; few fine roots; about 5 percent pebbles and 2 percent cobbles; discontinuous distinct dark brown (7.5YR 4/4) clay films on faces of peds; common distinct pale brown (10YR 6/3) uncoated silt and very fine sand grains, primarily on vertical faces of peds; very strongly acid; clear wavy boundary.

2Bt3—42 to 47 inches; dark yellowish brown (10YR 4/4) loam; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; friable; few fine roots; about 9 percent pebbles and 2 percent cobbles; discontinuous distinct dark brown (7.5YR 4/4) clay films on faces of peds; common distinct pale brown (10YR 6/3) uncoated silt and very fine sand grains, primarily on vertical faces of peds; very strongly acid; clear wavy boundary.

3Bt4—47 to 53 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam; weak medium and coarse subangular blocky structure; friable; few fine roots; about 18 percent pebbles and 2 percent cobbles; patchy distinct dark brown (7.5YR 3/4) clay films on faces of peds and clay bridging between most mineral grains; very strongly acid; abrupt wavy boundary.

3C—53 to 60 inches; yellowish brown (10YR 5/4) stratified sand and gravel; single grain; loose; about 27 percent pebbles and 2 percent cobbles; strongly acid.

The thickness of the solum ranges from 40 to 60 inches. The silty mantle is 26 to 42 inches thick. The content of pebbles ranges from 0 to 5 percent in the silty mantle, from 5 to 15 percent in the 2Bt3 horizon, from 15 to 35 percent in the 3Bt4 horizon, and from 15 to 60 percent in the 3C horizon. The content of cobbles ranges from 0 to 2 percent in the silty mantle and from 0 to 5 percent in the 2Bt3, 3Bt4, and 3C horizons. The solum is slightly acid to very strongly acid, and the substratum is slightly acid to strongly acid.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Some pedons have an A horizon. The 3Bt4 horizon is gravelly loamy sand, sandy loam, or gravelly sandy loam.

Loxley Series

The Loxley series consists of very poorly drained, moderately rapidly permeable soils that formed in organic material. These soils are on outwash plains, in glacial lake basins, and on moraines. Slope ranges from 0 to 2 percent.

Loxley soils are similar to Cathro, Markey, and Seelyeville soils. Cathro and Markey soils are underlain by loamy deposits and sandy deposits, respectively. These deposits are at a depth of 16 to 51 inches. Cathro, Markey, and Seelyeville soils are medium acid to neutral.

Typical pedon of Loxley peat, 2,110 feet north and 910 feet east of the southwest corner of sec. 23, T. 34 N., R. 12 E.

Oi—0 to 3 inches; olive brown (2.5Y 6/4), rubbed and pressed, fibric material; about 100 percent fiber, 90 percent rubbed; massive; very friable; common fine roots; primarily sphagnum fibers; about 3 percent leatherleaf twigs; white (10YR 8/2) sodium pyrophosphate extract; extremely acid (pH 3.5 by Truog method); clear smooth boundary.

Oe—3 to 12 inches; very dark grayish brown (2.5Y 3/2), broken face, very dark grayish brown (10YR 3/2), rubbed, dark grayish brown (2.5Y 4/2), pressed, hemic material; about 80 percent fiber, 40 percent rubbed; massive; very friable; primarily sphagnum fibers; about 5 percent leatherleaf twigs; about 5 percent mineral material; very pale brown (10YR 7/3) sodium pyrophosphate extract; extremely acid (pH 3.7 by Truog method); abrupt smooth boundary.

Oa1—12 to 24 inches; dark brown (7.5YR 3/2), broken face, very dark brown (10YR 2/2), rubbed and pressed, sapric material; about 50 percent fiber, 10 percent rubbed; massive; friable; tends to part along weaknesses in the fibers; primarily herbaceous fibers; about 2 percent dark brown (7.5YR 4/4) wood fragments; about 5 percent mineral material; light yellowish brown (10YR 6/4) sodium pyrophosphate extract; few layers of hemic material less than half an inch thick; extremely acid (pH 4.2 by Truog method); gradual smooth boundary.

Oa2—24 to 60 inches; dark brown (7.5YR 3/2), broken face, very dark brown (10YR 2/2), rubbed and pressed, sapric material; about 30 percent fiber, 5 percent rubbed; massive; very friable; tends to part along weaknesses in the fibers; primarily herbaceous fibers; about 2 percent dark brown (7.5YR 4/4) wood fragments; about 1 percent mineral material; yellowish brown (10YR 5/4) sodium pyrophosphate extract; few layers of hemic material less than half an inch thick; very weak platiness in the lower 12 inches; extremely acid (pH 4.4 by Truog method).

The organic material is more than 51 inches thick. A surface cover of sphagnum moss is as much as 8 inches thick. The content of wood fragments ranges from 0 to 5 percent. The content of mineral ash is as much as 10 percent.

The fibric material has hue of 10YR or 2.5Y and value and chroma of 3 to 6. The hemic material has hue of 5YR, 7.5YR, 10YR, or 2.5Y, value of 2 to 4, and chroma of 1 to 4. The sapric material has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3. In some pedons there are a few thin layers of hemic material within the sapric material.

Magnor Series

The Magnor series consists of somewhat poorly drained soils that formed in silty deposits and in the underlying loamy glacial till. These soils are on moraines. Permeability is moderate in the upper part of the profile and moderately slow in the lower part. Slope ranges from 0 to 4 percent.

Magnor soils are similar to Hatley, Mylrea, and Oesterle soils and are near Freeon soils. Freeon soils are moderately well drained and are mostly on the crests of swells above the Magnor soils. Hatley soils are stony and have a very friable substratum. Mylrea soils have a cambic horizon and a substratum of granite residuum. Oesterle soils have a sand and gravel substratum.

Typical pedon of Magnor silt loam, 0 to 4 percent slopes, 80 feet west and 1,270 feet north of the southeast corner of sec. 27, T. 32 N., R. 9 E.

A—0 to 4 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; many fine roots; about 2 percent pebbles and 2 percent cobbles; medium acid; abrupt wavy boundary.

E—4 to 6 inches; dark grayish brown (10YR 4/2) silt loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium platy structure; very friable; many fine roots; about 2 percent pebbles and 2 percent cobbles; many faint very dark gray (10YR 3/1) wormcasts; strongly acid; abrupt wavy boundary.

E/B—6 to 11 inches; brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; many fine prominent strong brown (7.5YR 5/6) mottles; moderate very thin platy structure; very friable; about 80 percent of the horizon occurring as tongues of E material extending into or completely surrounding isolated remnants of yellowish brown (10YR 5/4) silt loam (Bt); few fine distinct yellowish red (5YR 4/6) and common fine distinct grayish brown (10YR 5/2) mottles; weak very fine subangular blocky structure; friable; patchy distinct dark brown (7.5YR 4/2) clay films on faces of peds; common fine roots; about 2 percent pebbles and 2 percent cobbles; strongly acid; clear wavy boundary.

B/E—11 to 20 inches; dark brown (10YR 4/3) silt loam (Bt); common medium prominent yellowish red (5YR 4/6) and many medium prominent light brownish gray (10YR 6/2) mottles; weak medium prismatic structure parting to weak fine subangular blocky; friable; patchy faint dark brown (7.5YR 4/2) clay films on faces of peds; about 30 percent of the horizon occurring as tongues of brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; many medium prominent yellowish red (5YR 5/6) mottles; moderate thin platy structure; very friable; common fine roots; about 3 percent pebbles and 2 percent cobbles; very strongly acid; abrupt wavy boundary.

2Bt1—20 to 24 inches; dark brown (7.5YR 4/4) sandy loam; few medium prominent yellowish red (5YR 5/8) and many medium distinct yellowish red (5YR 4/6) and brown (7.5YR 5/2) mottles; weak medium prismatic structure; friable; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 10 percent pebbles and 4 percent cobbles; discontinuous distinct dark reddish brown (5YR 3/2) and dark reddish gray (5YR 4/2) clay films on faces of peds; common uncoated sand grains, primarily on vertical faces of peds; strongly acid; clear wavy boundary.

2Bt2—24 to 30 inches; reddish brown (5YR 4/3) sandy loam; common medium faint brown (7.5YR 5/2) mottles on faces of peds; few fine prominent yellowish red (5YR 4/6) and common medium prominent strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure; firm and very dense; few fine roots; about 10 percent pebbles and 4 percent cobbles; patchy faint dark reddish gray (5YR 4/2) clay films in pores and on faces of peds; few uncoated sand grains on faces of peds; medium acid; gradual wavy boundary.

2C—30 to 60 inches; reddish brown (5YR 4/4) sandy loam; few medium distinct strong brown (7.5YR 5/6) and brown (7.5YR 4/2) mottles along vertical planes of weakness; appears massive but has a few vertical cleavage planes in the upper 18 inches; firm and very compact; few fine roots; about 10 percent pebbles and 4 percent cobbles; slightly acid.

The thickness of the solum ranges from 30 to 50 inches. The silty mantle is 15 to 30 inches thick. The content of pebbles ranges from 0 to 5 percent in the silty mantle and from 5 to 15 percent in the 2Bt and 2C horizons. The content of cobbles ranges from 0 to 2 percent in the silty mantle and from 2 to 10 percent in the 2Bt and 2C horizons. The solum is medium acid to very strongly acid, and the substratum is slightly acid to strongly acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 5 inches thick. Some pedons have an Ap horizon. The 2Bt horizon is loam or sandy loam.

Marathon Series

The Marathon series consists of moderately well drained, moderately permeable soils on glacial moraines underlain by granite bedrock. These soils formed in loamy and sandy glacial drift and in loamy granite residuum. Slope ranges from 2 to 6 percent.

Marathon soils are near Mylrea soils. Mylrea soils are somewhat poorly drained, are underlain by weathered granite at a depth of more than 60 inches, and are mostly on the sides of swells below the Marathon soils.

Typical pedon of Marathon loam, bedrock substratum, 2 to 6 percent slopes, 550 feet east and 130 feet south of the northwest corner of sec. 30, T. 31 N., R. 10 E.

A—0 to 4 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; many fine roots; about 2 percent rounded pebbles and cobbles; slightly acid; abrupt wavy boundary.

E—4 to 5 inches; dark grayish brown (10YR 4/2) loam; weak medium platy structure; very friable; many fine roots; about 2 percent rounded pebbles and cobbles; many very dark gray (10YR 3/1) wormcasts; slightly acid; abrupt broken boundary.

Bs—5 to 12 inches; dark yellowish brown (10YR 3/4) loam; weak fine subangular blocky structure; very friable; many fine roots; about 2 percent rounded pebbles and cobbles; medium acid; clear wavy boundary.

E/B—12 to 19 inches; brown (10YR 5/3) loam (E), very pale brown (10YR 7/3) dry; weak thin platy structure; very friable; about 70 percent of the horizon occurring as tongues of E material extending into or completely surrounding isolated remnants of dark brown (10YR 4/3) loam (Bt); moderate fine subangular blocky structure; friable; patchy prominent dark reddish brown (5YR 3/4) clay films on faces of peds; common fine roots; about 2 percent rounded pebbles and 1 percent rounded cobbles; medium acid; clear wavy boundary.

2Bt1—19 to 27 inches; dark brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; very friable; common fine roots; patchy prominent dark reddish brown (5YR 3/4) clay films on faces of peds and clay bridging between most mineral grains; about 3 percent pebbles and cobbles, mostly rounded; medium acid; abrupt wavy boundary.

2Bt2—27 to 36 inches; dark brown (7.5YR 4/4) loamy sand; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium and coarse subangular blocky structure; very friable; few fine roots; patchy distinct dark reddish brown (5YR 3/4) clay films on faces of peds and clay bridging between most mineral grains; about 8 percent pebbles, mostly rounded; slightly acid; abrupt irregular boundary.

3Bt3—36 to 57 inches; dark brown (10YR 4/3) gravelly sandy loam; few medium prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; few fine roots; very compact; discontinuous prominent dark reddish brown (5YR 3/4) clay films on faces of peds and clay bridging between most mineral grains; about 33 percent pebbles, mostly angular; about 10 percent cobbles, mostly angular; broken layers of dark brown (7.5YR 4/4) gravelly sandy loam; horizon appears to be mostly granite residuum but is mixed with glacial drift; strongly acid; abrupt broken boundary.

3R—57 inches; unweathered, slightly fractured granite bedrock.

The thickness of the solum and the depth to unweathered granite bedrock range from 40 to 60 inches. The content of pebbles ranges from 0 to 5 percent in the upper part of the solum, from 2 to 15 percent in the 2Bt horizon, and from 15 to 50 percent in the 3Bt3 horizon. The content of cobbles ranges from 0 to 2 percent in the upper part of the solum and from 0 to 10 percent in the lower part. The solum is slightly acid to very strongly acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 5 inches thick. Some pedons have an Ap horizon. The 2Bt horizon is loam, sandy loam, or loamy sand. The 3Bt3 horizon is gravelly loam, very gravelly loam, gravelly sandy loam, or very gravelly sandy loam. Some pedons do not have a 3Bt3 horizon.

Markey Series

The Markey series consists of very poorly drained soils that formed in organic material over sandy deposits. These soils are on outwash plains, in glacial lake basins, and on moraines. Permeability is moderately rapid in the organic material and rapid in the mineral deposits. Slope ranges from 0 to 2 percent.

Markey soils are similar to Cathro, Loxley, and Seelyeville soils. Cathro soils are underlain by silty or loamy deposits. Loxley and Seelyeville soils have an organic layer that is more than 51 inches thick. Also, Loxley soils are extremely acid or very strongly acid.

Typical pedon of Markey muck, in an area of Seelyeville, Cathro, and Markey mucks, 100 feet east and 100 feet south of the northwest corner of sec. 27, T. 30 N., R. 11 E.

Oa1—0 to 5 inches; very dark gray (10YR 3/1), broken face, black (10YR 2/1), rubbed, very dark grayish brown (10YR 3/2), pressed, sapric material; about 30 percent fiber, 10 percent rubbed; weak medium subangular blocky structure; very friable; many fine roots; primarily herbaceous fibers and some woody ones; about 5 percent dark brown (7.5YR 4/4) wood fragments; about 15 percent mineral material; brown (10YR 4/3) sodium pyrophosphate extract; medium acid (pH 5.7 by Truog method); clear smooth boundary.

Oa2—5 to 15 inches; very dark gray (10YR 3/1), broken face, black (10YR 2/1), rubbed, very dark brown (10YR 2/2), pressed, sapric material; about 25 percent fiber, 10 percent rubbed; massive; very friable; tends to part along horizontal weaknesses in the fibers; many fine roots; primarily herbaceous fibers and some woody ones; about 5 percent dark brown (7.5YR 4/4) wood fragments; about 15 percent mineral material; very dark grayish brown (10YR 3/2) sodium pyrophosphate extract; medium acid (pH 5.8 by Truog method); clear smooth boundary.

Oa3—15 to 24 inches; black (5YR 2/1), broken face and rubbed, black (10YR 2/1), pressed, sapric material; about 15 percent fiber, 5 percent rubbed; weak coarse subangular blocky structure; very friable; few fine roots; primarily herbaceous fibers and some woody ones; about 10 percent dark brown (7.5YR 4/4) wood fragments; about 20 percent mineral material; very dark brown (10YR 2/2) sodium pyrophosphate extract; slightly acid (pH 6.2 by Truog method); clear smooth boundary.

Oa4—24 to 41 inches; dark reddish brown (5YR 3/2), broken face, dark reddish brown (5YR 2/2), rubbed, dark reddish brown (5YR 3/3), pressed, sapric material; about 20 percent fiber, 5 percent rubbed; massive; very friable; primarily woody fibers and some herbaceous ones; about 15 percent dark brown (7.5YR 4/4) wood fragments; about 40 percent mineral material; dark grayish brown (10YR 4/2) sodium pyrophosphate extract; few thin lenses and layers of dark gray (5Y 4/1) sand; few thin layers of black (N 2/0) sapric material; neutral (pH 7.0 by Truog method); abrupt smooth boundary.

Cg—41 to 60 inches; dark gray (10YR 4/1) sand; single grain; loose; mildly alkaline.

The organic material is 16 to 51 inches thick. Many pedons have a surface cover of sphagnum moss as much as 4 inches thick. The content of wood fragments in the organic material is as much as 15 percent. The content of mineral ash is as much as 40 percent. The organic material is medium acid to mildly alkaline.

The sapric material has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3. Some pedons have a few thin layers of hemic material within the sapric material. The Cg horizon is sand or loamy sand. It is neutral or mildly alkaline. The content of pebbles in this horizon ranges from 0 to 10 percent.

Menominee Series

The Menominee series consists of moderately well drained soils that formed in sandy deposits and in the underlying silty and loamy water-laid deposits. These soils are in glacial lake basins. Permeability is rapid in the upper deposits and moderately slow in the lower deposits. Slope ranges from 0 to 6 percent.

Menominee soils are near Ingalls soils. Ingalls soils are somewhat poorly drained, do not have an argillic horizon, and are on the lower parts of the glacial lake basins.

Typical pedon of Menominee loamy sand, 0 to 6 percent slopes, 1,050 feet south and 375 feet east of the northwest corner of sec. 11, T. 31 N., R. 12 E.

A—0 to 3 inches; black (N 2/0) loamy sand, dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; many fine roots; about 10 percent pebbles; common uncoated sand grains; medium acid; abrupt smooth boundary.

E—3 to 5 inches; brown (7.5YR 4/2) loamy sand; weak fine subangular blocky structure; very friable; many fine roots; about 10 percent pebbles; few uncoated sand grains; few black (N 2/0) wormcasts; medium acid; abrupt wavy boundary.

Bs1—5 to 7 inches; dark reddish brown (5YR 3/4) gravelly loamy sand; weak fine subangular blocky structure; very friable; many fine roots; about 20 percent pebbles and 2 percent cobbles; medium acid; abrupt wavy boundary.

Bs2—7 to 12 inches; reddish brown (5YR 4/4) gravelly loamy sand; weak fine subangular blocky structure; very friable; many fine roots; about 20 percent pebbles and 2 percent cobbles; medium acid; clear wavy boundary.

Bs3—12 to 22 inches; dark brown (7.5YR 4/4) sand; weak medium subangular blocky structure; very friable; common fine roots; about 11 percent pebbles; medium acid; clear wavy boundary.

E —22 to 39 inches; yellowish brown (10YR 5/4) sand; common fine prominent brownish yellow (10YR 6/8) mottles in the lower 5 inches; weak coarse subangular blocky structure; very friable; common fine roots; about 5 percent pebbles; slightly acid; abrupt wavy boundary.

2E/B—39 to 40 inches; brown (10YR 5/3) loamy sand (2E), very pale brown (10YR 7/3) dry; weak fine subangular blocky structure; very friable; about 80 percent of the horizon occurring as tongues of 2E material extending into or completely surrounding isolated remnants of yellowish brown (10YR 5/4) sandy loam (2Bt); common fine prominent strong brown (7.5YR 5/8) and common medium distinct grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; very friable; patchy prominent reddish brown (5YR 4/4) clay films on faces of peds; few fine roots; about 5 percent pebbles; slightly acid; abrupt wavy boundary.

3B/E—40 to 45 inches; grayish brown (2.5Y 5/2) silt loam that has a few thin strata of loam (3Btg); many fine prominent strong brown (7.5YR 5/6) and common fine prominent yellowish red (5YR 4/6) and dark reddish brown (5YR 3/3) mottles; weak coarse prismatic structure; friable; tends to part along horizontal cleavage planes inherited from the parent material; patchy prominent brown (7.5YR 5/2) clay films on faces of peds; about 20 percent of the horizon occurring as tongues of brown (10YR 5/3) silt loam that has a few thin strata of loam (3E) and that is very pale brown (10YR 7/3) when dry; weak thin platy structure; friable; few fine roots; about 2 percent pebbles; few fine dark reddish brown (5YR 2/2) concretions (iron and manganese oxides); common uncoated sand grains on faces of peds and in pores; strongly acid; clear wavy boundary.

3Btg—45 to 59 inches; grayish brown (10YR 5/2) silt loam that has a few thin strata of loam; many fine prominent strong brown (7.5YR 5/6), common fine prominent red (2.5YR 4/6), common medium prominent olive gray (5Y 5/2), and many fine distinct reddish brown (5YR 5/3) mottles; weak very coarse prismatic structure; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; trace of pebbles; many fine dark reddish brown (5YR 2/2) concretions (iron and manganese oxides); common faint brown (10YR 5/3) uncoated silt and sand grains on faces of peds and in pores; patchy distinct brown (7.5YR 5/2) clay films on faces of peds; strongly acid; abrupt smooth boundary.

3C—59 to 60 inches; grayish brown (10YR 5/2) silt loam that has a few thin strata of olive yellow (2.5Y 6/6) very fine sandy loam; many fine prominent strong brown (7.5YR 5/6) and common fine prominent yellowish red (5YR 4/6) mottles; massive; friable; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 2 percent pebbles; few thin dark reddish brown (5YR 2/2) concretions (iron and manganese oxides); strongly acid.

The thickness of the solum ranges from 30 to 60 inches. The sandy deposits are 20 to 40 inches thick. The content of cobbles in these deposits is 0 to 5 percent. The content of pebbles ranges from 0 to 15 percent in the A and E horizons, from 0 to 25 percent in the Bs and E' horizons, and from 0 to 5 percent in the 2E/B, 3B/E, 3Btg, and 3C horizons. The sandy part of the solum is slightly acid to strongly acid. The 2E/B, 3B/E, 3Btg, and 3C horizons are strongly acid to neutral.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is 0.5 inch to 4.0 inches thick. Some pedons have an Ap horizon. The E horizon is sand or loamy sand. The Bs and E' horizons are sand, gravelly sand, loamy sand, or gravelly loamy sand. The 2E/B horizon is loamy sand, sandy loam, or loam. The 3B/E, 3Btg, and 3C horizons are dominantly silty clay loam or silt loam, but they have thin strata of silt, loam, fine or very fine sandy loam, fine or very fine sand, loamy fine sand, or loamy very fine sand.

Milladore Series

The Milladore series consists of somewhat poorly drained, moderately slowly permeable soils on moraines. These soils formed in silty deposits and in the underlying glacial drift, which contains some granite residuum. Slope ranges from 0 to 4 percent.

These soils are grayer in the upper part of the Bt horizon than is definitive for the Milladore series. This difference, however, does not alter the usefulness or behavior of the soils.

Milladore soils are similar to Magnor soils and are near Sherry soils. Magnor soils have less clay in the lower part of the subsoil and in the substratum than the Milladore soils. Sherry soils are very poorly drained and are in depressional areas below the Milladore soils.

Typical pedon of Milladore silt loam, 0 to 4 percent slopes, 310 feet north and 40 feet west of the southeast corner of sec. 22, T. 31 N., R. 9 E.

A—0 to 3 inches; black (N 2/0) silt loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; very friable; many fine roots; about 2 percent pebbles and cobbles; strongly acid; abrupt smooth boundary.

E—3 to 8 inches; dark grayish brown (10YR 4/2) silt loam; common medium faint gray (10YR 5/1), common fine distinct dark brown (7.5YR 4/4), and few fine faint brown (10YR 4/3) mottles; weak medium platy structure; very friable; a few vertical cleavage planes through the platy structure; many fine roots; about 2 percent pebbles and cobbles; dark gray (10YR 4/1) vertical faces; common very dark grayish brown (10YR 3/2) wormcasts; medium acid; abrupt wavy boundary.

E/B1—8 to 16 inches; grayish brown (10YR 5/2) silt loam (E); weak thin platy structure; very friable; a few vertical cleavage planes through the platy structure; dark grayish brown (10YR 4/2) vertical faces; about 70 percent of the horizon occurring as tongues of E material extending into or completely surrounding isolated remnants of yellowish brown (10YR 5/4) silt loam (Bt); many medium distinct strong brown (7.5YR 5/6), common fine distinct yellowish red (5YR 4/6), and few coarse prominent gray (10YR 5/1) mottles; weak fine subangular blocky structure; friable; patchy faint dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; common fine roots; about 2 percent pebbles and cobbles; few dark reddish brown (5YR 3/3) concretions (iron and manganese oxides) 1 to 2 millimeters in diameter; medium acid; clear wavy boundary.

E/B2—16 to 20 inches; grayish brown (2.5Y 5/2) loam (2E); weak thin platy structure; very friable; a few vertical cleavage planes through the platy structure; grayish brown (10YR 5/2) vertical faces; about 70 percent of the horizon occurring as tongues of 2E material extending into or completely surrounding isolated remnants of brown (10YR 5/3) loam (2Bt); many medium prominent yellowish red (5YR 5/6), many fine prominent dark red (2.5YR 3/6), and few medium distinct gray (10YR 5/1) mottles; weak fine subangular blocky structure; friable; patchy distinct dark brown (7.5YR 4/2) clay films on faces of peds and in pores; common fine roots; about 3 percent pebbles and 2 percent cobbles; common dark reddish brown (5YR 3/3) concretions (iron and manganese oxides) 1 to 5 millimeters in diameter; strongly acid; abrupt wavy boundary.

2Bt—20 to 23 inches; dark brown (7.5YR 4/4) loamy sand; few fine distinct dark red (2.5YR 3/6), common fine distinct yellowish red (5YR 4/6), and common medium distinct grayish brown (10YR 5/2) mottles; weak coarse prismatic structure; very friable; tends to part along horizontal cleavage planes inherited from the parent material; common fine roots; patchy distinct dark reddish brown (5YR 3/3) clay films on faces of peds and in pores; about 3 percent pebbles and 2 percent cobbles; vertical faces of peds are grayish brown (10YR 5/2); medium acid; abrupt broken boundary.

3Btg—23 to 30 inches; gray (5Y 5/1) clay loam; many medium distinct brown (10YR 4/3) and common fine prominent strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) mottles; moderate coarse prismatic structure; firm; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; patchy prominent dark reddish gray (5YR 4/2) clay films on faces of peds; continuous prominent dark gray (10YR 4/1) clay films in pores; about 4 percent rounded and angular pebbles; continuous distinct light brownish gray (2.5Y 6/2) uncoated silt and sand grains on vertical faces of peds; very compact; medium acid; gradual wavy boundary.

3Bt—30 to 45 inches; reddish brown (5YR 4/4) sandy clay loam; common medium prominent dark grayish brown (2.5Y 4/2) and many medium distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; firm; few fine roots; patchy prominent dark gray (10YR 4/1) clay films on faces of peds, continuous in pores; about 2 percent rounded and angular pebbles; vertical faces of peds are mostly grayish brown (2.5Y 5/2); interior matrix of peds is yellowish red (5YR 4/6); very compact; medium acid; diffuse wavy boundary.

3C1—45 to 54 inches; yellowish red (5YR 4/6) sandy loam; many medium prominent olive (5Y 5/3) and few fine distinct dark red (2.5YR 3/6) mottles; massive; firm; very compact; few fine roots; about 5 percent rounded and angular pebbles; slightly acid; diffuse wavy boundary.

3C2—54 to 60 inches; olive (5Y 5/3) sandy loam; many coarse prominent yellowish red (5YR 4/6) and common fine prominent dark red (2.5YR 3/6) mottles; massive; firm; very compact; about 12 percent rounded and angular pebbles; neutral.

The thickness of the solum ranges from 36 to 60 inches. The silty mantle is 15 to 30 inches thick. The content of pebbles ranges from 0 to 5 percent in the silty mantle and from 2 to 15 percent in the lower part of the solum and in the substratum. The content of cobbles ranges from 0 to 2 percent in the silty mantle and from 0 to 10 percent in the lower part of the solum and in the substratum. The solum is very strongly acid to slightly acid, and the substratum is strongly acid to neutral.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 5 inches thick. Some pedons have an Ap horizon. The 2E/B2 and 2Bt horizons are loam, sandy loam, or loamy sand. The 3Btg, 3Bt, and 3C horizons are sandy loam, loam, sandy clay loam, or clay loam.

Minocqua Series

The Minocqua series consists of very poorly drained soils on outwash plains. These soils formed in silty and loamy deposits and in the underlying sand and gravel. Permeability is moderate in the upper part of the profile and rapid or very rapid in the lower part. Slope ranges from 0 to 2 percent.

Minocqua soils are near Oesterle soils and are similar to Cable and Sherry soils. Cable soils have a sandy or loamy glacial till substratum. Oesterle soils are mostly on low flats above the Minocqua soils, are somewhat poorly drained, and have an argillic horizon. Sherry soils have more clay in the subsoil than the Minocqua soils and have a loamy glacial till substratum.

Typical pedon of Minocqua muck, in an area of Minocqua, Cable, and Sherry mucks, 240 feet south and 2,170 feet west of the northeast corner of sec. 14, T. 32 N., R. 10 E.

Oa—0 to 4 inches; black (10YR 2/1), broken face, very dark brown (10YR 2/2), rubbed and pressed, sapric material; about 25 percent fiber, 8 percent rubbed; weak medium granular structure; very friable; many fine roots; primarily herbaceous fibers and some woody ones; about 5 percent dark brown (7.5YR 4/4) wood fragments; about 25 percent mineral material; brown (10YR 5/3) sodium pyrophosphate extract; strongly acid (pH 5.1 by Truog method); abrupt smooth boundary.

Bg1—4 to 7 inches; gray (10YR 5/1) silt loam; common medium prominent dark brown (7.5YR 4/4) mottles adjacent to vertical planes of weakness; massive; firm; a few vertical cleavage planes; few fine roots on vertical surfaces; about 3 percent pebbles; strongly acid; clear wavy boundary.

Bg2—7 to 12 inches; dark gray (10YR 4/1) silt loam; common medium prominent dark brown (7.5YR 4/4) mottles adjacent to vertical planes of weakness; massive; firm; a few vertical cleavage planes; few fine roots on vertical surfaces; about 2 percent pebbles; few dark reddish brown (2.5YR 2/4) concretions (iron and manganese oxides) about 1 to 3 millimeters thick; strongly acid; clear wavy boundary.

Bg3—12 to 18 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct dark brown (7.5YR 4/4) and many medium distinct yellowish brown (10YR 5/4) mottles adjacent to vertical surfaces; massive; a few vertical cleavage planes; friable; few fine roots on vertical surfaces; about 2 percent pebbles; strongly acid; clear wavy boundary.

2Bg4—18 to 31 inches; grayish brown (2.5Y 5/2) loam; many fine prominent strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; friable; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 2 percent pebbles; common dark reddish brown (5YR 3/2) concretions (iron and manganese oxides) about 1 to 2 millimeters thick; few dark brown (7.5YR 3/2) stains on faces of peds; strongly acid; gradual wavy boundary.

2Bg5—31 to 35 inches; grayish brown (2.5Y 5/2) sandy loam; many fine prominent strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; friable; tends to part along horizontal cleavage planes inherited from the parent material; about 5 percent pebbles and 2 percent cobbles; many dark reddish brown (5YR 3/2) concretions (iron and manganese oxides) about 1 to 5 millimeters thick; common dark brown (7.5YR 3/2) stains on faces of peds; strongly acid; abrupt wavy boundary.

3C—35 to 60 inches; brown (10YR 5/3) stratified sand and gravel; single grain; loose; about 16 percent pebbles and 2 percent cobbles; medium acid.

The thickness of the solum ranges from 20 to 40 inches. The silty mantle is as much as 30 inches thick. The content of pebbles ranges from 0 to 15 percent in the upper part of the solum, from 5 to 35 percent in the 2Bg5 horizon, and from 5 to 60 percent in the 3C horizon. The content of cobbles ranges from 0 to 5 percent throughout the profile. The solum is very strongly acid to mildly alkaline, and the substratum is medium acid to mildly alkaline.

The Oa horizon has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is 2 to 6 inches thick. The Bg and 2Bg4 horizons are silt loam, sandy loam, or loam. The 2Bg5 horizon is sand, gravelly sand, loamy sand, gravelly loamy sand, sandy loam, or gravelly sandy loam.

Mylrea Series

The Mylrea series consists of somewhat poorly drained soils on moraines underlain by granite bedrock. These soils formed in silty deposits and in the underlying loamy or sandy glacial drift and granite residuum. Permeability is moderate in the upper part of the profile and moderately rapid or rapid in the lower part. Slope ranges from 0 to 4 percent.

Mylrea soils are similar to the Hatley, Magnor, and Oesterly soils, which have an argillic horizon. Hatley soils are stony, Magnor soils have a firm and very compact substratum, and Oesterle soils have a sand and gravel substratum.

Typical pedon of Mylrea silt loam, 0 to 4 percent slopes, 607 feet east and 2,138 feet south of the northwest corner of sec. 30, T. 31 N., R. 10 E.

A—0 to 3 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; many fine roots; about 2 percent rounded pebbles and 2 percent cobbles; medium acid; abrupt smooth boundary.

E1—3 to 7 inches; dark grayish brown (10YR 4/2) silt loam; weak medium platy structure; very friable; many fine roots; about 2 percent rounded pebbles and 2 percent cobbles; many black (10YR 2/1) wormcasts; medium acid; abrupt wavy boundary.

E2—7 to 11 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; few fine faint dark brown (7.5YR 4/4) mottles; weak medium platy structure; very friable; common fine roots; about 2 percent rounded pebbles and cobbles; strongly acid; clear wavy boundary.

E/B—11 to 15 inches; brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; weak medium platy structure; very friable; about 70 percent of the horizon occurring as tongues of E material extending into or completely surrounding isolated remnants of dark yellowish brown (10YR 4/4) silt loam (Bt); common medium distinct grayish brown (10YR 5/2) and common fine prominent strong brown (7.5YR 5/6) mottles, weak very fine angular blocky structure; friable; tends to part along horizontal cleavage planes inherited from the parent material; patchy faint gray (10YR 5/1) clay films on faces of peds;

common fine roots; about 2 percent rounded pebbles and cobbles; few dark reddish brown (5YR 3/2) concretions (iron and manganese oxides) 1 to 2 millimeters in diameter; strongly acid; clear wavy boundary.

Btg—15 to 22 inches; grayish brown (10YR 5/2) silt loam; many coarse prominent strong brown (7.5YR 5/6), common medium distinct dark yellowish brown (10YR 4/4), and few fine prominent yellowish red (5YR 4/6) mottles; weak fine angular blocky structure; friable; tends to part along horizontal cleavage planes inherited from the parent material; common fine roots; patchy faint gray (10YR 5/1) clay films on faces of peds; about 2 percent rounded pebbles and cobbles; common dark reddish brown (5YR 3/2) concretions (iron and manganese oxides) 1 to 2 millimeters in diameter; very strongly acid; abrupt smooth boundary.

2Bt1—22 to 30 inches; dark brown (7.5YR 4/4) sandy loam; common medium distinct grayish brown (10YR 5/2), few coarse prominent yellowish red (5YR 5/8), and few fine distinct yellowish red (5YR 4/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; friable; few fine roots; patchy distinct reddish brown (5YR 4/3) clay films on faces of peds and clay bridging between most mineral grains; about 6 percent pebbles, mostly rounded, and 2 percent cobbles; brown (10YR 5/3) vertical faces of peds; very strongly acid; clear wavy boundary.

2Bt2—30 to 33 inches; dark brown (7.5YR 4/4) loam; few fine distinct yellowish red (5YR 4/6) and common medium distinct grayish brown (5YR 5/2) and yellowish red (5YR 5/6) mottles; moderate coarse prismatic structure parting to weak medium subangular blocky; firm; few fine roots; discontinuous distinct reddish brown (5YR 4/3) clay films on faces of peds; about 6 percent pebbles, mostly rounded, and 2 percent cobbles; grayish brown (2.5Y 5/2) vertical faces of peds; very strongly acid; abrupt wavy boundary.

3Bt3—33 to 37 inches; dark brown (7.5YR 4/4) gravelly loam; many coarse distinct brown (7.5YR 5/2) and common medium distinct strong brown (7.5YR 5/6) mottles; moderate coarse prismatic structure parting to weak medium subangular blocky; firm; few fine roots; discontinuous faint dark brown (7.5YR 4/2) clay films on faces of peds, continuous in pores; patchy distinct dark gray (10YR 4/1) clay films on vertical faces of peds; vertical faces of peds are grayish brown (2.5Y 5/2) if they have no clay films; about 15 percent angular pebbles and 5 percent rounded pebbles; very compact; very strongly acid; clear wavy boundary.

3Bt4—37 to 48 inches; brown (10YR 4/3) very gravelly sandy loam; common fine prominent strong brown (7.5YR 5/6) and common coarse faint brown (10YR 5/3) mottles; weak medium subangular blocky structure; friable; few fine roots; patchy distinct brown (7.5YR 5/2) clay films on faces of peds and clay bridging between most mineral grains; about 40 percent angular pebbles; very strongly acid; gradual wavy boundary.

3C—48 to 60 inches; pale brown (10YR 6/3) very gravelly sandy loam; few fine prominent yellowish red (5YR 4/6) and common medium prominent yellowish brown (10YR 5/6) mottles; massive; very friable; about 40 percent angular pebbles; very strongly acid.

The thickness of the solum ranges from 24 to 50 inches. The silty mantle is 15 to 30 inches thick. The content of pebbles ranges from 0 to 5 percent in the silty mantle, from 2 to 15 percent in the 2Bt horizon, and from 15 to 50 percent in the 3Bt and 3C horizons. The content of cobbles ranges from 0 to 2 percent in the silty mantle and from 0 to 10 percent in the 2Bt horizon. The profile is very strongly acid to slightly acid throughout.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 5 inches thick. The 2Bt horizon is loam, sandy loam, or loamy sand. The 3Bt horizon is gravelly loam, very gravelly loam, gravelly sandy loam, or very gravelly sandy loam. The 3C horizon is gravelly or very gravelly sandy loam.

Oesterle Series

The Oesterle series consists of somewhat poorly drained soils that formed in silty and loamy deposits and in the underlying sand and gravel. These soils are on outwash plains. Permeability is moderate in the upper part of the profile and rapid or very rapid in the lower part. Slope ranges from 0 to 2 percent.

These soils have a lower content of fine sand or coarser sand in the 2Bt horizon than is definitive for the Oesterle series. This difference, however, does not alter the usefulness or behavior of the soils.

Oesterle soils are similar to Hatley, Magnor, and Mylrea soils and are near Scott Lake soils. Hatley soils are stony, have a solum that is thicker than that of the Oesterle soils, and have a substratum of loamy or sandy glacial till. Magnor soils have a firm and very compact substratum of loamy glacial till. Mylrea soils have a cambic horizon and a substratum of granite residuum. Scott Lake soils are moderately well drained and are on the slightly higher flats.

Typical pedon of Oesterle silt loam, 555 feet north and 700 feet east of the southwest corner of sec. 15, T. 31 N., R. 10 E.

A—0 to 4 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; many fine roots; about 2 percent pebbles and 1 percent cobbles; medium acid; abrupt wavy boundary.

E—4 to 8 inches; grayish brown (10YR 5/2) silt loam; few fine prominent strong brown (7.5YR 5/6) and few fine distinct dark brown (7.5YR 4/4) mottles; weak thin platy structure; very friable; common fine roots; about 2 percent pebbles and 1 percent cobbles; many prominent dark reddish brown (5YR 2/2) concretions (iron and manganese oxides) less than 2 millimeters in diameter; medium acid; clear wavy boundary.

E/B—8 to 18 inches; brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; many fine prominent strong brown (7.5YR 5/8) mottles; weak thin platy structure; very friable; about 70 percent of the horizon occurring as tongues of E material extending into or completely surrounding isolated remnants of dark brown (7.5YR 4/4) silt loam (Bt); many fine distinct yellowish red (5YR 5/6) and common fine distinct light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; friable; patchy faint dark brown (7.5YR 3/4) clay films on faces of peds, discontinuous in pores; common fine roots; about 4 percent pebbles and 2 percent cobbles; common distinct dark reddish brown (5YR 2/2) concretions (iron and manganese oxides) less than 2 millimeters in diameter; very strongly acid; clear wavy boundary.

B/E—18 to 24 inches; dark brown (7.5YR 4/4) silt loam (Bt); common fine distinct yellowish red (5YR 5/6) and light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; friable; patchy distinct dark reddish brown (5YR 3/4) clay films on faces of peds, discontinuous in pores; about 20 percent of the horizon occurring as tongues of brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; many fine distinct strong brown (7.5YR 5/6) mottles; weak medium platy structure; very friable; few fine roots; about 4 percent pebbles and 2 percent cobbles; common distinct dark reddish brown (5YR 2/2) concretions (iron and manganese oxides) less than 2 millimeters in diameter; very strongly acid; clear wavy boundary.

2Bt1—24 to 28 inches; dark brown (7.5YR 4/4) loam; few fine distinct yellowish red (5YR 5/6) and common medium distinct strong brown (7.5YR 5/6) and light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; few fine roots; about 4 percent pebbles and 2 percent cobbles; patchy distinct dark reddish brown (5YR 3/4) clay films on faces of peds, discontinuous in pores; few distinct dark reddish brown (5YR 2/2) concretions (iron and manganese oxides) less than 2 millimeters in diameter; very strongly acid; abrupt wavy boundary.

3Bt2—28 to 32 inches; dark brown (7.5YR 3/4) gravelly loamy sand; common fine distinct brown (10YR 5/3) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; few fine roots; about 25 percent pebbles and 4 percent cobbles; distinct dark reddish brown (5YR 3/4) clay bridging between most mineral grains; very strongly acid; clear wavy boundary.

3C—32 to 60 inches; brown (10YR 5/3) stratified sand and gravel; single grain; loose; about 35 percent pebbles and 5 percent cobbles; medium acid.

The thickness of the solum ranges from 22 to 40 inches. The silty mantle is as much as 32 inches thick. The content of pebbles ranges from 0 to 5 percent in the silty mantle, from 0 to 15 percent in the 2Bt1 horizon, from 5 to 35 percent in the 3Bt2 horizon, and from 5 to 60 percent in the 3C horizon. The content of cobbles ranges from 0 to 2 percent in the silty mantle and from 0 to 5 percent in the 2Bt1, 3Bt2, and 3C horizons. The solum is slightly acid to very strongly acid, and the substratum is medium acid to slightly acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 5 inches thick. Some pedons have an Ap horizon. The E/B and B/E horizons are silt loam or loam. The 3Bt2 horizon is loamy sand, gravelly loamy sand, sandy loam, or gravelly sandy loam.

Pence Series

The Pence series consists of well drained soils on outwash plains, eskers, and kames. These soils formed in loamy and sandy deposits. Permeability is moderately rapid in the upper part of the profile and rapid or very rapid in the lower part. Slope ranges from 0 to 45 percent.

Pence soils are near Vilas soils. The nearby soils are in positions on the landscape similar to those of the Pence soils. They are excessively drained and are sandy throughout.

Typical pedon of Pence sandy loam, 15 to 45 percent slopes, 710 feet east and 20 feet north of the southwest corner of sec. 23, T. 34 N., R. 11 E.

A—0 to 3 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many fine roots; about 8 percent pebbles and 2 percent cobbles; common uncoated sand grains; medium acid; abrupt smooth boundary.

E—3 to 5 inches; brown (7.5YR 5/2) sandy loam; weak medium platy structure; very friable; many fine roots; about 10 percent pebbles and 2 percent cobbles; medium acid; abrupt broken boundary.

Bs1—5 to 9 inches; dark reddish brown (5YR 3/4) gravelly sandy loam; weak medium subangular blocky structure; very friable; common fine roots; about 17 percent pebbles and 2 percent cobbles; medium acid; clear wavy boundary.

Bs2—9 to 18 inches; dark brown (7.5YR 4/4) gravelly loamy sand; weak medium subangular blocky structure; very friable; common fine roots; about 21 percent pebbles and 2 percent cobbles; medium acid; abrupt wavy boundary.

BC—18 to 27 inches; dark brown (7.5YR 4/4) gravelly sand; single grain; loose; few fine roots; about 21 percent pebbles and 2 percent cobbles; medium acid; clear wavy boundary.

C—27 to 60 inches; yellowish brown (10YR 5/4) stratified sand and gravel; single grain; loose; about 21 percent pebbles and 2 percent cobbles; medium acid.

The thickness of the solum ranges from 20 to 36 inches. The content of pebbles ranges from 2 to 15 percent in the A and E horizons and from 5 to 35 percent in the Bs, BC, and C horizons. The content of cobbles ranges from 0 to 5 percent throughout the profile. The solum is slightly acid to very strongly acid, and the substratum is slightly acid or medium acid.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is 2 to 5 inches thick. Some pedons have an Ap horizon. The Bs1 horizon is sandy loam or gravelly sandy loam. The Bs2 horizon is loamy sand or gravelly loamy sand. The BC horizon is sand, gravelly sand, loamy sand, or gravelly loamy sand.

Scott Lake Series

The Scott Lake series consists of moderately well drained soils that formed in silty and loamy deposits and in the underlying sand and gravel. These soils are on outwash plains. Permeability is moderate or moderately rapid in the upper part of the profile and rapid or very rapid in the lower part. Slope ranges from 0 to 2 percent.

These soils have a lower content of fine sand or coarser sand in the 2Bt horizon than is definitive for the Scott Lake series. This difference, however, does not alter the usefulness or behavior of the soils.

Scott Lake soils are near Antigo and Oesterle soils. Antigo soils are well drained and are on the higher upland flats and on swells, hills, knolls, and ridges above the Scott Lake soils. Oesterle soils are somewhat poorly drained and are on the lower flats and in swales and drainageways below the Scott Lake soils.

Typical pedon of Scott Lake silt loam, 1,790 feet south and 140 feet west of the northeast corner of sec. 27, T. 32 N., R. 10 E.

A—0 to 5 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; many fine roots; about 2 percent pebbles and cobbles; strongly acid; abrupt wavy boundary.

Bs—5 to 8 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine subangular blocky structure; very friable; many fine roots; about 2 percent pebbles and cobbles; very strongly acid; clear wavy boundary.

E—8 to 13 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; moderate thin platy structure; very friable; common fine roots; about 2 percent pebbles and cobbles; strongly acid; clear wavy boundary.

B/E—13 to 19 inches; dark yellowish brown (10YR 4/4) silt loam (Bt); moderate fine angular blocky structure; friable; discontinuous distinct dark brown (7.5YR 4/4) clay films on faces of peds; about 40 percent of the horizon occurring as tongues of brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; weak thin platy structure; very friable; common fine roots; about 3 percent pebbles and 2 percent cobbles; very strongly acid; clear wavy boundary.

Bt1—19 to 30 inches; dark yellowish brown (10YR 4/4) silt loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine angular blocky structure; friable; common fine roots; trace of pebbles and 2 percent cobbles; discontinuous prominent dark reddish brown (5YR 3/4) clay films on faces of peds; common distinct pale brown (10YR 6/3) uncoated silt and very fine sand grains, primarily on vertical faces of peds; very strongly acid; clear wavy boundary.

2Bt2—30 to 35 inches; dark yellowish brown (10YR 4/4) loam; few fine distinct grayish brown (10YR 5/2), common fine distinct yellowish red (5YR 4/6), and common medium distinct strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; few fine roots; about 6 percent pebbles and 2 percent cobbles; patchy prominent dark reddish brown (5YR 3/4) clay films on faces of peds; very strongly acid; abrupt wavy boundary.

3Bt3—35 to 39 inches; dark brown (7.5YR 4/4) gravelly sandy loam; few fine distinct yellowish red (5YR 4/6) and common fine distinct strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; very friable; tends to part along horizontal cleavage planes inherited from the parent material; few fine roots; about 16 percent pebbles and 2 percent cobbles; patchy distinct dark reddish brown (5YR 3/4) clay films on faces of peds and clay bridging between most mineral grains; very strongly acid; clear wavy boundary.

3C—39 to 60 inches; yellowish brown (10YR 5/4) stratified sand and gravel; single grain; loose; about 24 percent pebbles and 2 percent cobbles; medium acid.

The thickness of the solum ranges from 22 to 40 inches. The silty mantle is as much as 32 inches thick. The content of pebbles ranges from 0 to 5 percent in the silty mantle, from 0 to 15 percent in the 2Bt2 horizon, from 5 to 35 percent in the 3Bt3 horizon, and from 5 to 60 percent in the 3C horizon. The content of cobbles ranges from 0 to 2 percent in the silty mantle and from 0 to 5 percent in the 2Bt2, 3Bt3, and 3C horizons. The solum is very strongly acid to slightly acid, and the substratum is slightly acid or medium acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 2 to 5 inches thick. Some pedons have an Ap horizon. The E, B/E, and Bt1 horizons are loam or silt loam. The 3Bt3 horizon is loamy sand, gravelly loamy sand, sandy loam, or gravelly sandy loam.

Seelyeville Series

The Seelyeville series consists of very poorly drained, moderately rapidly permeable soils that formed in organic material. These soils are on outwash plains, in glacial lake basins, and on moraines. Slope ranges from 0 to 2 percent.

These soils have redder hue and contain more wood fragments and fibers than is definitive for the Seelyeville series. These differences, however, do not alter the usefulness or behavior of the soils.

Seelyeville soils are similar to Cathro, Loxley, and Markey soils. Cathro and Markey soils are underlain by loamy deposits and sandy deposits, respectively. These deposits are at a depth of 16 to 51 inches. Loxley soils are extremely acid or very strongly acid.

Typical pedon of Seelyeville muck, in an area of Seelyeville, Cathro, and Markey mucks, 2,300 feet west and 230 feet south of the northeast corner of sec. 18, T. 32 N., R. 11 E.

Oa1—0 to 6 inches; black (N 2/0), broken face and rubbed, black (5YR 2/1), pressed, sapric material; about 30 percent fiber, 10 percent rubbed; weak medium subangular blocky structure; very friable; many fine roots; primarily herbaceous fibers and some woody ones; about 10 percent dark brown (7.5YR 4/4) wood fragments; about 15 percent mineral material; brown (10YR 5/3) sodium pyrophosphate extract; slightly acid (pH 6.2 by Truog method); clear smooth boundary.

Oa2—6 to 29 inches; black (5YR 2/1), broken face and rubbed, dark reddish brown (5YR 2/2), pressed, sapric material; about 35 percent fiber, 10 percent rubbed; massive; very friable; tends to part along weaknesses in the fibers; primarily herbaceous fibers and some woody ones; about 15 percent dark brown (7.5YR 4/4) wood fragments; about 15 percent mineral material; brown (10YR 5/3) sodium pyrophosphate extract; slightly acid (pH 6.1 by Truog method); clear smooth boundary.

Oa3—29 to 60 inches; dark reddish brown (5YR 3/2), broken face and pressed, black (5YR 2/1), rubbed, sapric material; about 30 percent fiber, 5 percent rubbed; massive; very friable; tends to part along weaknesses in the fibers; primarily herbaceous fibers and some woody ones; about 15 percent dark brown (7.5YR 4/4) wood fragments; about 20 percent mineral content; brown (10YR 5/3) sodium pyrophosphate extract; slightly acid (pH 6.5 by Truog method).

The organic material is more than 51 inches thick. Many pedons have a surface cover of sphagnum moss as much as 4 inches thick. The content of wood fragments is as much as 30 percent. The content of mineral ash is also as much as 30 percent. The organic material is medium acid to mildly alkaline.

The sapric material has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3. Some pedons have a few thin layers of hemic material.

Sherry Series

The Sherry series consists of very poorly drained soils on moraines. These soils formed in silty deposits and in the underlying glacial drift, which contains some granite residuum. Permeability is moderate or moderately slow in the upper part of the profile and moderately slow in the lower part. Slope ranges from 0 to 2 percent.

These soils have a thinner dark mineral surface layer, are grayer in the lower part of the solum, and have a smaller increase in clay content in the B horizon than is definitive for the Sherry series. These differences, however, do not alter the usefulness or behavior of the soils.

Sherry soils are similar to Cable and Minocqua soils and are near Milladore soils. Cable and Minocqua soils have less clay in the subsoil than the Sherry soils. Minocqua soils have a stratified sand and gravel substratum. Milladore soils are somewhat poorly drained. They are on knolls and swells above the Sherry soils.

Typical pedon of Sherry muck, in an area of Minocqua, Cable, and Sherry mucks, 40 feet north and 1,150 feet west of the southeast corner of sec. 23, T. 31 N., R. 9 E.

Oa—0 to 6 inches; black (N 2/0), broken face, very dark gray (10YR 3/1), rubbed and pressed, sapric material; about 20 percent fiber, 4 percent rubbed; moderate very fine granular structure; very friable; many fine roots; primarily herbaceous fibers and some woody ones; about 2 percent dark brown (7.5YR 4/4) wood fragments; about 30 percent mineral material; dark brown (10YR 3/3) sodium pyrophosphate extract; about 2 percent rounded pebbles and cobbles; strongly acid (pH 5.4 by Truog method); abrupt wavy boundary.

A—6 to 8 inches; very dark gray (10YR 3/1) silt loam; common fine faint dark brown (7.5YR 3/2) and few fine prominent brown (7.5YR 4/4) mottles; weak coarse prismatic structure; firm; tends to part along horizontal cleavage planes inherited from the parent material; common fine roots; trace of pebbles and cobbles; strongly acid; abrupt wavy boundary.

Bg—8 to 12 inches; dark gray (10YR 4/1) silt loam; few fine distinct brown (10YR 4/3) and common fine prominent dark brown (7.5YR 4/4) mottles; weak coarse prismatic structure; firm; tends to part along horizontal cleavage planes inherited from the parent material; common fine roots; trace of pebbles and cobbles; few thin broken layers of very dark gray (10YR 3/1) silt loam; medium acid; clear wavy boundary.

Btg1—12 to 22 inches; gray (5Y 5/1) silt loam; many medium prominent yellowish red (5YR 5/6) and few fine prominent red (2.5YR 4/8) mottles; weak coarse prismatic structure parting to weak fine angular blocky; friable; few fine roots; patchy prominent dark gray (10YR 4/1) clay films on faces of peds, continuous in pores; trace of pebbles and cobbles; slightly acid; clear wavy boundary.

2Btg2—22 to 28 inches; gray (5Y 5/1) loam; many fine prominent yellowish red (5YR 5/6) and common fine prominent red (2.5YR 4/8) mottles; weak coarse prismatic structure parting to moderate fine subangular blocky; friable; few fine roots; patchy prominent dark gray (10YR 4/1) clay films on faces of peds, continuous in pores; about 6 percent rounded pebbles; slightly acid; gradual wavy boundary.

3Btg3—28 to 43 inches; olive gray (5Y 5/2) sandy loam; few fine faint greenish gray (5GY 5/1), many coarse faint olive (5Y 5/3), and common fine prominent yellowish red (5Y 5/6) and red (2.5YR 4/8) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; firm; few fine roots; patchy prominent dark gray (10YR 4/1) clay films on faces of peds, continuous in pores; about 5 percent rounded and angular pebbles; continuous prominent dark grayish brown (10YR 4/2) uncoated sand and silt grains on vertical faces of peds; very compact; neutral; diffuse wavy boundary.

3C1—43 to 52 inches; olive gray (5Y 5/2) sandy clay loam; few medium distinct dark greenish gray (5G 4/1), few fine prominent red (2.5YR 4/8), common coarse faint olive (5Y 5/3), and few medium faint dark greenish gray (5GY 4/1) mottles; massive; firm; few fine roots; about 13 percent rounded and angular pebbles; few thin broken layers of reddish gray (5YR 5/2) sandy loam; very compact; neutral; clear wavy boundary.

3C2—52 to 57 inches; olive gray (5Y 4/2) sandy loam; common medium prominent dark red (2.5YR 3/6), many coarse prominent yellowish red (5YR 4/6), and few medium faint greenish gray (5GY 5/1) mottles; massive; firm; very compact; about 8 percent angular and rounded pebbles; neutral; clear wavy boundary.

3C3—57 to 60 inches; olive gray (5Y 4/2) sandy loam; few medium prominent dark red (2.5YR 3/6), many fine prominent reddish brown (5YR 4/4), and few medium faint dark greenish gray (5GY 4/1) mottles; massive; firm; very compact; about 8 percent angular and rounded pebbles; neutral.

The thickness of the solum ranges from 30 to 50 inches. The silty mantle is 15 to 30 inches thick. The content of pebbles ranges from 0 to 5 percent in the silty mantle and from 2 to 15 percent in the lower part of the solum and in the substratum. The content of cobbles ranges from 0 to 2 percent in the silty mantle and from 0 to 10 percent in the lower part of the solum and in the substratum. The solum is very strongly acid to neutral, and the substratum is strongly acid to mildly alkaline.

The Oa horizon has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is 2 to 6 inches thick. The 2Btg2 horizon is loam, sandy loam, or loamy sand. The 3Btg3 and 3C horizons are sandy loam, loam, sandy clay loam, or clay loam.

Vilas Series

The Vilas series consists of excessively drained, rapidly permeable soils that formed in sandy deposits. These soils are on outwash plains. Slope ranges from 0 to 15 percent.

These soils contain less extractable iron and aluminum in the Bs horizon than is definitive for the Vilas series. This difference, however, does not alter the usefulness or behavior of the soils.

Vilas soils are near the sandy Au Gres and Croswell soils. The somewhat poorly drained Au Gres soils and the moderately well drained Croswell soils are on low flats and in swales and drainageways below the Vilas soils.

Typical pedon of Vilas loamy sand, 0 to 6 percent slopes, 660 feet west and 50 feet south of the northeast corner of sec. 14, T. 34 N., R. 11 E.

A—0 to 3 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; many fine roots; about 2 percent pebbles; common uncoated sand grains; strongly acid; abrupt smooth boundary.

E—3 to 4 inches; brown (7.5YR 4/2) loamy sand; weak fine subangular blocky structure; very friable; many fine roots; about 2 percent pebbles; strongly acid; abrupt smooth boundary.

Bs1—4 to 8 inches; dark reddish brown (5YR 3/4) loamy sand; weak medium subangular blocky structure; very friable; many fine roots; about 2 percent pebbles; strongly acid; clear wavy boundary.

Bs2—8 to 13 inches; dark brown (7.5YR 4/4) loamy sand; weak coarse subangular blocky structure; very friable; common fine roots; about 3 percent pebbles; strongly acid; gradual wavy boundary.

BC—13 to 29 inches; brown (7.5YR 5/4) sand; weak coarse subangular blocky structure; very friable; few fine roots; about 4 percent pebbles; medium acid; clear wavy boundary.

C—29 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; few fine roots; about 3 percent pebbles; slightly acid.

The thickness of the solum ranges from 24 to 36 inches. The content of pebbles ranges from 0 to 10 percent throughout the profile. The solum is slightly acid to very strongly acid, and the substratum is slightly acid or medium acid.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is 0.5 inch to 4.0 inches thick. Some pedons have an Ap horizon. The E horizon is sand or loamy sand.

Formation of the Soils

The following paragraphs give information about the geology and underlying material in Langlade County and relate the factors and processes of soil formation to the soils in the county.

Geology and Underlying Material

Robert N. Cheetham, geologist, Soil Conservation Service, helped prepare this section.

Crystalline bedrock of Precambrian age underlies glacial deposits in Langlade County (*8*). The bedrock is a complex of folded and faulted, igneous and metamorphic rocks that are part of the Canadian Shield.

The surface of the bedrock is rather smooth but is irregular, having a relief of several hundred feet in the county. The slope of the bedrock is generally north to south at about 6 feet per mile. Joints or other cracks are in the bedrock, but these openings seldom extend more than 30 feet below the surface of the bedrock.

Bedrock is close to the surface in Ackley Township, where Marathon and Mylrea soils occur. The lower layers of these soils formed in granite residuum. Hard granite is 40 to 60 inches below the surface of the Marathon soils. A few bedrock outcrops are along the Wolf River.

Glaciers moved into or across the survey area several times after the Ice Age began, more than 1 million years ago. They transported a great amount of pulverized and other rock material, called glacial drift. The glacial drift was derived from local bedrock, from material deposited by previous glaciers, and from other material transported into the area. When the ice melted or stagnated, the glacial drift was deposited throughout the county in the form of till, outwash, and lacustrine deposits. The glacial drift is several hundred feet thick in the hilly areas but is thinner in the southwestern part of the county.

The glacial drift in Langlade County is of several different ages. The older drift, which generally has a silty mantle, is a surface deposit in the southwestern part of the county. Areas where this drift is deposited are distinguished by a scarcity of lakes, undrained depressions, and hilly topography. The older drift is mostly till characterized by reddish colors (hue of 5YR or 2.5YR), loamy texture, and few stones. The upper part of the till is firm and very dense, restricting the downward movement of water.

The till in the older drift area of the county is probably from two different ages of glaciation, as is indicated by differences in lithology, particle-size components, and clay flows. The oldest till, called Wausau till, is in map unit 6 on the general soil map. This is a thin layer of till over Precambrian bedrock. The lithology of the till is similar to that of the underlying bedrock, but erratics also are evident. The fine earth fraction (material less than 2 millimeters in size) of the unweathered parts is commonly loam that averages 48 percent sand, 29 percent silt, and 23 percent clay. The content of cobbles averages 2 percent and the content of pebbles 6 percent. The clay flows in the Wausau till are more developed than those in the younger Merrill till, indicating considerable weathering.

The Merrill till is in map unit 3 on the general soil map. It is much thicker than the Wausau till. The fine earth fraction of the unweathered parts is commonly sandy loam that averages 67 percent sand, 21 percent silt, and 12 percent clay. The content of cobbles averages 4 percent and the content of pebbles 9 percent. The Merrill till is more than 40,000 years old. Its weathering profiles suggest that it is probably of pre-Wisconsinan age (*7*).

The most recent glaciation of the survey area occurred during the Cary substage of the Wisconsinan Glaciation, between 12,500 and 20,000 years ago. During this substage, three lobes of glacial ice moved into the survey area (*9*). The Wisconsin Valley lobe, which formed the Harrison Moraine at its furthest advance, came from the northwest. It covered only a small part of the area, the northwest corner. The drift deposited by this lobe is similar to that deposited by the other lobes, but it is redder, having hue of 5YR or 2.5YR. The Langlade lobe came from the northeast, moving down the crystalline bedrock slope. The rock fragments that it incorporated were mostly granite, quartzite, schist, and gneiss. The Green Bay lobe moved up the bedrock slope from the southeast, passing over limestone, sandstone, and crystalline bedrock. The pink granite, dolomite, and sandstone fragments that it carried reflect this movement (*3*). The lobes passed over their own outwash and the Merrill drift as they moved into the survey area.

The furthest advance of the lobes is marked by a belt of morainic hills (terminal moraines). This belt extends southeastward from the northwest corner of the county to the central part (Parrish Moraine) and then southwestward to the Marathon County line (Outer Moraine). Subsequent melting and readvances of the ice lobes created recessional moraines along the ice margins but behind the terminal moraines. The Summit Lake Moraine was formed about 3 miles northeast of the Parrish Moraine. The Elderon Moraine, marked by ridges of outwash trending northeast to southwest, was formed about 6 miles southeast of the Outer Moraine. The Bowler Moraine lies about 8 miles southeast of the Elderon Moraine. Most of its features are buried by outwash deposits.

The morainic hills are the roughest part of the county. They have many kettles created by the melting of buried ice blocks. Many of these kettles are lakes, ponds, bogs, or swamps. The moraines, especially the Parrish Moraine, also have many small, ice-contact lake basins. These basins were formerly water-filled holes in the surface of the glacial ice. They commonly contain lacustrine deposits and are bordered by prominent ridges of glacial drift.

Ground moraines from the Cary substage are scarce in Langlade County. Most initial formations were subsequently destroyed by readvances of the ice lobes or buried by outwash deposits when the ice lobes melted. Elongated and rather smooth swells and hills of till, called drumlins, are in the northeastern and southeastern parts of the county. They were shaped in grooves at the base of the ice lobes. Most are outwash-cored and till-capped drumlins oriented parallel to the movement of the ice lobes.

The till of Cary age has brownish colors (hue of 10YR or 7.5YR). It is loamy sand or sand and has many stones. It averages 10 percent cobbles and 13 percent pebbles. The fine earth fraction of unweathered parts averages 84 percent sand, 10 percent silt, and 6 percent clay.

Glacial outwash in Langlade County is mostly from the Cary substage. It occurs as eskers, kames, and outwash plains. Narrow, snake-shaped ridges, called eskers, and gravelly knobs, called kames, were created when meltwater deposited sand and gravel in holes and channels in the glacial ice.

The meltwater also deposited outwash on, within, and between the moraines. The result is a landscape of rather flat outwash plains intermixed with swells and hills of outwash and stony till. Many of the outwash plains have kettles and meltwater flow channels. The kettles, or pits, were created by the melting of ice blocks within the outwash deposits (fig. 19).

The largest outwash plain, known as the Antigo Flats, is in the south-central part of the county. As meltwater deposited outwash during the Cary substage, this trian-

Figure 19.—A kettle in an area of an Antigo soil.

gular plain was formed in the angle between the distal edges of the Langlade and Green Bay lobes.

Many of the outwash plains are stratified sand and gravel mantled with silty or loamy deposits. Strong winds may have carried some of the finer textured material onto the adjacent uplands. This material contains pebbles and cobbles. Windthrow of trees or frost action may have mixed some coarse fragments from the underlying outwash into the finer textured material. The coarse fragments may also indicate, however, that the finer textured material is of glaciofluvial origin. The coarse fragments may have rolled or ice-rafted into the silty or loamy material. This theory is supported by the presence of fine sand or coarser material throughout the finer textured material and by horizontal bedding planes in part of this material.

An outwash plain in the Post Lake area is mostly sand. The content of coarse fragments in this sandy material is less than 10 percent.

Lacustrine deposits ranging from clay to sand were laid down in kettles and glacial lakes by slowly moving or ponded glacial meltwater. Some alluvial deposits are along the major drainageways in the county. This alluvium eroded from the uplands after the Cary ice lobes melted.

During the postglacial period, many shallow lakes and waterways provided a favorable environment for aquatic plants. The organic soils in the county formed in the decomposed residue of these aquatic plants.

Factors of Soil Formation

The soils in Langlade County formed through processes acting on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate that has existed since the parent material accumulated; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the processes of soil formation have acted on the soil material (*5*). Each of these factors affects the formation of every soil, but the relative importance of each differs from place to place. One factor, for example, may dominate the formation of a soil and determine most if its properties. In general, however, the effect of each of these factors is modified by the effects of the others.

Parent Material

Parent material in Langlade County consists mostly of glacial till, outwash, and lacustrine deposits, which in places are covered by a thin layer of silty or loamy windblown material. Some of the soils formed in more recent deposits of organic material or alluvium.

Many soils in the county formed entirely or partly in glacial till of different ages. Hatley, Kennan, and Keweenaw soils and some of the Cable soils formed in Cary till. Amery, Freeon, and Magnor soils and most of the Cable soils formed in Merrill till. Amery soils are on the highest parts of the landscape, where the upper part of the till appears to have been reworked by glacial meltwater. Marathon, Milladore, Mylrea, and Sherry soils formed in Wausau till. Marathon and Mylrea soils are on the highest parts of the Wausau till landscape, where bedrock is very close to the surface.

Many of the soils formed entirely or partly in glacial outwash. Antigo, Langlade, Minocqua, Oesterle, and Scott Lake soils formed in areas where sand and gravel outwash is mantled with silty and loamy deposits. Pence soils formed on eskers and kames and in other areas where sand and gravel outwash is mantled with loamy or sandy deposits. Au Gres, Croswell, and Vilas soils formed in areas where most of the outwash is sandy.

Comstock, Crystal Lake, Ingalls, and Menominee soils formed entirely or partly in glacial lacustrine deposits. Fordum soils formed in postglacial deposits of alluvium along the major drainageways. Cathro, Loxley, Markey, and Seelyeville soils formed in postglacial deposits of organic material in bogs and other depressional areas.

Climate

Climate directly affects soil formation through the weathering of rocks. It also alters the parent material through the mechanical action of freezing and thawing. It indirectly affects the accumulation of organic matter by supplying energy and a suitable environment for the growth of both plant and animal organisms.

Precipitation and temperature are the chief elements of climate responsible for soil features. These elements determine the amount of water available for percolation and the formation and decomposition of organic matter, the major processes in the formation of soils.

Percolating water from rainfall and snowmelt affects both the solution and hydration of mineral material and the organic substances. The movement of this water also controls the distribution of substances throughout the soil.

The soils in Langlade County usually have a frozen layer in winter. This layer restricts the percolation of water. Consequently, the processes of soil formation are very slow or are suspended in winter. The physical action of frost heave also affects profile development. The high temperature in summer increases the evaporation and transpiration of moisture, thus limiting the amount of percolating water available for soil formation. Temperature also affects the growth and decomposition of organic matter. Decomposition is much slower in cooler climates than in warmer ones.

Wind indirectly affects the moisture content of soils by influencing the rate of evaporation. In addition, the wind often blows away fine particles of soil and organic material, thereby eroding the surface layer. These particles are deposited elsewhere as new parent material.

Climate is modified by variations in slope aspect. The soils on south- or west-facing slopes are warmed and dried by the sun and wind more thoroughly than those on north- and east-facing slopes. The soils on the cooler, more humid north- and east-facing slopes generally contain more moisture and are frozen for a longer period.

Plant and Animal Life

Living organisms, such as plants, bacteria, fungi, insects, earthworms, and rodents, influence the formation of soils. Plants generally have the greatest influence on soil formation. Plant roots penetrate the soil body, thereby creating channels for percolating water. The roots excrete a number of acid substances that act on rocks and minerals and bring nutrients or mineral substances into solution. These nutrients are absorbed and translocated upwared to stems and leaves. When the plants die, the translocated minerals are released to the upper soil layers. The organic acids formed from the decaying plant residue accelerate soil formation by reacting with rock and mineral constituents.

Plants indirectly affect soil formation by modifying the effects of climate. For example, they reduce the force of winds, thereby influencing the evaporation rate of percolating water and the deposition of windblown parent material.

Animals burrow into the soil and mix the material of the different layers. Roots and percolating water follow the channels created by the animals. Animal life affects soil structure, helps to decompose organic matter, and carries nutrients upward in the soil profile. When these animals die, they contribute to the supply of organic matter in the soil.

Human activities recently have had important effects on the soils in the county. The original condition of some soils has been altered by these activities, which include removing the native vegetation, mixing the upper layers through cultivation, and planting crops that are different from the native vegetation. Removal of the native vegetation has accelerated erosion on sloping soils. Heavy tillage and harvesting equipment has compacted the soil. Applications of lime and fertilizer have altered the pH value and fertility of soils. Some cropping practices have reduced the content of organic matter. The content of soil moisture has been altered by irrigation and artificial drainage. Some of the effects of human activities, for example, the addition of fertilizer, pesticide, herbicide, and fungicide, may not be known for many years.

Relief

Relief influences the formation of soils through its effect on drainage, runoff, and erosion. Differences in elevation and slope are closely related to differences in drainage, the thickness and organic matter content of the topsoil, the depth of the soil, and the susceptibility of erosion.

Amery and other sloping, well drained soils absorb less water than the less sloping soils because of a higher rate of runoff. Consequently, they show no evidence of mottling or prolonged wetness, tend to have a thinner profile and less horizon development than the less sloping soils, and are more susceptible to erosion.

Oesterle and other somewhat poorly drained soils are mottled in the subsoil. They commonly are less sloping than the well drained soils and are affected by a slower runoff rate, or they are lower on the landscape. They usually receive runoff from the adjacent uplands.

Minocqua and other very poorly drained soils are in the lowest positions on the landscape, where runoff is very slow or ponded. They have a grayish subsoil as a result of excessive moisture and poor aeration. Their surface layer generally is darker and thicker than that of the upland soils because the moisture content is more favorable for plant growth and for the accumulation of organic matter. Organic soils form in wet depressions where decomposing plant residue accumulates to a depth of several feet.

Time

Generally, a long time is needed for soil formation. The degree of horizon development depends on the length of time that the soil-forming processes have been active. Some soils, however, form more rapidly than others. The length of time needed for the formation of a particular kind of soil depends on the other factors involved.

When a soil begins to form, the characteristics of the soil material and parent material are almost identical and the soil is said to be immature. Fordum soils, for example, are considered immature. Few or no genetic differences are evident between their horizons. Generally, a soil is considered mature if it has well defined horizons as a result of soil-forming processes that have been active for thousands of years. Kennan soils, for example, are considered mature.

Processes of Soil Formation

Physical, chemical, and biological reactions result from the interaction of the factors of soil formation. These reactions occur as soil-forming processes, such as the accumulation of organic matter in the surface layer, the transformation of soil material, and the removal, transfer, and deposition of soil components from one part of the soil profile to another (fig. 20).

The soil-forming processes are active in all soils in varying degrees. In Langlade County the kinds of parent material and the relief have largely determined the processes that have been dominant in the formation of the soils.

Magnor soils illustrate how the soil-forming processes affect soil formation. These soils formed in silty deposits and in the underlying slightly acid, compacted sandy

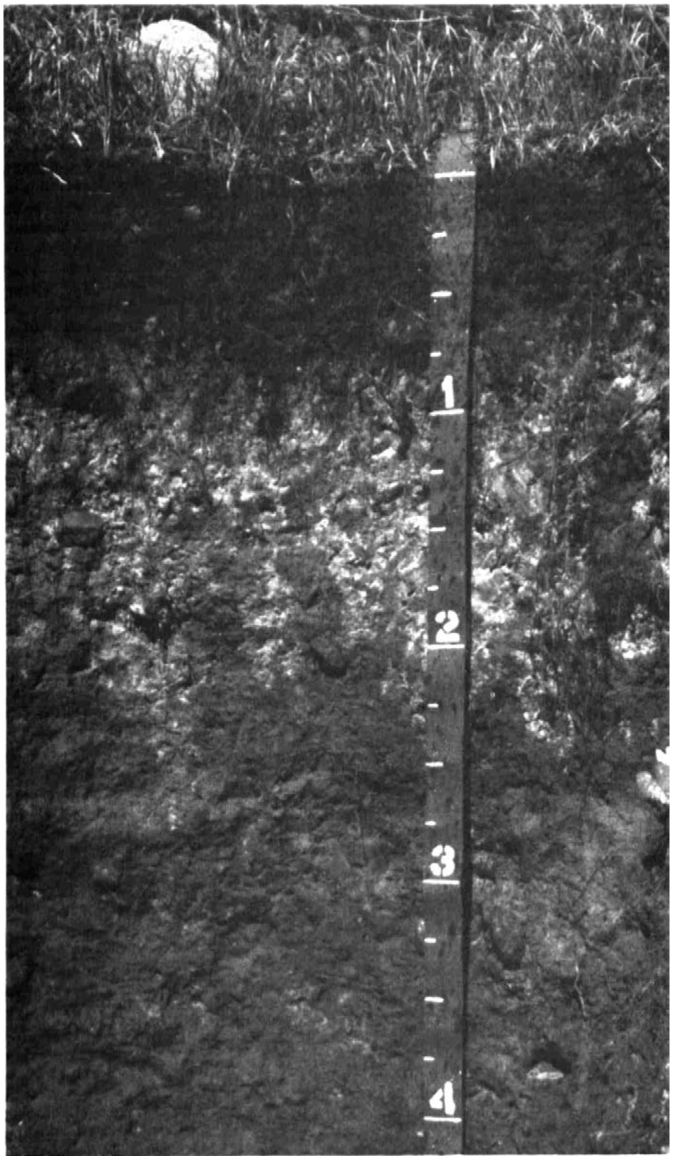


Figure 20.—Profile of a Kennan soil, which has a light colored E horizon. Silicate clay, iron, and aluminum have been transformed and removed from this horizon by soil-forming processes. Scale is in feet.

loam glacial till. The relief, or lay of the land, influenced the other factors of soil formation by affecting the amount of water available for percolation. A large amount of the rainfall and snowmelt infiltrated these soils because of the nearly level and gently sloping topography. This infiltration contributed to the characteristics that made the soils somewhat poorly drained. The climate, along with living organisms, affected the accumulation of organic matter and organic acids and was conducive to the downward movement of water in the profile. In time, the changes caused by the factors and processes of soil formation accelerated.

Organic matter accumulated in the surface layer of Magnor soils as the forest litter decomposed. The surface layer became darker than it was originally. Organic acids produced during the decomposition acted on the parent material, separating minerals or altering them chemically. The iron, aluminum, and silicate clay minerals became more soluble and, along with organic matter, were subsequently moved downward in the profile by percolating water. The result is a lower base status, a more acid solum, and a substantial loss of clay and other material from the leached subsurface layer. The bleached color of this layer is primarily the color of the remaining mineral separates, such as quartz.

The translocated material was deposited in the subsoil on the faces of peds, in cracks, and in openings left by plant roots, worms, and insects. As a result, the subsoil of Magnor soils has a higher content of clay than other parts of the profile. A subsoil of clay accumulation formed and later was partly destroyed. The degradation or destruction of the subsoil resulted when clay films were stripped from the faces of peds and flushed downward or horizontally by percolating water, leaving behind skeletal frameworks of uncoated silt or sand. This destruction resulted in an intermingling of the subsurface layer and subsoil.

The downward movement of water in Magnor soils is restricted because the upper part of the glacial till is compacted. The result is a perched seasonal high water table. These soils are mottled because of the seasonally alternating reduction and oxidation of the component iron.

As a result of these soil-forming processes, Magnor soils have a very dark gray surface layer, a mottled and clay-depleted subsurface layer that penetrates into the subsoil, and a mottled and clay-enriched subsoil that is more acid than the substratum. At a depth of about 30 inches, they are underlain by unweathered glacial till that has changed little since it was deposited by a glacier.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Chisel plowing. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clearcutting. Removal of all the timber in a stand when trees are harvested.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Critical area planting. Planting stabilizing vegetation, such as trees, shrubs, vines, grasses, and legumes in critical areas.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Eutrophication. Nutrient enrichment of surface water through natural means or as a result of human activities.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field border. A strip of perennial vegetation established at the edge of a field.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter is expressed as—

	Percent
Very low	less than 0.5
Low	0.5 to 1.0
Moderately low	1.0 to 2.0
Moderate	2.0 to 4.0
High	4.0 to 8.0
Very high	more than 8.0

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material).

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Much has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shelterwood cut. A method of tree harvest in which some large trees are left to adequately protect the younger and shorter trees from windthrow and other damage.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multipled by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. The slope classes in Langlade County are—

	Percent
Nearly level (simple, complex)	0 to 2
Gently sloping (simple)	2 to 6
Undulating (complex)	2 to 6
Sloping (simple)	6 to 15
Rolling (complex)	6 to 15
Moderately steep to very steep (simple)	15 to 45
Hilly to very steep (complex)	15 to 45

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Strip cut. A type of tree harvest in which the timber is clearcut in strips, commonly 50 to 100 feet wide.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a depressional area.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Vegetative row barrier. A row of tall perennial herbaceous plants established on cropland.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data were recorded in the period 1951-80 at Antigo, Wisconsin]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	21.5	2.2	11.9	42	-30	0	0.90	0.36	1.35	3	12.1
February---	27.0	5.2	16.1	47	-25	0	.84	.27	1.29	3	9.7
March------	37.2	16.5	26.9	61	-16	0	1.79	.64	2.74	5	10.0
April------	53.9	31.4	42.7	82	9	21	2.68	1.42	3.77	7	3.6
May--------	67.8	41.9	54.9	88	23	208	3.40	2.14	4.53	8	.3
June-------	75.8	51.2	63.5	91	33	405	4.15	2.31	5.77	8	.0
July-------	80.3	55.7	68.0	93	39	558	4.01	2.42	5.43	7	.0
August-----	77.8	54.0	65.9	91	35	493	4.45	2.46	6.20	8	.0
September--	68.6	45.9	57.3	87	26	226	4.24	2.09	6.09	8	.0
October----	57.9	36.8	47.4	80	17	93	2.14	.89	3.18	5	.3
November---	40.1	24.1	32.1	63	-5	0	1.79	.70	2.70	4	5.6
December---	26.7	10.8	18.8	49	-22	0	1.22	.55	1.78	4	12.2
Yearly:											
Average--	52.9	31.3	42.1	---	---	---	---	---	---	---	---
Extreme--	---	---	---	94	-30	---	---	---	---	---	---
Total----	---	---	---	---	---	2,004	31.61	27.71	35.37	70	53.8

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Data were recorded in the period 1951-80 at Antigo, Wisconsin]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 9	May 21	June 5
2 years in 10 later than--	May 4	May 15	May 31
5 years in 10 later than--	Apr. 25	May 5	May 22
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 27	Sept. 22	Aug. 22
2 years in 10 earlier than--	Oct. 4	Sept. 27	Aug. 30
5 years in 10 earlier than--	Oct. 16	Oct. 6	Sept. 16

TABLE 3.--GROWING SEASON

[Data were recorded in the period 1951-80 at Antigo, Wisconsin]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	148	130	83
8 years in 10	157	138	94
5 years in 10	174	153	116
2 years in 10	191	168	137
1 year in 10	200	176	148

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
AmC	Amery loam, 6 to 15 percent slopes	750	0.1
AoA	Antigo silt loam, 0 to 2 percent slopes	41,280	7.4
AoB	Antigo silt loam, 2 to 6 percent slopes	39,050	7.0
AoC	Antigo silt loam, 6 to 15 percent slopes	37,540	6.7
As	Au Gres loamy sand	2,400	0.4
Co	Comstock silt loam	3,560	0.6
Cs	Croswell loamy sand	1,730	0.3
CyB	Crystal Lake silt loam, 0 to 6 percent slopes	4,490	0.8
Fm	Fordum mucky silt loam	2,990	0.5
FoB	Freeon silt loam, 2 to 6 percent slopes	2,620	0.5
HyB	Hatley silt loam, 2 to 6 percent slopes, stony	10,240	1.8
Ig	Ingalls loamy sand	1,570	0.3
KnC	Kennan loam, 6 to 15 percent slopes, stony	64,869	11.6
KoB	Kennan silt loam, 2 to 6 percent slopes, stony	25,640	4.6
KwD	Keweenaw sandy loam, 15 to 45 percent slopes, stony	60,820	10.9
LgA	Langlade silt loam, 0 to 2 percent slopes	11,540	2.1
LgB	Langlade silt loam, 2 to 6 percent slopes	730	0.1
Lx	Loxley peat	13,350	2.4
MgB	Magnor silt loam, 0 to 4 percent slopes	44,260	7.9
MhB	Marathon loam, bedrock substratum, 2 to 6 percent slopes	310	0.1
MnB	Menominee loamy sand, 0 to 6 percent slopes	7,840	1.4
MoB	Milladore silt loam, 0 to 4 percent slopes	4,360	0.8
Ms	Minocqua, Cable, and Sherry mucks	27,570	4.9
MyB	Mylrea silt loam, 0 to 4 percent slopes	3,650	0.7
Os	Oesterle silt loam	23,780	4.3
PsB	Pence sandy loam, 0 to 6 percent slopes	8,430	1.5
PsC	Pence sandy loam, 6 to 15 percent slopes	9,320	1.7
PsD	Pence sandy loam, 15 to 45 percent slopes	39,250	7.0
Pt	Pits, gravel	370	0.1
Sc	Scott Lake silt loam	13,110	2.3
Sy	Seelyeville, Cathro, and Markey mucks	46,410	8.3
VsB	Vilas loamy sand, 0 to 6 percent slopes	4,010	0.7
VsC	Vilas loamy sand, 6 to 15 percent slopes	1,150	0.2
	Total land area	558,989	100.0
	Water	9,344	
	Total area	568,333	

TABLE 5.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
AmC: Amery	2a	Slight	Slight	Slight	Slight	Sugar maple	63	Red pine, eastern white pine, white spruce.
						Northern red oak	65	
						Quaking aspen	---	
						White oak	---	
						White ash	---	
						American basswood	---	
						Bigtooth aspen	---	
						Yellow birch	---	
						Black cherry	---	
AoA, AoB, AoC: Antigo	1a	Slight	Slight	Slight	Slight	Sugar maple	66	Eastern white pine, red pine, white spruce.
						American basswood	69	
						Northern red oak	---	
						Eastern white pine	---	
						Yellow birch	71	
						White ash	74	
						Bigtooth aspen	---	
						Quaking aspen	---	
						Black cherry	---	
As: Au Gres	2w	Slight	Moderate	Slight	Moderate	Quaking aspen	70	White spruce, eastern white pine, northern white-cedar, Norway spruce.
						Bigtooth aspen	---	
						Balsam fir	---	
						Paper birch	---	
						Yellow birch	---	
						Red maple	---	
						Eastern hemlock	---	
						Eastern white pine	---	
						Northern white-cedar	---	
Co: Comstock	2w	Slight	Moderate	Slight	Moderate	Red maple	65	Eastern white pine, white spruce, red pine, white ash.
						Balsam fir	---	
						Quaking aspen	---	
						White ash	---	
						Sugar maple	---	
						Paper birch	---	
						Bigtooth aspen	---	
						Yellow birch	---	
Cs: Croswell	2s	Slight	Slight	Moderate	Slight	Quaking aspen	68	Red pine, eastern white pine, white spruce, jack pine.
						Red pine	55	
						Jack pine	53	
						Northern red oak	---	
						Eastern white pine	---	
						Bigtooth aspen	---	
						Red maple	---	
						Balsam fir	---	
						Northern pin oak	---	
						Paper birch	---	
CyB: Crystal Lake	2a	Slight	Slight	Slight	Slight	Sugar maple	59	Eastern white pine, red pine, white spruce.
						American basswood	69	
						Yellow birch	---	
						Quaking aspen	---	
						Bigtooth aspen	---	
						American elm	---	
						White ash	---	
						Black cherry	---	

TABLE 5.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
Fm----------------- Fordum	3w	Slight	Severe	Severe	Severe	Silver maple--------	80	Silver maple, red maple, white ash, white spruce, black spruce.
						Red maple-----------	---	
						White ash-----------	---	
						Northern white-cedar	---	
						Tamarack------------	---	
						Black spruce--------	---	
						Balsam fir----------	---	
						White spruce--------	---	
						Quaking aspen-------	---	
						Paper birch---------	---	
						American elm--------	---	
						Yellow birch--------	---	
						Black ash-----------	---	
FoB---------------- Freeon	2a	Slight	Slight	Slight	Slight	Sugar maple---------	62	Red pine, eastern white pine, white spruce.
						Northern red oak----	63	
						American basswood---	---	
						Red maple-----------	---	
						White oak-----------	---	
						Quaking aspen-------	---	
						Bigtooth aspen------	---	
						White ash-----------	---	
						Yellow birch--------	---	
						Black cherry--------	---	
HyB---------------- Hatley	2x	Slight	Moderate	Slight	Moderate	Red maple-----------	66	Red pine, eastern white pine, white spruce, white ash.
						Balsam fir----------	---	
						Bigtooth aspen------	---	
						White ash-----------	---	
						Quaking aspen-------	---	
						Paper birch---------	---	
						Yellow birch--------	---	
						Sugar maple---------	---	
Ig----------------- Ingalls	3w	Slight	Moderate	Slight	Moderate	Quaking aspen-------	60	Eastern white pine, white spruce.
						White ash-----------	---	
						Red maple-----------	---	
						Sugar maple---------	---	
						Jack pine-----------	---	
						Northern pin oak----	---	
						Northern white-cedar	---	
						Balsam fir----------	---	
						Paper birch---------	---	
						Red maple-----------	---	
						Bigtooth aspen------	---	
KnC, KoB----------- Kennan	1x	Slight	Moderate	Slight	Slight	Sugar maple---------	69	Red pine, eastern white pine, white spruce.
						Northern red oak----	76	
						American basswood---	72	
						White ash-----------	77	
						Bigtooth aspen------	---	
						Quaking aspen-------	---	
						Yellow birch--------	---	
						Black cherry--------	---	

TABLE 5.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
KwD----------------- Keweenaw	2r	Severe	Severe	Moderate	Slight	Sugar maple---------	61	Red pine, eastern white pine.
						Eastern hemlock-----	---	
						Yellow birch--------	---	
						Northern red oak----	---	
						Paper birch---------	---	
						Black cherry--------	---	
						Eastern white pine--	---	
						Balsam fir----------	---	
						Quaking aspen-------	---	
						Bigtooth aspen------	---	
						American basswood---	---	
						Red pine------------	---	
LgA, LgB----------- Langlade	1a	Slight	Slight	Slight	Slight	Sugar maple---------	66	Eastern white pine, red pine, white spruce.
						White ash-----------	70	
						American basswood---	---	
						Northern red oak----	---	
						Eastern white pine--	---	
						Quaking aspen-------	---	
						Bigtooth aspen------	---	
						Yellow birch--------	---	
						Black cherry--------	---	
MgB---------------- Magnor	2w	Slight	Moderate	Slight	Moderate	Red maple-----------	65	Eastern white pine, white spruce, red pine, white ash.
						Northern red oak----	67	
						American basswood---	67	
						Sugar maple---------	61	
						Yellow birch--------	---	
						White ash-----------	---	
						Quaking aspen-------	---	
						Bigtooth aspen------	---	
						Balsam fir----------	---	
MhB---------------- Marathon	2a	Slight	Slight	Slight	Slight	Sugar maple---------	58	White spruce, eastern white pine, red pine.
						American basswood---	60	
						White ash-----------	63	
						Red maple-----------	---	
						Northern red oak----	---	
						American elm--------	---	
						Black cherry--------	---	
						Bigtooth aspen------	---	
						Quaking aspen-------	---	
						Paper birch---------	---	
						Yellow birch--------	---	
MnB---------------- Menominee	2s	Slight	Slight	Moderate	Slight	Sugar maple---------	65	Red pine, Norway spruce, eastern white pine.
						Quaking aspen-------	74	
						Red pine------------	---	
						Paper birch---------	---	
						Yellow birch--------	---	
						American basswood---	---	
						Black cherry--------	---	
						Bigtooth aspen------	---	
						Northern red oak----	---	
						Balsam fir----------	---	
MoB---------------- Milladore	2w	Slight	Moderate	Slight	Moderate	Red maple-----------	61	Eastern white pine, white spruce, white ash, red maple.
						Northern red oak----	61	
						White ash-----------	---	
						Bigtooth aspen------	---	
						Quaking aspen-------	---	
						Paper birch---------	---	
						Sugar maple---------	---	

TABLE 5.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
Ms*:								
Minocqua	3w	Slight	Severe	Severe	Severe	Red maple	55	Red maple, white ash, white spruce, black spruce.
						White ash	---	
						Balsam fir	54	
						Black ash	---	
						Tamarack	55	
						Northern white-cedar	---	
						Quaking aspen	---	
						Paper birch	---	
						American elm	---	
						White spruce	---	
						Yellow birch	---	
						Black spruce	---	
Cable	3w	Slight	Severe	Severe	Severe	Red maple	60	White spruce, red maple, black spruce, white ash.
						Black ash	48	
						White ash	---	
						Balsam fir	---	
						Black spruce	---	
						Quaking aspen	---	
						White spruce	---	
						Paper birch	---	
						American elm	---	
						Yellow birch	---	
						Northern white-cedar	---	
						Tamarack	---	
Sherry	3w	Slight	Severe	Severe	Severe	Red maple	60	White spruce, black spruce, red maple, white ash.
						Black ash	53	
						White ash	66	
						Quaking aspen	---	
						Yellow birch	---	
						White spruce	---	
						Black spruce	---	
						Paper birch	---	
						Northern red oak	61	
						American elm	---	
						Balsam fir	---	
						Tamarack	---	
MyB Mylrea	2w	Slight	Moderate	Slight	Moderate	Red maple	70	Red pine, eastern white pine, white spruce, white ash.
						Sugar maple	63	
						American basswood	---	
						Northern red oak	69	
						Yellow birch	---	
						White ash	---	
						Quaking aspen	---	
						Bigtooth aspen	---	
						Paper birch	---	
Os Oesterle	2w	Slight	Moderate	Slight	Moderate	Red maple	66	Red maple, white ash, white spruce, red pine, eastern white pine.
						Northern red oak	72	
						Quaking aspen	78	
						Balsam fir	---	
						Paper birch	---	
						Yellow birch	---	
						Sugar maple	---	
						Bigtooth aspen	---	

See footnote at end of table.

TABLE 5.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
PsB, PsC----------- Pence	2s	Slight	Slight	Moderate	Slight	Sugar maple---------	58	Red pine, eastern white pine, jack pine.
						Red pine------------	59	
						Eastern white pine--	57	
						American basswood---	---	
						Balsam fir----------	---	
						Quaking aspen-------	---	
						Paper birch---------	---	
						Yellow birch--------	---	
PsD---------------- Pence	2r	Severe	Severe	Moderate	Slight	Sugar maple---------	58	Red pine, eastern white pine, jack pine.
						Red pine------------	59	
						Eastern white pine--	57	
						American basswood---	---	
						Balsam fir----------	---	
						Quaking aspen-------	---	
						Paper birch---------	---	
						Yellow birch--------	---	
Sc----------------- Scott Lake	2a	Slight	Slight	Slight	Slight	Sugar maple---------	61	Eastern white pine, red pine, white spruce.
						Northern red oak----	65	
						Yellow birch--------	---	
						American basswood---	---	
						Red maple-----------	---	
						Quaking aspen-------	---	
						Bigtooth aspen------	---	
						White ash-----------	---	
						Eastern white pine--	---	
						Black cherry--------	---	
Sy*:								
Seelyeville-------	3w	Slight	Severe	Severe	Severe	Balsam fir----------	57	
						Black spruce--------	---	
						Northern white-cedar	---	
						Tamarack------------	---	
						Quaking aspen-------	---	
						Red maple-----------	---	
						Paper birch---------	---	
						American elm--------	---	
						White spruce--------	---	
						Yellow birch--------	---	
Cathro------------	3w	Slight	Severe	Severe	Severe	Balsam fir----------	53	
						Black spruce--------	---	
						Northern white-cedar	---	
						Tamarack------------	---	
						Quaking aspen-------	---	
						Red maple-----------	---	
						Paper birch---------	---	
						American elm--------	---	
						White spruce--------	---	
						Yellow birch--------	---	
Markey------------	3w	Slight	Severe	Severe	Severe	Balsam fir----------	52	
						Black spruce--------	---	
						Northern white-cedar	---	
						Tamarack------------	---	
						Quaking aspen-------	---	
						Red maple-----------	---	
						Paper birch---------	---	
						American elm--------	---	
						White spruce--------	---	
						Yellow birch--------	---	

See footnote at end of table.

TABLE 5.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
VsB, VsC----------- Vilas	3s	Slight	Slight	Moderate	Slight	Red pine------------ Jack pine----------- Eastern white pine-- Northern pin oak---- Balsam fir---------- Quaking aspen--------	57 65 57 --- --- ---	Red pine, eastern white pine, jack pine.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Bromegrass-alfalfa hay	Timothy-red clover hay	Bromegrass-alfalfa pasture
		Bu	Tons	Bu	Tons	Tons	AUM*
AmC------------- Amery	IIIe	75	12	65	3.5	2.5	5.0
AoA------------- Antigo	IIs	90	15	70	4.0	3.5	5.8
AoB------------- Antigo	IIe	85	13	70	4.0	3.5	5.8
AoC------------- Antigo	IIIe	75	12	65	3.5	2.5	5.0
As-------------- Au Gres	IVw	50	8	50	2.5	2.0	3.3
Co-------------- Comstock	IIw	80	13	70	4.5	3.5	6.3
Cs-------------- Croswell	IVs	50	8	50	2.5	2.0	3.3
CyB------------- Crystal Lake	IIe	100	17	75	4.5	3.5	6.3
Fm-------------- Fordum	Vw	---	---	---	---	---	---
FoB------------- Freeon	IIe	85	13	70	4.5	3.5	6.3
HyB------------- Hatley	VIs	---	---	---	---	---	---
Ig-------------- Ingalls	IIIw	70	11	60	4.0	3.0	5.8
KnC, KoB-------- Kennan	VIs	---	---	---	---	---	---
KwD------------- Keweenaw	VIIs	---	---	---	---	---	---
LgA------------- Langlade	I	100	17	75	4.5	3.5	6.3
LgB------------- Langlade	IIe	95	16	75	4.5	3.5	6.3
Lx-------------- Loxley	VIIw	---	---	---	---	---	---
MgB------------- Magnor	IIw	80	13	70	---	3.5	---
MhB------------- Marathon	IIe	---	---	---	---	---	---

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Bromegrass-alfalfa hay	Timothy-red clover hay	Bromegrass-alfalfa pasture
		Bu	Tons	Bu	Tons	Tons	AUM*
MnB------------- Menominee	IIIs	75	12	65	4.0	3.0	5.8
MoB------------- Milladore	IIw	---	---	---	---	---	---
Ms-------------- Minocqua, Cable, and Sherry	VIw	---	---	---	---	---	---
MyB------------- Mylrea	IIw	---	---	---	---	---	---
Os-------------- Oesterle	IIw	80	13	70	4.0	3.5	5.8
PsB------------- Pence	IIIe	60	10	55	3.0	2.5	4.2
PsC------------- Pence	IVe	50	8	50	2.5	2.0	3.3
PsD------------- Pence	VIIe	---	---	---	---	---	---
Pt**. Pits							
Sc-------------- Scott Lake	IIs	90	15	70	4.0	3.5	5.8
Sy-------------- Seelyeville, Cathro, and Markey	VIw	---	---	---	---	---	---
VsB------------- Vilas	IVs	50	8	50	2.5	2.0	3.3
VsC------------- Vilas	VIs	---	---	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--LAND CAPABILITY AND YIELDS PER ACRE OF VEGETABLE CROPS

[Only the major soils that are used for vegetable crops are listed. Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability		Irish potatoes		Snap beans	
	N	I	N	I	N	I
			Cwt	Cwt	Bu	Bu
AoA----------- Antigo	IIs	I	275	450	165	235
AoB----------- Antigo	IIe	IIe	225	450	135	235
AoC----------- Antigo	IIIe	IIIe	---	450	---	235
LgA----------- Langlade	I	I	300	450	200	235
LgB----------- Langlade	IIe	IIe	250	450	165	235
Os------------ Oesterle	IIw	IIw	250	450	155	235
PsB----------- Pence	IIIe	IIe	---	450	---	235
PsC----------- Pence	IVe	IIIe	---	450	---	235
Sc------------ Scott Lake	IIs	I	275	450	165	235
VsB----------- Vilas	IVs	IIIe	---	450	---	235

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
AmC: Amery	---	Lilac, American cranberrybush, Amur maple, northern white-cedar, gray dogwood.	White spruce, Norway spruce, Black Hills spruce.	Eastern white pine, red pine, white ash, red maple.	---
AoA, AoB, AoC: Antigo	Manyflower cotoneaster.	Gray dogwood, American cranberrybush, Amur maple, lilac, eastern redcedar, Siberian peashrub, silky dogwood.	Norway spruce	Jack pine, red pine, eastern white pine.	---
As: Au Gres	---	Silky dogwood, American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, northern white-cedar, Manchurian crabapple.	Norway spruce, green ash, eastern white pine.	Carolina poplar.
Co: Comstock	---	Nannyberry viburnum, northern white-cedar, lilac, American cranberrybush, silky dogwood, redosier dogwood.	White spruce	Eastern white pine, red pine, white ash, red maple, silver maple.	---
Cs: Croswell	Manyflower cotoneaster.	Lilac, silky dogwood, Amur maple, Amur privet.	White spruce, eastern redcedar, Siberian crabapple.	Red pine, Norway spruce, eastern white pine.	Carolina poplar.
CyB: Crystal Lake	---	Gray dogwood, Amur maple, American cranberrybush, lilac, northern white-cedar.	Black Hills spruce, Norway spruce, white spruce.	Eastern white pine, red pine, white ash, red maple.	---
Fm. Fordum					
FoB. Freeon					
HyB. Hatley					
Ig: Ingalls	---	American cranberrybush, silky dogwood, Amur privet, common ninebark, Roselow sargent crabapple.	White spruce, northern white-cedar, Manchurian crabapple.	Norway spruce, eastern white pine, green ash.	Carolina poplar.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
KnC, KoB. Kennan					
KwD. Keweenaw					
LgA, LgB: Langlade	---	Northern white-cedar, lilac, Amur maple, American cranberrybush, gray dogwood.	White spruce, Norway spruce, Black Hills spruce.	Eastern white pine, red pine, white ash, red maple.	---
Lx. Loxley					
MgB: Magnor	---	Northern white-cedar, lilac, American cranberrybush, nannyberry viburnum, silky dogwood, redosier dogwood.	White spruce	Eastern white pine, red pine, white ash, red maple, silver maple.	---
MhB: Marathon	Manyflower cotoneaster.	Siberian peashrub, lilac, Amur maple, American cranberrybush, silky dogwood, gray dogwood, eastern redcedar.	Norway spruce	Eastern white pine, red pine, jack pine.	---
MnB: Menominee	---	Lilac, arrowwood, nannyberry viburnum, Amur privet, Siberian crabapple, Amur maple.	Eastern redcedar	Red pine, eastern white pine, Norway spruce, Austrian pine.	Carolina poplar.
MoB: Milladore	---	Northern white-cedar, lilac, American cranberrybush, nannyberry viburnum, silky dogwood, redosier dogwood.	White spruce	Eastern white pine, red pine, white ash, red maple, silver maple.	---
Ms*: Minocqua.					
Cable.					
Sherry.					

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
MyB----- Mylrea	---	Northern white-cedar, lilac, American cranberrybush, nannyberry viburnum, silky dogwood, redosier dogwood.	White spruce------	Eastern white pine, red pine, white ash, red maple, silver maple.	---
Os----- Oesterle	---	Nannyberry viburnum, American cranberrybush, redosier dogwood, lilac, northern white-cedar, silky dogwood.	White spruce------	Red maple, silver maple, white ash, red pine, eastern white pine.	---
PsB, PsC, PsD----- Pence	Manyflower cotoneaster.	Eastern redcedar, lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---
Pt*. Pits					
Sc----- Scott Lake	Manyflower cotoneaster.	American cranberrybush, eastern redcedar, Siberian peashrub, lilac, gray dogwood, American cranberrybush, Amur maple.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---
Sy*: Seelyeville.					
Cathro.					
Markey.					
VsB, VsC----- Vilas	Manyflower cotoneaster.	Eastern redcedar, lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
AmC: Amery	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
AoA: Antigo	Slight	Slight	Slight	Slight	Slight.
AoB: Antigo	Slight	Slight	Moderate: slope.	Slight	Slight.
AoC: Antigo	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
As: Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Co: Comstock	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Cs: Croswell	Moderate: wetness.	Moderate: wetness.	Moderate: small stones, wetness.	Slight	Moderate: droughty.
CyB: Crystal Lake	Slight	Slight	Moderate: slope.	Slight	Slight.
Fm: Fordum	Severe: flooding, ponding.	Severe: ponding.	Severe: small stones, ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
FoB: Freeon	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
HyB: Hatley	Severe: wetness.	Moderate: wetness, small stones.	Severe: small stones, wetness.	Moderate: large stones, wetness.	Severe: large stones.
Ig: Ingalls	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
KnC: Kennan	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: large stones.	Severe: large stones.
KoB: Kennan	Slight	Slight	Moderate: large stones, slope.	Moderate: large stones.	Severe: large stones.
KwD: Keweenaw	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: large stones, slope.
LgA: Langlade	Slight	Slight	Slight	Slight	Slight.
LgB: Langlade	Slight	Slight	Moderate: slope.	Slight	Slight.
Lx: Loxley	Severe: ponding, excess humus, too acid.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, too acid.	Severe: ponding, excess humus.	Severe: too acid, ponding, excess humus.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
MgB------------------ Magnor	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
MhB------------------ Marathon	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: large stones.
MnB------------------ Menominee	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Moderate: droughty.
MoB------------------ Milladore	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness.
Ms*:					
Minocqua-------------	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Cable----------------	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Sherry---------------	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
MyB------------------ Mylrea	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness.
Os------------------- Oesterle	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness, droughty.
PsB------------------ Pence	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: large stones, droughty.
PsC------------------ Pence	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: large stones, droughty, slope.
PsD------------------ Pence	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pt*. Pits					
Sc------------------- Scott Lake	Slight----------	Slight----------	Moderate: small stones.	Slight----------	Moderate: large stones, droughty.
Sy*:					
Seelyeville----------	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Cathro---------------	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Sy*:					
Markey	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
VsB Vilas	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
VsC Vilas	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
AmC: Amery	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
AoA, AoB: Antigo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
AoC: Antigo	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
As: Au Gres	Poor	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Co: Comstock	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Cs: Croswell	Poor	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
CyB: Crystal Lake	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Fm: Fordum	Very poor.	Very poor.	Poor	Fair	Fair	Good	Good	Very poor.	Fair	Good.
FoB: Freeon	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
HyB: Hatley	Very poor.	Poor	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Ig: Ingalls	Poor	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
KnC, KoB: Kennan	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
KwD: Keweenaw	Very poor.	Poor	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
LgA, LgB: Langlade	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Lx: Loxley	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
MgB: Magnor	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
MhB: Marathon	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
MnB: Menominee	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
MoB: Milladore	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
Ms*:										
Minocqua----------	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
Cable-------------	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
Sherry------------	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
MyB---------------- Mylrea	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Os----------------- Oesterle	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
PsB, PsC----------- Pence	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
PsD---------------- Pence	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Pt*. Pits										
Sc----------------- Scott Lake	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Sy*:										
Seelyeville-------	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
Cathro------------	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
Markey------------	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
VsB, VsC----------- Vilas	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AmC: Amery	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
AoA: Antigo	Severe: cutbanks cave.	Slight	Slight	Slight	Severe: frost action.	Slight.
AoB: Antigo	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Severe: frost action.	Slight.
AoC: Antigo	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
As: Au Gres	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Co: Comstock	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Cs: Croswell	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty.
CyB: Crystal Lake	Moderate: cutbanks cave, wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
Fm: Fordum	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: ponding, flooding.
FoB: Freeon	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Moderate: wetness, frost action.	Slight.
HyB: Hatley	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Severe: large stones.
Ig: Ingalls	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
KnC: Kennan	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, frost action, large stones.	Severe: large stones.
KoB: Kennan	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: frost action, large stones.	Severe: large stones.
KwD: Keweenaw	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: large stones, slope.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
LgA--------------- Langlade	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Severe: frost action.	Slight.
LgB--------------- Langlade	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Severe: frost action.	Slight.
Lx---------------- Loxley	Severe: excess humus, ponding.	Severe: ponding, low strength, subsides.	Severe: ponding, low strength, subsides.	Severe: ponding, low strength, subsides.	Severe: ponding, frost action, subsides.	Severe: too acid, ponding, excess humus.
MgB--------------- Magnor	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
MhB--------------- Marathon	Severe: cutbanks cave.	Slight---------	Moderate: wetness, depth to rock.	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
MnB--------------- Menominee	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Moderate: slope.	Slight---------	Moderate: droughty.
MoB--------------- Milladore	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness.
Ms*:						
Minocqua---------	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Cable------------	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Sherry-----------	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
MyB--------------- Mylrea	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness.
Os---------------- Oesterle	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness, droughty.
PsB--------------- Pence	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: large stones, droughty.
PsC--------------- Pence	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
PsD--------------- Pence	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pt*. Pits						

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Sc: Scott Lake	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Moderate: large stones, droughty.
Sy*:						
Seelyeville	Severe: excess humus, ponding.	Severe: ponding, low strength, subsides.	Severe: ponding, low strength, subsides.	Severe: ponding, low strength, subsides.	Severe: ponding, subsides, frost action.	Severe: ponding, excess humus.
Cathro	Severe: excess humus, ponding.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
Markey	Severe: cutbanks cave, excess humus, ponding.	Severe: ponding, low strength, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
VsB: Vilas	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
VsC: Vilas	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "poor," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AmC----------------- Amery	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
AoA, AoB----------- Antigo	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
AoC----------------- Antigo	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
As------------------ Au Gres	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Co------------------ Comstock	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Cs------------------ Croswell	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
CyB----------------- Crystal Lake	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Fair: wetness.
Fm------------------ Fordum	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, small stones.
FoB----------------- Freeon	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness, too sandy.	Moderate: wetness.	Fair: too sandy, small stones.
HyB----------------- Hatley	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, wetness, small stones.
Ig------------------ Ingalls	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
KnC----------------- Kennan	Moderate: slope, large stones.	Severe: seepage, slope.	Severe: seepage.	Moderate: slope.	Poor: small stones.
KoB----------------- Kennan	Moderate: large stones.	Severe: seepage.	Severe: seepage.	Slight-----------	Poor: small stones.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
KwD----------------- Keweenaw	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
LgA, LgB------------ Langlade	Slight-----------	Severe: seepage.	Severe: seepage.	Slight-----------	Fair: thin layer.
Lx------------------ Loxley	Severe: ponding, subsides.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus, too acid.
MgB----------------- Magnor	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
MhB----------------- Marathon	Severe: wetness.	Severe: wetness.	Severe: depth to rock, wetness.	Severe: wetness.	Poor: seepage, small stones.
MnB----------------- Menominee	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
MoB----------------- Milladore	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: small stones, wetness.
Ms*:					
Minocqua-----------	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
Cable--------------	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: seepage, small stones, ponding.
Sherry-------------	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: small stones, ponding.
MyB----------------- Mylrea	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, small stones, wetness.
Os------------------ Oesterle	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
PsB----------------- Pence	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
PsC----------------- Pence	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
PsD----------------- Pence	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Pt*. Pits					
Sc------------------ Scott Lake	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
Sy*:					
Seelyeville--------	Severe: ponding, subsides.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Cathro-------------	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
Markey-------------	Severe: ponding, poor filter, subsides.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
VsB----------------- Vilas	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VsC----------------- Vilas	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AmC Amery	Good	Probable	Probable	Poor: small stones, area reclaim.
AoA, AoB, AoC Antigo	Good	Probable	Probable	Poor: area reclaim, small stones.
As Au Gres	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Co Comstock	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Cs Croswell	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy.
CyB Crystal Lake	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Fm Fordum	Poor: wetness.	Probable	Probable	Poor: small stones, wetness.
FoB Freeon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
HyB Hatley	Fair: wetness, large stones.	Probable	Probable	Poor: small stones, area reclaim.
Ig Ingalls	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
KnC, KoB Kennan	Fair: large stones.	Probable	Probable	Poor: large stones, area reclaim.
KwD Keweenaw	Poor: slope.	Probable	Probable	Poor: large stones, area reclaim, slope.
LgA, LgB Langlade	Good	Probable	Probable	Poor: area reclaim.
Lx Loxley	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness, too acid.
MgB Magnor	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
MhB------------------ Marathon	Fair: area reclaim, thin layer, wetness.	Improbable: thin layer.	Improbable: thin layer.	Poor: small stones, area reclaim.
MnB------------------ Menominee	Fair: wetness.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy.
MoB------------------ Milladore	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Ms*:				
Minocqua------------	Poor: wetness.	Probable------------	Probable------------	Poor: excess humus, small stones.
Cable---------------	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, excess humus, small stones.
Sherry--------------	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, small stones, area reclaim.
MyB------------------ Mylrea	Fair: wetness.	Probable------------	Probable------------	Poor: small stones, area reclaim.
Os------------------- Oesterle	Fair: wetness.	Probable------------	Probable------------	Poor: small stones, area reclaim.
PsB, PsC------------- Pence	Good----------------	Probable------------	Probable------------	Poor: small stones, area reclaim.
PsD------------------ Pence	Poor: slope.	Probable------------	Probable------------	Poor: small stones, area reclaim, slope.
Pt*. Pits				
Sc------------------- Scott Lake	Fair: wetness.	Probable------------	Probable------------	Poor: small stones, area reclaim.
Sy*:				
Seelyeville---------	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Cathro--------------	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Markey--------------	Poor: wetness.	Probable------------	Improbable: too sandy.	Poor: excess humus, wetness.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
VsB, VsC-------------- Vilas	Good------------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
AmC: Amery	Severe: slope.	Severe: seepage, piping.	Deep to water	Slope	Slope	Slope.
AoA: Antigo	Severe: seepage.	Severe: seepage, piping.	Deep to water	Erodes easily	Erodes easily, too sandy.	Erodes easily.
AoB: Antigo	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, erodes easily.	Erodes easily, too sandy.	Erodes easily.
AoC: Antigo	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily, too sandy.	Slope, erodes easily.
As: Au Gres	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
Co: Comstock	Moderate: seepage.	Severe: piping, wetness.	Frost action, cutbanks cave.	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
Cs: Croswell	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
CyB: Crystal Lake	Moderate: seepage, slope.	Severe: piping.	Frost action, slope.	Wetness, slope, erodes easily.	Erodes easily, wetness.	Erodes easily.
Fm: Fordum	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, flooding, frost action.	Ponding, droughty, flooding.	Ponding, too sandy.	Wetness, droughty.
FoB: Freeon	Moderate: seepage, slope.	Severe: seepage, piping.	Slope, cutbanks cave.	Wetness, rooting depth, slope.	Erodes easily, wetness.	Erodes easily, rooting depth.
HyB: Hatley	Severe: seepage.	Severe: seepage, wetness, piping.	Frost action, slope, cutbanks cave.	Large stones, wetness, droughty.	Wetness, too sandy, large stones.	Wetness, droughty, large stones.
Ig: Ingalls	Severe: seepage.	Severe: piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Erodes easily, wetness, soil blowing.	Wetness, erodes easily, droughty.
KnC: Kennan	Severe: slope.	Severe: piping.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
KoB: Kennan	Moderate: seepage, slope.	Severe: piping.	Deep to water	Large stones, droughty, slope.	Large stones	Large stones, droughty.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
KwD---------------- Keweenaw	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Large stones, droughty, slope.	Slope, large stones, too sandy.	Large stones, slope, droughty.
LgA---------------- Langlade	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
LgB---------------- Langlade	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
Lx----------------- Loxley	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, too acid.	Ponding--------	Wetness.
MgB---------------- Magnor	Moderate: seepage, slope.	Severe: piping, wetness.	Frost action, slope.	Wetness, rooting depth, slope.	Erodes easily, wetness.	Wetness, erodes easily, rooting depth.
MhB---------------- Marathon	Moderate: seepage, depth to rock, slope.	Severe: seepage.	Slope----------	Wetness, slope.	Large stones, wetness.	Large stones.
MnB---------------- Menominee	Severe: seepage.	Severe: seepage, piping.	Slope, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
MoB---------------- Milladore	Slight---------	Severe: piping.	Frost action---	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
Ms*:						
Minocqua----------	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, frost action.	Ponding, soil blowing.	Erodes easily, ponding, too sandy.	Wetness, erodes easily.
Cable-------------	Moderate: seepage.	Severe: seepage, piping, ponding.	Ponding, frost action, cutbanks cave.	Ponding, rooting depth, soil blowing.	Large stones, erodes easily, ponding.	Large stones, wetness, erodes easily.
Sherry------------	Moderate: seepage.	Severe: piping, ponding.	Ponding, frost action.	Ponding, soil blowing, rooting depth.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily, rooting depth.
MyB---------------- Mylrea	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness, erodes easily.	Large stones, erodes easily, wetness.	Wetness, erodes easily.
Os----------------- Oesterle	Severe: seepage.	Severe: seepage, wetness, piping.	Frost action, cutbanks cave.	Wetness, droughty.	Wetness, too sandy.	Wetness, droughty.
PsB---------------- Pence	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
PsC, PsD----------- Pence	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Pt*. Pits						
Sc----------------- Scott Lake	Severe: seepage.	Severe: seepage, piping.	Large stones, cutbanks cave.	Wetness, droughty.	Large stones, wetness, too sandy.	Large stones, droughty.
Sy*: Seelyeville------	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
Cathro-----------	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
Markey-----------	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
VsB--------------- Vilas	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
VsC--------------- Vilas	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
AmC-------------- Amery	0-12	Loam-------------	ML, CL-ML, SM, SM-SC	A-4	0-5	80-100	75-100	65-100	45-95	<25	1-7
	12-18	Sandy loam, fine sandy loam, loam.	SM, SC, CL, ML	A-4, A-2, A-1	3-15	50-100	50-95	30-95	15-75	<28	NP-9
	18-60	Loamy sand, fine sandy loam, gravelly sandy loam.	SM, SC, SP-SM, SP-SC	A-4, A-2, A-1	3-15	50-100	50-95	25-85	10-50	<28	NP-9
AoA, AoB, AoC---- Antigo	0-12	Silt loam--------	ML, CL-ML	A-4	0-3	95-100	90-100	90-100	85-95	<25	2-7
	12-28	Silt loam--------	CL	A-6, A-4	0-3	95-100	90-100	90-100	85-95	25-35	9-15
	28-33	Gravelly sandy loam, loam, gravelly loamy sand.	SM, GM, ML, GM-GC	A-2, A-4, A-1, A-3	0-9	50-100	45-100	25-95	7-75	<35	NP-15
	33-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-2, A-3, A-1	0-9	30-100	25-100	10-70	1-12	---	NP
As--------------- Au Gres	0-6	Loamy sand-------	SM, SP-SM	A-2-4	0	95-100	85-100	50-95	10-25	---	NP
	6-41	Sand, loamy sand	SP-SM, SP, SM	A-2-4, A-3	0	95-100	85-100	60-95	0-20	---	NP
	41-60	Sand-------------	SP, SP-SM	A-3, A-2-4	0	95-100	85-100	50-90	0-10	---	NP
Co--------------- Comstock	0-3	Silt loam--------	CL-ML, CL, ML	A-4, A-6	0	100	100	85-100	65-100	15-35	3-15
	3-13	Silt loam--------	CL-ML, CL, ML	A-4, A-6	0	100	100	90-100	85-100	15-35	3-15
	13-31	Silt loam, silty clay loam.	CL	A-6, A-4	0	100	100	90-100	85-100	25-40	9-20
	31-60	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	85-100	65-95	15-35	3-15
Cs--------------- Croswell	0-4	Loamy sand-------	SM	A-2	0	90-100	85-100	50-95	15-30	<20	NP-4
	4-45	Sand, loamy sand	SP-SM, SM	A-3, A-2-4	0	90-100	85-100	50-95	5-25	---	NP
	45-60	Sand-------------	SP-SM, SM	A-3, A-2-4	0	90-100	85-100	50-90	5-25	---	NP
CyB-------------- Crystal Lake	0-16	Silt loam--------	CL-ML, CL, ML	A-4, A-6	0	100	100	85-100	70-100	19-32	3-13
	16-38	Silt loam, silty clay loam.	CL	A-6, A-4	0	100	100	90-100	85-100	25-40	9-18
	38-60	Silt loam, silt	CL, CL-ML, ML	A-4, A-6	0	100	100	85-100	75-100	19-32	3-13
Fm--------------- Fordum	0-6	Mucky silt loam	ML, CL, GM, GC	A-4, A-6, A-2	0-15	30-100	25-100	20-100	15-95	20-35	3-15
	6-30	Loam, mucky loam, mucky silt loam.	GM, GC, ML, CL	A-2, A-4, A-1	0-15	30-100	25-100	15-85	2-75	<30	3-10
	30-60	Stratified sand to gravel.	SP, SM, GP, GM	A-3, A-2, A-1	0-15	30-100	25-100	10-80	2-35	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
FoB------------- Freeon	0-13	Silt loam--------	ML, CL, CL-ML	A-4	0-5	90-100	90-100	85-100	85-100	<30	1-10
	13-20	Silt loam--------	ML, CL, CL-ML	A-4	0-5	90-100	90-100	85-100	85-100	<30	1-10
	20-40	Loam, sandy loam, gravelly sandy loam.	SM, SC, ML, CL	A-4, A-6, A-2	0-15	65-100	65-95	35-90	10-70	<35	NP-15
	40-60	Sandy loam, loam, gravelly loamy sand.	SM, SC, ML, CL	A-4, A-2, A-6, A-1	0-15	65-95	65-95	35-90	10-70	<35	NP-15
HyB------------- Hatley	0-5	Silt loam--------	CL, CL-ML, SC, SM-SC	A-4	25-50	75-100	70-100	60-100	40-90	<26	6-8
	5-56	Silt loam, loam, sandy loam.	SC, SM, CL, ML	A-1, A-2, A-4	0-25	75-100	70-100	40-100	20-90	<30	NP-10
	56-60	Sandy loam, loamy sand, gravelly loamy sand.	SM, SP-SM	A-1, A-2	0-25	70-95	60-95	30-70	10-35	<20	NP-4
Ig-------------- Ingalls	0-6	Loamy sand-------	SM	A-2	0-8	95-100	75-100	50-75	15-30	---	NP
	6-38	Loamy sand, sand, fine sand.	SM, SP-SM	A-2, A-3	0-8	95-100	60-100	60-95	5-30	---	NP
	38-60	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	90-100	65-95	65-95	20-35	4-15
KnC------------- Kennan	0-2	Loam-------------	ML, CL-ML, SM, SM-SC	A-4	25-50	75-100	75-100	65-100	45-90	<25	3-7
	2-30	Sandy loam, fine sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-25	75-100	75-100	40-100	20-90	<30	NP-10
	30-46	Sandy loam, loam, loamy sand.	SM, SC, ML, CL	A-1-b, A-2, A-4	0-25	65-95	65-95	35-90	10-70	<30	NP-9
	46-60	Loamy sand, sandy loam, gravelly loamy sand.	SM-SC, SM, SP-SM	A-1-b, A-2-4	0-25	65-95	60-95	30-70	10-25	<20	NP-5
KoB------------- Kennan	0-2	Silt loam--------	ML, CL-ML, SM, SM-SC	A-4	25-50	75-100	75-100	65-100	45-90	<25	3-7
	2-30	Sandy loam, silt loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-25	75-100	75-100	40-100	20-90	<30	NP-10
	30-46	Sandy loam, loam, loamy sand.	SM, SC, ML, CL	A-1-b, A-2, A-4	0-25	65-95	65-95	35-90	10-70	<30	NP-9
	46-60	Loamy sand, sandy loam, gravelly loamy sand.	SM-SC, SM, SP-SM	A-1-b, A-2-4	0-25	65-95	60-95	30-70	10-25	<20	NP-5
KwD------------- Keweenaw	0-2	Sandy loam-------	SM, SC, SM-SC	A-2, A-4, A-1-b	25-50	80-100	75-100	45-75	20-40	<20	NP-10
	2-16	Loamy sand, loamy fine sand, gravelly loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b	0-25	75-100	70-100	45-75	10-30	<20	NP-10
	16-36	Sand, loamy sand, gravelly loamy sand.	SM, SC, SP, SP-SM	A-2, A-3, A-1-b	0-25	75-100	70-100	45-75	0-30	<20	NP-10
	36-53	Sandy loam, sand, loamy sand.	SM, SC, SP, SM-SC	A-2, A-3, A-1-b	0-25	60-100	55-100	35-75	0-35	<30	NP-10
	53-60	Loamy sand, gravelly loamy sand, gravelly sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b, A-3	0-25	60-100	50-100	30-75	3-30	<20	NP-10

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
LgA, LgB--------- Langlade	0-14	Silt loam--------	ML, CL, CL-ML	A-4	0-3	95-100	95-100	80-100	60-95	<25	NP-8
	14-42	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0-3	95-100	95-100	80-100	60-95	<35	NP-15
	42-47	Loam, sandy loam	SC, CL, SM, SM-SC	A-2, A-4, A-1	0-8	80-100	75-100	45-90	20-70	<30	NP-10
	47-53	Gravelly sandy loam, gravelly loamy sand, sandy loam.	SM, SP-SM	A-1, A-2, A-3	0-8	55-100	50-90	25-60	7-30	<20	NP-4
	53-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-8	30-100	25-75	5-55	1-12	---	NP
Lx--------------- Loxley	0-12	Fibric material	PT	A-8	0	---	---	---	---	---	---
	12-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
MgB-------------- Magnor	0-11	Silt loam--------	CL, CL-ML, ML	A-4	0-15	95-100	90-100	85-100	65-100	<28	2-10
	11-20	Silt loam, silt	CL, CL-ML, ML	A-4	0-15	95-100	90-100	85-100	65-100	<35	NP-10
	20-30	Loam, sandy loam, gravelly sandy loam.	ML, CL-ML, SM, SM-SC	A-2, A-4, A-1	0-15	75-100	70-95	40-90	20-70	<25	NP-7
	30-60	Sandy loam, loam, gravelly sandy loam.	ML, CL-ML, SM, SM-SC	A-2, A-4, A-1	0-15	75-100	70-95	40-90	20-70	<25	NP-6
MhB-------------- Marathon	0-12	Loam-------------	ML, CL-ML	A-4	0-7	95-100	75-100	75-95	55-80	<25	NP-7
	12-19	Loam-------------	ML, CL-ML	A-4	0-7	95-100	75-100	75-95	55-80	<25	NP-7
	19-36	Sandy loam, loamy sand, loam.	SM, SP-SM, ML, CL-ML	A-2, A-4, A-1	0-25	80-100	75-100	35-95	10-75	<23	NP-6
	36-57	Gravelly sandy loam, very gravelly sandy loam, gravelly loam.	SM, SP-SM, GM, GP-GM	A-1, A-2, A-4	0-25	45-85	35-75	20-70	10-45	<23	NP-6
	57-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
MnB-------------- Menominee	0-5	Loamy sand-------	SM	A-2-4	0-8	95-100	75-100	50-75	15-30	---	NP
	5-39	Sand, loamy sand, gravelly loamy sand.	SP, SM, SP-SM	A-2-4, A-3	0-8	85-100	60-100	50-75	0-15	---	NP
	39-60	Silt loam, loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-10	85-100	85-100	80-95	60-90	25-40	5-20
MoB-------------- Milladore	0-8	Silt loam--------	ML, CL-ML, CL	A-4	0-7	90-100	90-100	85-100	65-90	20-30	3-10
	8-16	Silt loam--------	ML, CL-ML, CL	A-4, A-6	0-7	90-100	90-100	85-100	65-90	<35	NP-15
	16-45	Sandy clay loam, loam, clay loam.	CL-ML, CL, SM-SC, SC	A-4, A-6, A-1, A-2	0-15	65-100	60-100	35-100	20-80	20-45	5-25
	45-60	Gravelly sandy loam, sandy loam, clay loam.	SC, SM, CL, ML	A-1, A-2, A-4, A-6	0-15	60-100	55-100	30-100	15-80	<35	NP-15

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ms*:											
Minocqua--------	0-4	Sapric material	PT	A-8	0	---	---	---	---	---	---
	4-31	Silt loam, loam, sandy loam.	SC, SM-SC, CL, CL-ML	A-2, A-4, A-6	0-7	80-100	75-100	45-100	25-90	20-35	4-13
	31-35	Sandy loam, gravelly loamy sand, gravelly sandy loam.	SM, GM, GP, SP	A-2, A-1, A-3, A-4	0-7	50-100	45-100	5-70	2-40	<20	NP-4
	35-60	Stratified sand to gravel.	SP, SM, GP, GM	A-1, A-3, A-2	0-7	35-100	30-100	5-70	0-30	---	NP
Cable-----------	0-6	Sapric material	PT	A-8	0	---	---	---	---	---	---
	6-16	Silt loam, loam, fine sandy loam.	SM, SC, ML, CL	A-2, A-4	0-25	75-100	75-100	50-100	30-90	<33	2-10
	16-38	Loam, sandy loam, gravelly sandy loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-25	65-100	60-100	35-95	20-75	<27	2-8
	38-60	Sandy loam, gravelly sandy loam, loamy sand.	SM, SP-SM, ML, CL-ML	A-2, A-1, A-4	0-25	65-100	60-100	30-90	10-70	<23	NP-6
Sherry----------	0-6	Sapric material	PT	A-8	0	---	---	---	---	---	---
	6-22	Silt loam, silty clay loam.	CL, ML, CL-ML	A-4, A-6	0-7	90-100	85-100	80-100	60-95	20-40	5-20
	22-43	Loam, clay loam, sandy loam.	SC, CL, SM-SC, CL-ML	A-2, A-4, A-6, A-1	0-15	55-100	50-100	40-100	15-75	20-40	5-25
	43-60	Loam, sandy clay loam, sandy loam.	GC, SM, CL, CL-ML	A-2, A-4, A-6, A-1	0-15	35-100	35-100	20-95	10-75	<35	NP-15
MyB-------------- Mylrea	0-15	Silt loam--------	CL-ML, ML, CL	A-4	0-7	90-100	85-100	75-100	60-90	20-30	3-10
	15-22	Silt loam--------	CL, CL-ML, ML	A-4	0-7	90-100	85-100	75-100	60-90	20-30	3-10
	22-33	Sandy loam, loam, gravelly loam.	CL, ML, SC, SM	A-2, A-4, A-1	0-25	75-100	70-100	35-95	10-75	<32	NP-10
	33-60	Gravelly loam, very gravelly sandy loam.	GM, GP, SP, SM	A-1	0-25	10-85	5-80	0-55	0-30	<25	NP-4
Os--------------- Oesterle	0-18	Silt loam--------	CL-ML, SM-SC, CL, SC	A-4	0-7	80-100	75-100	65-95	45-85	20-26	4-8
	18-28	Silt loam, loam	CL-ML, CL, SM-SC, SC	A-2, A-4, A-1	0-7	75-100	70-100	40-95	20-75	20-30	4-10
	28-32	Sandy loam, loamy sand, gravelly loamy sand.	SM, SP-SM, SM-SC, GM	A-2, A-1	0-7	55-95	55-95	25-75	10-35	<23	NP-6
	32-60	Stratified sand to gravel.	SW, SP, GW, GP	A-1, A-3, A-2	0-7	35-95	35-95	15-70	0-30	---	NP

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
PsB, PsC, PsD---- Pence	0-5	Sandy loam-------	SM, ML	A-4, A-2, A-1	0-7	85-100	75-100	45-85	20-55	<21	NP-4
	5-18	Sandy loam, gravelly sandy loam, gravelly loamy sand.	SP-SM, CL-ML, SM-SC	A-4, A-2, A-1, A-3	0-7	55-85	50-80	25-80	5-65	<25	NP-7
	18-27	Gravelly sand, loamy sand, sand.	SM, SP-SM, GM, GP-GM	A-2, A-1	0-8	55-85	50-80	25-75	10-30	---	NP
	27-60	Stratified sand to gravel.	SP, SM, GP, GM	A-1, A-3, A-2	0-15	50-85	50-80	25-60	2-20	---	NP
Pt*. Pits											
Sc--------------- Scott Lake	0-13	Silt loam--------	ML, CL-ML, SM, SM-SC	A-4	0-7	85-100	75-100	65-100	45-95	<25	3-7
	13-35	Loam, sandy loam, silt loam.	SC, CL, SM, ML	A-2, A-4, A-6	0-7	85-100	75-100	45-100	25-95	20-35	3-13
	35-39	Sandy loam, gravelly sandy loam, loamy coarse sand.	SM, SW-SM, SP-SM, SM-SC	A-1, A-2, A-3, A-4	0-35	70-100	50-95	20-80	7-50	<25	NP-6
	39-60	Stratified sand to gravel.	SP, SM, GP, GM	A-1, A-2, A-3	0-35	30-95	30-95	20-95	3-25	---	NP
Sy*: Seelyeville-----	0-6	Sapric material	PT	A-8	0	---	---	---	---	---	---
	6-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
Cathro----------	0-12	Sapric material	PT	A-8	0	---	---	---	---	---	---
	12-40	Sapric material, muck.	PT	A-8	0	---	---	---	---	---	---
	40-60	Sandy loam, loam, silt loam.	SM, ML, SC, CL	A-4	0-5	80-100	65-100	60-100	35-90	<25	3-10
Markey----------	0-41	Sapric material	PT	A-8	---	---	---	---	---	---	---
	41-60	Sand, loamy sand, fine sand.	SP, SM, SP-SM	A-2, A-3	0	100	85-100	60-75	0-20	---	NP
VsB, VsC--------- Vilas	0-4	Loamy sand-------	SM, SP-SM	A-1, A-2	0	80-100	75-100	35-90	12-30	---	NP
	4-13	Loamy sand-------	SP-SM, SM	A-1, A-2	0	80-100	75-100	35-90	12-30	---	NP
	13-29	Sand-------------	SM, SP-SM	A-1, A-2, A-3	0	80-100	75-100	35-90	5-20	---	NP
	29-60	Sand-------------	SP, SP-SM, SM	A-1, A-2, A-3	0	80-100	75-100	35-90	1-20	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
AmC--------------	0-12	6-14	1.25-1.80	0.6-2.0	0.15-0.24	4.5-7.3	Low-----------	0.32	5	5	1-3
Amery	12-18	6-18	1.70-1.80	0.6-2.0	0.04-0.18	4.5-7.3	Low-----------	0.24			
	18-60	4-18	1.65-1.80	0.6-2.0	0.04-0.15	5.1-6.5	Low-----------	0.17			
AoA, AoB, AoC----	0-12	8-15	1.25-1.55	0.6-2.0	0.20-0.24	4.5-6.5	Low-----------	0.37	4	5	1-3
Antigo	12-28	11-20	1.55-1.65	0.6-2.0	0.16-0.22	4.5-6.5	Low-----------	0.37			
	28-33	2-22	1.55-1.80	0.6-2.0	0.05-0.19	4.5-6.5	Low-----------	0.24			
	33-60	1-6	1.50-1.80	>6.0	0.02-0.06	5.1-6.5	Low-----------	0.10			
As---------------	0-6	10-15	0.65-1.55	6.0-20	0.07-0.09	4.5-7.3	Low-----------	0.17	5	2	.5-4
Au Gres	6-41	1-15	1.20-1.55	6.0-20	0.06-0.09	4.5-7.3	Low-----------	0.15			
	41-60	0-8	1.20-1.65	6.0-20	0.05-0.07	5.1-7.3	Low-----------	0.15			
Co---------------	0-3	8-22	1.35-1.65	0.6-2.0	0.20-0.24	5.1-7.3	Low-----------	0.37	5	5	2-4
Comstock	3-13	8-20	1.60-1.70	0.6-2.0	0.20-0.22	4.5-6.0	Low-----------	0.37			
	13-31	18-30	1.50-1.60	0.6-2.0	0.18-0.22	4.5-6.0	Moderate-----	0.37			
	31-60	8-20	1.45-1.55	0.2-0.6	0.12-0.22	5.1-7.3	Low-----------	0.37			
Cs---------------	0-4	10-15	1.25-1.50	6.0-20	0.10-0.12	3.6-7.3	Low-----------	0.17	5	2	.5-2
Croswell	4-45	0-10	1.25-1.60	6.0-20	0.06-0.08	3.6-7.3	Low-----------	0.15			
	45-60	0-10	1.25-1.60	6.0-20	0.05-0.07	5.1-8.4	Low-----------	0.15			
CyB--------------	0-16	8-20	1.35-1.55	0.6-2.0	0.20-0.24	4.5-6.5	Low-----------	0.37	5	5	2-4
Crystal Lake	16-38	18-30	1.50-1.60	0.6-2.0	0.18-0.22	4.5-6.0	Moderate-----	0.37			
	38-60	8-20	1.45-1.55	0.2-0.6	0.20-0.22	4.5-7.3	Low-----------	0.37			
Fm---------------	0-6	10-23	1.35-1.45	0.6-2.0	0.06-0.2	4.5-8.4	Low-----------	0.24	4	8	4-12
Fordum	6-30	8-18	1.40-1.50	0.6-6.0	0.03-0.19	4.5-8.4	Low-----------	0.32			
	30-60	2-5	1.55-1.70	>6.0	0.02-0.10	4.5-8.4	Low-----------	0.15			
FoB--------------	0-13	5-18	1.25-1.55	0.6-2.0	0.20-0.24	4.5-7.3	Low-----------	0.37	5	5	1-3
Freeon	13-20	5-18	1.35-1.65	0.6-2.0	0.18-0.22	4.5-6.5	Low-----------	0.37			
	20-40	5-18	1.70-1.80	0.2-2.0	0.08-0.18	4.5-6.5	Low-----------	0.37			
	40-60	3-27	1.80-1.95	0.2-0.6	0.02-0.06	5.1-7.8	Low-----------	0.28			
HyB--------------	0-5	12-16	1.35-1.55	0.6-2.0	0.11-0.20	4.5-6.5	Low-----------	0.24	5	8	3-7
Hatley	5-56	5-18	1.55-1.65	0.6-2.0	0.07-0.22	4.5-6.5	Low-----------	0.24			
	56-60	4-10	1.55-1.70	0.6-6.0	0.05-0.12	5.1-7.8	Low-----------	0.24			
Ig---------------	0-6	2-10	1.25-1.40	6.0-20	0.07-0.10	4.5-7.3	Low-----------	0.17	5	2	.5-3
Ingalls	6-38	3-15	1.35-1.45	6.0-20	0.08-0.10	4.5-7.3	Low-----------	0.17			
	38-60	2-25	1.45-1.80	0.2-0.6	0.09-0.22	5.6-8.4	Low-----------	0.43			
KnC, KoB---------	0-2	5-15	1.20-1.60	0.6-2.0	0.10-0.20	4.5-7.3	Low-----------	0.24	5	8	3-7
Kennan	2-30	5-18	1.55-1.70	0.6-2.0	0.08-0.22	4.5-7.3	Low-----------	0.24			
	30-46	5-18	1.55-1.70	0.6-2.0	0.04-0.18	4.5-7.3	Low-----------	0.24			
	46-60	3-10	1.55-1.70	0.6-6.0	0.03-0.12	5.1-7.3	Low-----------	0.17			
KwD--------------	0-2	2-15	1.35-1.70	0.6-2.0	0.13-0.15	4.5-6.5	Low-----------	0.17	5	8	1-2
Keweenaw	2-16	2-15	1.25-1.70	2.0-6.0	0.08-0.11	4.5-6.5	Low-----------	0.17			
	16-36	0-15	1.25-1.60	2.0-6.0	0.05-0.11	4.5-6.5	Low-----------	0.17			
	36-53	0-15	1.25-1.60	0.6-6.0	0.06-0.14	4.5-6.5	Low-----------	0.17			
	53-60	2-15	1.20-1.50	2.0-6.0	0.04-0.10	5.1-7.3	Low-----------	0.17			
LgA, LgB---------	0-14	5-16	1.35-1.55	0.6-2.0	0.20-0.24	4.5-6.5	Low-----------	0.37	5	5	2-4
Langlade	14-42	6-20	1.55-1.65	0.6-2.0	0.19-0.22	4.5-6.5	Low-----------	0.37			
	42-47	6-18	1.40-1.70	0.6-2.0	0.10-0.18	4.5-6.5	Low-----------	0.37			
	47-53	2-10	1.40-1.70	0.6-6.0	0.05-0.11	4.5-6.5	Low-----------	0.17			
	53-60	1-4	1.55-1.80	>6.0	0.02-0.04	5.1-7.3	Low-----------	0.10			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
Lx	0-12	---	0.30-0.40	2.0-6.0	0.35-0.45	<4.5	-------------	----	2	5	70-90
Loxley	12-60	---	0.10-0.35	2.0-6.0	0.35-0.45	<4.5	-------------	----			
MgB	0-11	5-18	1.35-1.55	0.6-2.0	0.18-0.24	4.5-6.0	Low	0.37	5	5	1-3
Magnor	11-20	5-18	1.60-1.70	0.6-2.0	0.17-0.22	4.5-6.0	Low	0.37			
	20-30	3-12	1.40-1.70	0.2-2.0	0.08-0.18	4.5-6.0	Low	0.37			
	30-60	3-12	1.80-1.95	0.2-0.6	0.02-0.06	4.5-6.5	Low	0.24			
MhB	0-12	5-14	1.35-1.55	0.6-2.0	0.18-0.22	4.5-6.5	Low	0.32	5	5	2-4
Marathon	12-19	5-14	1.55-1.65	0.6-2.0	0.16-0.19	4.5-6.5	Low	0.32			
	19-36	3-12	1.40-1.70	0.6-2.0	0.07-0.19	4.5-6.5	Low	0.24			
	36-57	3-12	1.40-1.70	0.6-2.0	0.05-0.16	4.5-6.5	Low	0.17			
	57-60	---	---	---	---	---	-------------	----			
MnB	0-5	1-15	1.14-1.60	2.0-6.0	0.10-0.12	5.1-6.5	Low	0.17	5	2	.5-4
Menominee	5-39	1-15	1.26-1.59	6.0-20	0.04-0.10	5.1-6.5	Low	0.17			
	39-60	18-35	1.33-1.70	0.2-0.6	0.14-0.18	5.1-7.8	Moderate	0.32			
MoB	0-8	8-15	1.35-1.55	0.6-2.0	0.18-0.24	4.5-7.3	Low	0.37	5	5	2-4
Milladore	8-16	8-25	1.55-1.65	0.6-2.0	0.17-0.22	4.5-6.5	Low	0.37			
	16-45	18-35	1.40-1.70	0.2-0.6	0.07-0.18	4.5-6.5	Moderate	0.24			
	45-60	5-30	1.35-1.80	0.2-0.6	0.06-0.18	4.5-7.3	Low	0.17			
Ms*:											
Minocqua	0-4	---	0.15-0.45	2.0-6.0	0.35-0.45	4.5-7.8	Low	----	4	2	60-80
	4-31	10-18	1.35-1.45	0.6-2.0	0.11-0.19	4.5-7.8	Low	0.37			
	31-35	3-10	1.65-1.75	2.0-6.0	0.06-0.13	4.5-7.8	Low	0.10			
	35-60	0-3	1.75-1.85	>6.0	0.02-0.04	4.5-7.8	Low	0.10			
Cable	0-6	---	0.15-0.35	2.0-6.0	0.35-0.45	4.5-7.3	Low	----	5	2	50-80
	6-16	8-18	1.35-1.45	0.2-2.0	0.10-0.22	4.5-7.3	Low	0.37			
	16-38	8-16	1.40-1.90	0.2-2.0	0.03-0.18	4.5-7.3	Low	0.37			
	38-60	5-10	1.60-1.90	0.2-0.6	0.03-0.13	5.1-7.8	Low	0.28			
Sherry	0-6	---	0.10-0.35	2.0-6.0	0.35-0.45	4.5-7.3	-------------	----	5	2	60-80
	6-22	12-30	1.55-1.65	0.2-2.0	0.15-0.22	4.5-7.3	Low	0.37			
	22-43	18-30	1.40-1.80	0.2-0.6	0.05-0.19	4.5-7.3	Moderate	0.37			
	43-60	8-25	1.35-1.80	0.2-0.6	0.04-0.19	5.1-7.8	Low	0.37			
MyB	0-15	10-14	1.35-1.55	0.6-2.0	0.20-0.24	4.5-6.5	Low	0.37	4	5	2-4
Mylrea	15-22	7-18	1.35-1.55	0.6-2.0	0.18-0.22	4.5-6.5	Low	0.37			
	22-33	4-18	1.55-1.70	0.6-2.0	0.03-0.18	4.5-6.5	Low	0.24			
	33-60	3-10	1.55-1.70	2.0-20	0.02-0.05	4.5-6.5	Low	0.10			
Os	0-18	10-15	1.35-1.55	0.6-2.0	0.16-0.24	4.5-6.5	Low	0.32	4	5	2-3
Oesterle	18-28	10-18	1.55-1.65	0.6-2.0	0.09-0.19	4.5-6.5	Low	0.24			
	28-32	6-12	1.55-1.70	0.6-6.0	0.05-0.13	4.5-6.5	Low	0.24			
	32-60	1-6	1.55-1.70	>6.0	0.02-0.09	5.1-6.5	Low	0.10			
PsB, PsC, PsD	0-5	3-11	1.20-1.65	2.0-6.0	0.10-0.18	4.5-6.5	Low	0.24	3	3	1-3
Pence	5-18	2-12	1.35-1.45	2.0-6.0	0.10-0.15	4.5-6.0	Low	0.24			
	18-27	2-10	1.65-1.75	2.0-6.0	0.05-0.08	4.5-6.0	Low	0.10			
	27-60	0-4	1.35-1.80	>6.0	0.02-0.05	5.1-6.5	Low	0.10			
Pt*. Pits											
Sc	0-13	10-15	1.35-1.50	0.6-2.0	0.16-0.24	4.5-6.5	Low	0.32	4	5	2-3
Scott Lake	13-35	8-18	1.55-1.70	0.6-6.0	0.09-0.19	4.5-6.5	Low	0.32			
	35-39	5-12	1.55-1.80	0.6-6.0	0.05-0.13	4.5-6.5	Low	0.24			
	39-60	1-6	1.55-1.80	>6.0	0.01-0.07	4.5-7.3	Low	0.10			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
Sy*:											
Seelyeville-----	0-6	---	0.10-0.25	2.0-6.0	0.35-0.45	4.5-7.3	-------------	----	2	2	>25
	6-60	---	0.10-0.25	2.0-6.0	0.35-0.45	4.5-7.3	-------------	----			
Cathro----------	0-12	---	0.28-0.45	2.0-6.0	0.45-0.55	5.6-7.8	-------------	----	2	2	60-85
	12-40	---	0.15-0.30	2.0-6.0	0.35-0.45	5.6-7.8	-------------	----			
	40-60	10-25	1.50-1.70	2.0-2.0	0.11-0.22	6.6-8.4	Low----------	----			
Markey----------	0-41	---	0.15-0.45	2.0-6.0	0.35-0.45	4.5-7.8	-------------	----	2	2	55-85
	41-60	0-10	1.40-1.65	6.0-20	0.03-0.08	4.5-8.4	Low----------	----			
VsB, VsC--------- Vilas	0-4	2-6	1.35-1.65	6.0-20	0.09-0.12	4.5-6.5	Low----------	0.17	5	2	<1
	4-13	2-6	1.50-1.65	6.0-20	0.07-0.12	4.5-6.5	Low----------	0.17			
	13-29	1-3	1.50-1.70	6.0-20	0.05-0.08	4.5-6.5	Low----------	0.17			
	29-60	0-3	1.50-1.70	6.0-20	0.04-0.07	5.1-6.5	Low----------	0.17			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "frequent," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
AmC------------ Amery	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	High.
AoA, AoB, AoC--- Antigo	B	None--------	---	---	>6.0	---	---	>60	---	---	High-----	Moderate	High.
As-------------- Au Gres	B	None--------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	---	Moderate	Low------	Moderate.
Co-------------- Comstock	C	None--------	---	---	1.0-3.0	Apparent	Sep-May	>60	---	---	High-----	Moderate	High.
Cs-------------- Croswell	A	None--------	---	---	2.0-3.0	Apparent	Nov-Apr	>60	---	---	Low------	Low------	Moderate.
CyB------------- Crystal Lake	B	None--------	---	---	2.5-6.0	Perched	Sep-May	>60	---	---	High-----	Low------	High.
Fm-------------- Fordum	D	Frequent----	Long------	Mar-Jun	+1-1.0	Apparent	Jan-Dec	>60	---	---	High-----	High-----	High.
FoB------------- Freeon	B	None--------	---	---	2.0-3.0	Perched	Nov-May	>60	---	---	Moderate	Low------	Moderate.
HyB------------- Hatley	C	None--------	---	---	1.0-3.0	Apparent	Nov-May	>60	---	---	High-----	Moderate	High.
Ig-------------- Ingalls	B	None--------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	---	Moderate	Moderate	Moderate.
KnC, KoB-------- Kennan	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	High.
KwD------------- Keweenaw	A	None--------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	High.
LgA, LgB-------- Langlade	B	None--------	---	---	>6.0	---	---	>60	---	---	High-----	Moderate	High.
Lx-------------- Loxley	A/D	None--------	---	---	+1-1.0	Apparent	Nov-May	>60	---	50-55	High-----	High-----	High.
MgB------------- Magnor	C	None--------	---	---	0.5-3.0	Perched	Nov-Jun	>60	---	---	High-----	Low------	Moderate.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
MhB------------- Marathon	B	None---------	---	---	2.5-4.5	Apparent	Nov-May	40-60	Hard	---	Moderate	Moderate	Moderate.
MnB------------- Menominee	A	None---------	---	---	2.5-4.0	Perched	Dec-Apr	>60	---	---	Low------	Low------	Moderate.
MoB------------- Milladore	C	None---------	---	---	1.0-2.5	Perched	Nov-Jun	>60	---	---	High-----	Moderate	Moderate.
Ms*:													
Minocqua--------	B/D	None---------	---	---	+1-1.0	Apparent	Nov-May	>60	---	---	High-----	High-----	High.
Cable-----------	B/D	None---------	---	---	+1-1.0	Apparent	Nov-May	>60	---	---	High-----	High-----	High.
Sherry----------	B/D	None---------	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	---	High-----	High-----	High.
MyB------------- Mylrea	C	None---------	---	---	1.0-3.0	Apparent	Nov-May	>60	---	---	High-----	Low------	High.
Os-------------- Oesterle	C	None---------	---	---	1.0-3.0	Apparent	Oct-May	>60	---	---	High-----	Low------	Moderate.
PsB, PsC, PsD--- Pence	B	None---------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	Moderate.
Pt*. Pits													
Sc-------------- Scott Lake	B	None---------	---	---	2.5-6.0	Apparent	Nov-May	>60	---	---	Moderate	Low------	High.
Sy*:													
Seelyeville-----	A/D	None---------	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	50-55	High-----	High-----	Moderate.
Cathro----------	A/D	None---------	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	19-22	High-----	High-----	Low.
Markey----------	A/D	None---------	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	25-30	High-----	High-----	Low.
VsB, VsC-------- Vilas	A	None---------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	High.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--ENGINEERING INDEX TEST DATA

[Dashes indicate that data were not available. MAX means maximum dry density; OPT, optimum moisture; LL, liquid limit; PI, plasticity index; UN, Unified; and NP, nonplastic]

Soil name and location	Parent material	Report number	Depth	Moisture density		Percentage passing sieve*--				Percentage smaller than*--				LL	PI	Classification	
				MAX	OPT	No. 4	No. 10	No. 40	No. 200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	UN
			In	Lb/ft3	Pct									Pct			
Antigo silt loam**: SE1/4SE1/4 sec. 16, T. 31 N., R. 11 E.	Silty and loamy deposits and the underlying sand and gravel.	S78WI-034-88-1	19-28	---	---	100	100	95	88	84	58	28	20	33.0	10.6	A-6(8)	CL
		88-2	33-60	---	---	56	47	18	5	5	4	3	2	---	NP	A-1-a (0)	SP-SM
Au Gres loamy sand: SW1/4SE1/4 sec. 7, T. 34 N., R. 12 E.	Sandy deposits.	S82WI-067-315-1	7-12	---	---	100	100	84	16	8	2	0	0	---	NP	A-2-4 (0)	SM
Comstock silt loam: SE1/4SE1/4 sec. 16, T. 32 N., R. 12 E.	Silty water-laid deposits.	S80WI-067-192-1	25-31	---	---	100	100	98	91	85	61	28	19	33.0	11.6	A-6(9)	CL
Croswell loamy sand: NW1/4SE1/4 sec. 13, T. 34 N., R. 11 E.	Sandy deposits.	S82WI-067-90-1	9-15	---	---	98	94	76	8	7	5	3	1	---	NP	A-3(0)	SP-SM
Ingalls loamy sand: SW1/4NW1/4 sec. 18, T. 34 N., R. 12 E.	Sandy deposits over silty water-laid deposits.	S82WI-067-201-1	15-26	---	---	98	97	83	22	15	8	3	2	---	NP	A-2-4 (0)	SM
		201-2	26-38	---	---	100	100	61	7	5	3	1	1	---	NP	A-3(0)	SP-SM
		201-3	43-60	---	---	100	100	92	76	73	68	32	15	26.8	7.3	A-4(8)	CL
Kennan silt loam: SE1/4SE1/4 sec. 36, T. 31 N., R. 11 E.	Silty and loamy deposits and the underlying loamy or sandy glacial till.	S78WI-34-5-1	22-30	---	---	94	93	82	62	55	33	14	11	23.0	NP	A-4(5)	ML
		5-2	47-60	129.0	7.8	87	82	57	17	15	11	5	4	12.3	NP	A-2-4 (0)	SM

See footnotes at end of table.

TABLE 18.--ENGINEERING INDEX TEST DATA--Continued

Soil name and location	Parent material	Report number	Depth	Moisture density		Percentage passing sieve*--				Percentage smaller than*--				LL	PI	Classification	
				MAX	OPT	No. 4	No. 10	No. 40	No. 200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	UN
			In	Lb/ft3	Pct									Pct			
Langlade silt loam: SE1/4SE1/4 sec. 21, T. 32 N., R. 12 E.	Silty and loamy deposits and the underlying sand and gravel.	S80WI-067-134-1	16-27	---	---	98	97	92	80	75	52	21	16	27.6	6.3	A-4(8)	CL-ML
Marathon loam, bedrock substratum: NW1/4NW1/4 sec. 30, T. 31 N., R. 10 E.	Loamy and sandy glacial drift and the underlying loamy residuum.	S81WI-067-281-1	12-19	---	---	100	97	86	58	54	33	10	5	---	NP	A-4(4)	ML
		281-2	19-27	---	---	100	95	80	38	36	22	7	3	---	NP	A-4(1)	SM
		281-3	36-57	---	---	67	53	38	18	16	11	5	3	---	NP	A-1-b (0)	SM
Menominee loamy sand: NW1/4NW1/4 sec. 11, T. 31 N., R. 12 E.	Sandy deposits and the underlying silty and loamy water-laid deposits.	S80WI-067-195-1	12-22	---	---	88	82	60	6	4	3	2	1	---	NP	A-3(0)	SP-SM
		195-2	45-59	---	---	100	100	92	80	72	53	26	18	28.6	9.1	A-4(8)	CL
Milladore silt loam**: SE1/4SE1/4 sec. 22, T. 31 N., R. 9. E.	Silty deposits and the underlying glacial drift.	S81WI-067-278-1	8-16	---	---	100	98	91	72	67	44	15	8	---	NP	A-4(7)	ML
		278-2	30-45	---	---	100	97	82	50	47	39	25	21	35.3	18.5	A-6(6)	SC
		278-3	45-54	---	---	96	92	75	41	37	28	18	14	28.6	12.7	A-6(2)	SC
Oesterle silt loam**: SW1/4SW1/4 sec. 15, T. 31 N., R. 10 E.	Silty and loamy deposits and the underlying sand and gravel.	S82WI-067-302-1	24-28	---	---	97	94	79	56	49	33	15	10	24.0	5.1	A-4(4)	CL-ML
Scott Lake silt loam**: SE1/4NE1/4 sec. 27, T. 32 N., R. 10 E.	Silty and loamy deposits and the underlying sand and gravel.	S82WI-067-331-1	19-30	---	---	100	100	95	81	75	48	22	16	29.4	9.4	A-4(8)	CL

See footnotes at end of table.

TABLE 18.--ENGINEERING INDEX TEST DATA--Continued

Soil name and location	Parent material	Report number	Depth	Moisture density		Percentage passing sieve*--				Percentage smaller than*--				LL	PI	Classi-fication	
				MAX	OPT	No. 4	No. 10	No. 40	No. 200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	UN
			In	Lb/ft3	Pct									Pct			
Sherry muck**: SE1/4SE1/4 sec. 23, T. 31 N., R. 9 E.	Silty deposits and the under-lying glacial drift.	S81WI-067-261-1	8-22	---	---	100	100	98	88	85	63	32	24	37.8	19.4	A-6(12)	CL
		261-2	28-43	---	---	97	92	76	45	41	31	18	14	25.8	10.8	A-6(2)	SC
		261-3	52-60	---	---	92	88	71	38	34	23	11	8	---	NP	A-4(1)	SM
Vilas loamy sand**: NE1/4NE1/4 sec. 14, T. 34 N., R. 11 E.	Sandy deposits.	S80WI-067-89-1	13-29	---	---	96	93	51	10	9	6	2	1	---	NP	A-3(0)	SP-SM
		89-2	29-60	---	---	98	95	39	2	1	1	1	1	---	NP	A-1-b (0)	SP

* Mechanical analysis according to the AASHTO Designation T88-57 (1). Results from this procedure can differ somewhat from the results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all material up to and including that 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculation of grain-size fractions. The mechanical analysis data given in this table are not suitable for use in naming textural classes of soils.

** The soil is a taxadjunct. See the series description for an explanation.

TABLE 19.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Amery	Coarse-loamy, mixed Typic Glossoboralfs
*Antigo	Fine-silty over sandy or sandy-skeletal, mixed Typic Glossoboralfs
Au Gres	Sandy, mixed, frigid Entic Haplaquods
Cable	Coarse-loamy, mixed, nonacid, frigid Typic Haplaquepts
Cathro	Loamy, mixed, euic Terric Borosaprists
Comstock	Fine-silty, mixed Aquic Glossoboralfs
Croswell	Sandy, mixed, frigid Entic Haplorthods
Crystal Lake	Fine-silty, mixed Typic Glossoboralfs
Fordum	Coarse-loamy, mixed, nonacid, frigid Mollic Fluvaquents
Freeon	Coarse-loamy, mixed Typic Glossoboralfs
Hatley	Coarse-loamy, mixed Aquic Glossoboralfs
Ingalls	Sandy over loamy, mixed, frigid Entic Haplaquods
Kennan	Coarse-loamy, mixed Typic Glossoboralfs
Keweenaw	Sandy, mixed, frigid Alfic Haplorthods
Langlade	Coarse-loamy, mixed Typic Glossoboralfs
Loxley	Dysic Typic Borosaprists
Magnor	Coarse-loamy, mixed Aquic Glossoboralfs
Marathon	Coarse-loamy, mixed Typic Glossoboralfs
Markey	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Menominee	Sandy over loamy, mixed, frigid Alfic Haplorthods
*Milladore	Fine-loamy, mixed Aquic Glossoboralfs
Minocqua	Coarse-loamy over sandy or sandy-skeletal, mixed, nonacid, frigid Typic Haplaquepts
Mylrea	Coarse-loamy, mixed, frigid Aquic Dystrochrepts
*Oesterle	Coarse-loamy, mixed Aquic Glossoboralfs
Pence	Sandy, mixed, frigid Entic Haplorthods
*Scott Lake	Coarse-loamy, mixed Typic Glossoboralfs
Seelyeville	Euic Typic Borosaprists
*Sherry	Fine-loamy, mixed, frigid Udollic Ochraqualfs
*Vilas	Sandy, mixed, frigid Entic Haplorthods

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