United States
Department of
Agriculture

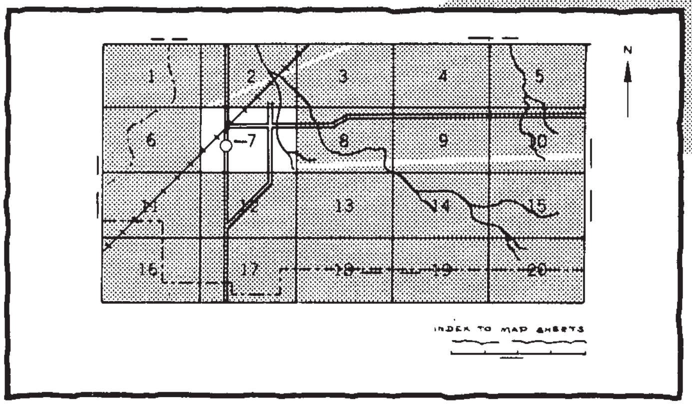
Soil
Conservation
Service

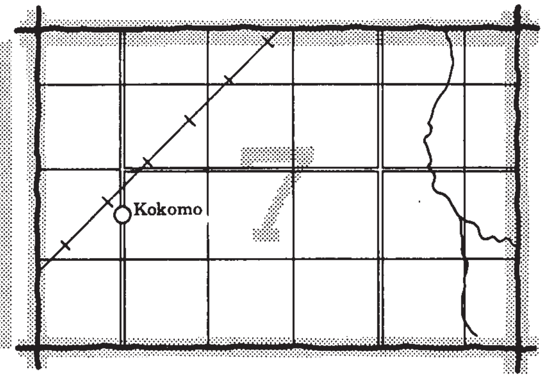
In cooperation with the
Michigan Department of
Agriculture,
Michigan Agricultural
Experiment Station, and
Michigan Technological
University

Soil Survey of Kent County, Michigan

HOW TO USE

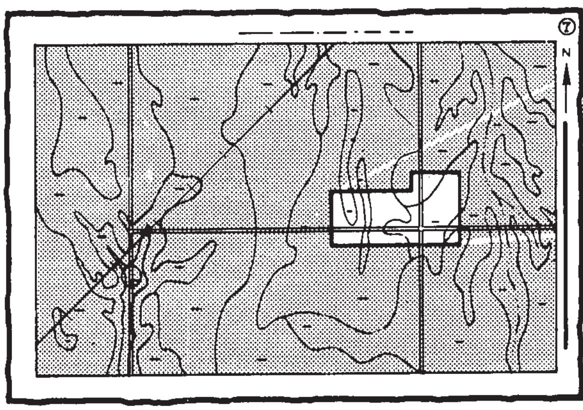
1. Locate your area of interest on the "Index to Map Sheets."

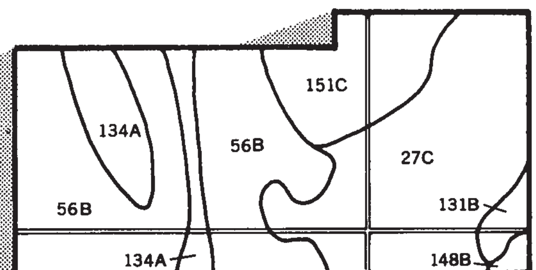




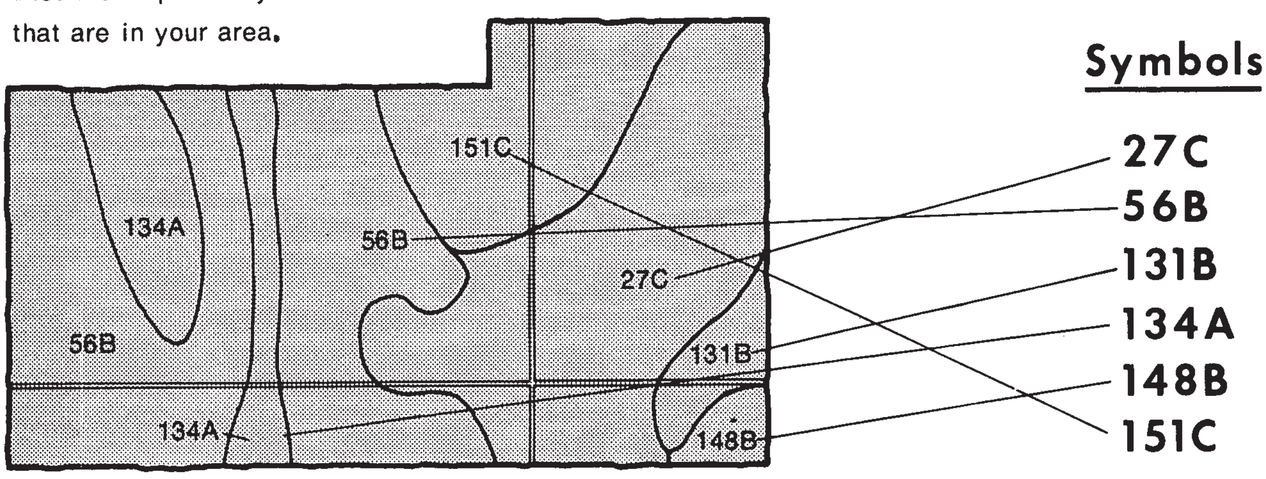
2. Note the number of the map sheet and turn to that sheet.

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



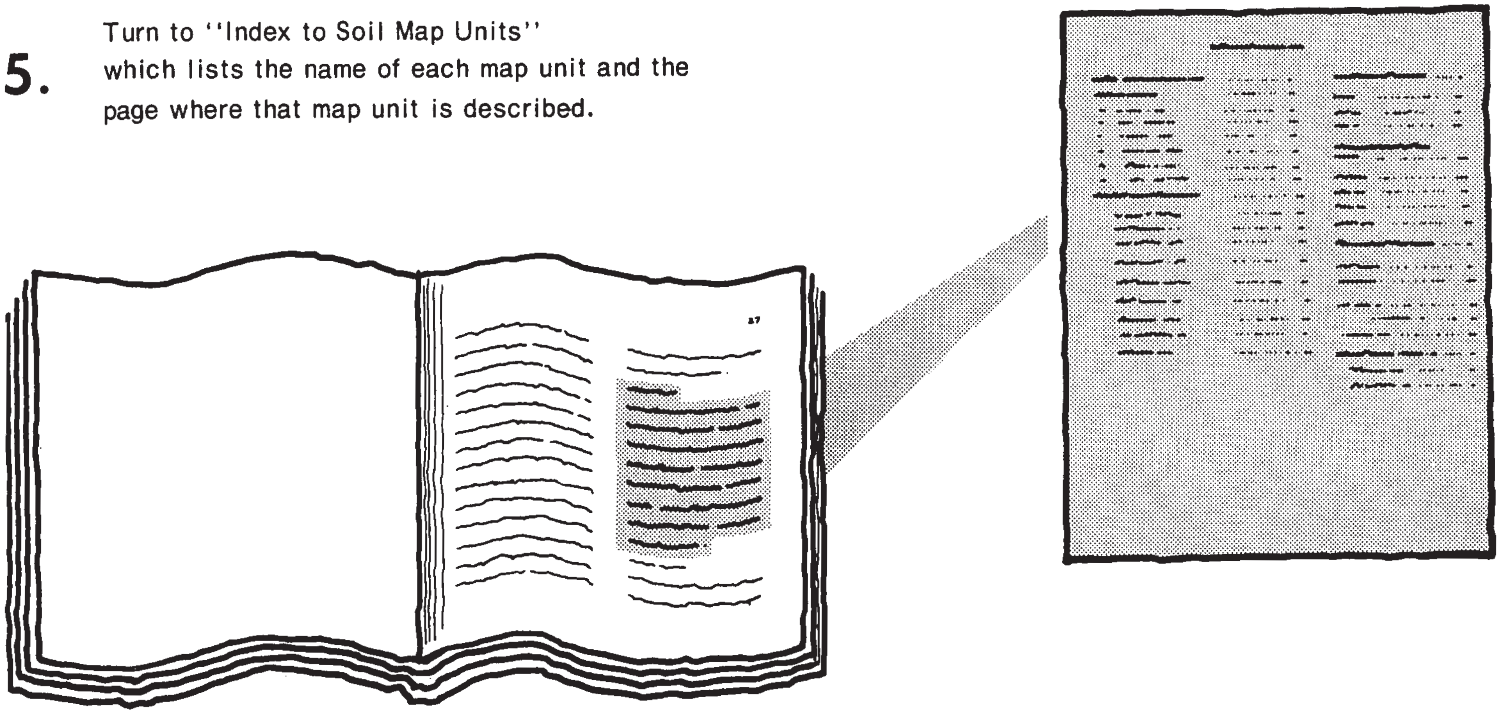


4. List the map unit symbols that are in your area.

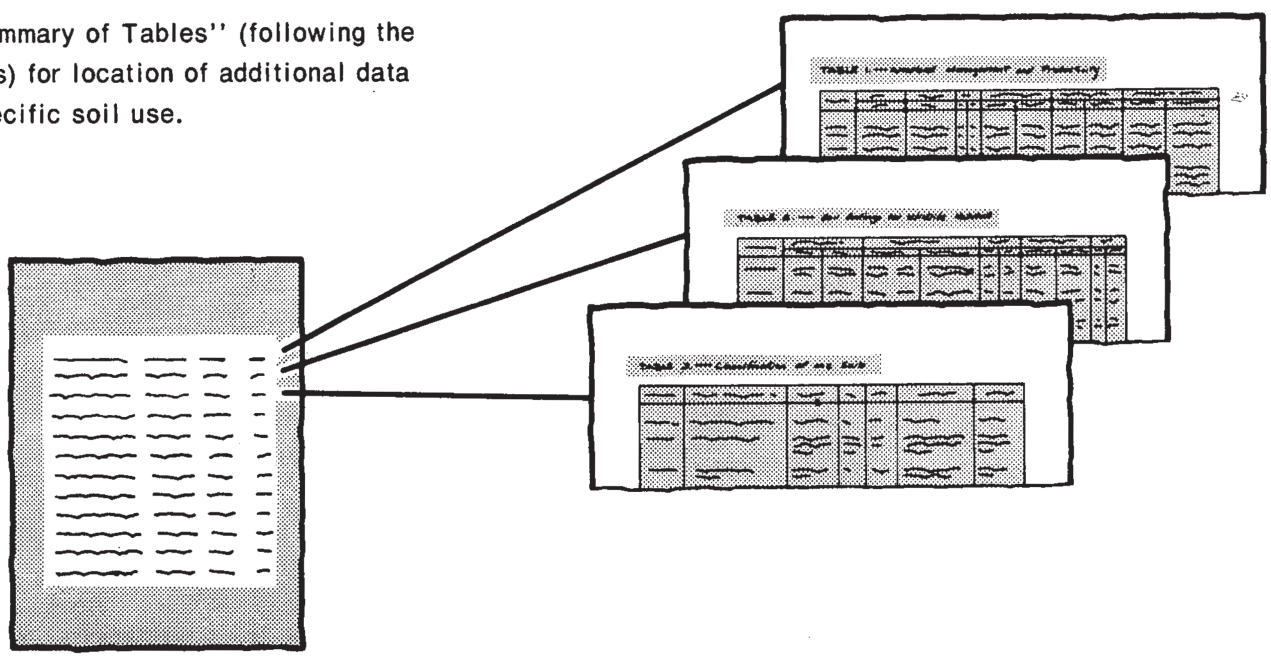


THIS SOIL SURVEY

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; for 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 1983. 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 and the Michigan Department of Agriculture, Michigan Agricultural Experiment Station, and Michigan Technological University. It is part of the technical assistance furnished to the Kent County Soil Conservation District. Financial assistance was made available by the Kent County Board of Commissioners.

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: Apples grown in an area of the Marlette-Capac-Metamora association in the northwestern part of Kent County.

Contents

Soil Series

Issued April 1986

Index to Map Units

Summary of Tables

Foreword

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

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

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

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

Homer R. Hilner
State Conservationist
Soil Conservation Service

Location of Kent County in Michigan.

Soil Survey of
Kent County, Michigan

By Thomas H. Purkey, Soil Conservation Service

Fieldwork by Karl E. Pregitzer and Thomas H. Purkey,
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Michigan Department of Agriculture

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
Michigan Department of Agriculture,
Michigan Agricultural Experiment Station,
and Michigan Technological University

KENT COUNTY is in the west-central part of the Lower Peninsula of Michigan. It is rectangular, having a width of 24 miles and a length of 36 miles. The land area is 551,533 acres, or approximately 862 square miles. Grand Rapids, the county seat and the second largest city in Michigan, is in the southwestern part of the county. In 1977, the population of the county was about 450,350 (*5*).

This survey updates the soil survey of Kent County published in 1926 (*19*). It provides additional information and larger maps, which show the soils in greater detail.

General Nature of the County

This section gives general information about the county. It describes the climate, settlement and development, lakes and streams, transportation facilities, physiography and relief, and farming.

Climate

Prepared by the Michigan Department of Agriculture, Climatology Division, East Lansing, Michigan.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Grand Rapids in the period 1964 to 1980 and at Greenville, in neighboring Montcalm County, 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 23.7 degrees F at Grand Rapids and 23.6 degrees at Greenville. The average daily minimum temperature is 16.4 degrees at Grand Rapids and 15.8 degrees at Greenville. The lowest temperature on record at Grand Rapids was -24 degrees on February 13 and 14, 1899. The lowest temperature on record at Greenville was -25 degrees on February 12, 1914. In summer the average temperature is 69.1 degrees at Grand Rapids and 69.2 degrees at Greenville. The average daily maximum temperature is 80.6 degrees at Grand Rapids and 81.8 degrees at Greenville. The highest recorded temperature, which occurred at Grand Rapids and Greenville on July 13, 1936, was 108 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 36.37 inches at Grand Rapids and 33.11 inches at Greenville. Of this, 20.93 inches, or about 58 percent, usually falls in April through September at Grand Rapids and 19.06 inches, or about 58 percent, at Greenville. 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 16.1 inches at Grand Rapids and less than 15.9 inches at Greenville. The heaviest 1-day rainfall during the period of record was 5.48 inches at Grand Rapids on May 10 and 11, 1981, and 5.80 inches at Greenville on October 1, 1981. Thunderstorms occur on about 36 days each year. An average of six occur in each of the months of June, July, and August.

The average seasonal snowfall is 76.0 inches at Grand Rapids and 55.3 inches at Greenville. The greatest snow depth at any one time during the period of record was 27 inches at Grand Rapids and 30 inches at Greenville. On the average, 72 days of the year have at least 1 inch of snow on the ground at Grand Rapids and 81 days at Greenville. The number of such days varies greatly from year to year.

At Grand Rapids, the highest seasonal snowfall total was 132.0 inches during the 1951-52 season, the lowest seasonal snowfall total was 20.0 inches during the 1905-06 season, the heaviest 1-day snowfall on record was more than 16.1 inches on January 26, 1978, and the greatest monthly snowfall was 51.3 inches during December 1951. At Greenville, the highest seasonal snowfall since 1940 was 97.2 inches during the 1978-79 season, the lowest seasonal snowfall total was 19.3 inches during the 1948-49 season, the heaviest 1-day snowfall on record was more than 18.5 inches on January 26, 1978, and the greatest monthly snowfall was 43.8 inches during January 1979.

The average relative humidity in midafternoon is about 62 percent. Humidity is higher at night, and the average at dawn is about 82 percent. The sun shines 62 percent of the time possible in summer and 32 percent in winter. The prevailing wind is from the west. Average windspeed is highest, 11.5 miles per hour, in January.

Settlement and Development

The first settlers who arrived in what is now Kent County found the land occupied by Indians. This area had been Indian territory for thousands of years. The Hopewell Indians inhabited the area near Grand Rapids from about 300 B.C. to 300 A.D. They were mound builders. Their mounds, which were used for religious, burial, and ceremonial purposes, have been found in an area at the mouth of the Flat River near Lowell and south of the Pearl Street Bridge on the west bank of the Grand River in Grand Rapids. The most famous mounds are in an area along the Grand River near Grandville. The last mounds have been excavated, and the artifacts that were found indicate that the Hopewells had engaged in heavy trade with other Indian tribes over a vast section of the United States (*3*).

The Hopewells left this area when the Ottawa Indians moved in. The Ottawas built wigwams, traded among themselves, and fished the rapids in the Grand River. When the Europeans began to arrive in the 1820's, they found Indians camped at Lowell, where the Grand River and the Flat River meet, near Ada on the Thornapple, near Grandville and Plainfield, and in two big camps on the west side of the river in what is now Grand Rapids. The first settlers came to trade with the Indians (*7*).

Most of the early settlers came from New England via upstate New York; many of these came via the Erie Canal when it was completed in 1825. They also came by train from Detroit to Jackson and then by crude rafts down the Grand River or on foot over the old Indian trails. They settled the fertile land along the banks of the Grand River. The river provided a source of power for mills to grind wheat into flour. In the 1860's and 1870's, after railroads extended into the county, the northern part of the county was developed and the lumbering industry was begun.

Kent County was separated from Kalamazoo County on March 2, 1831, by an act of the Legislative Council of the Territory of Michigan (*7*). It was named after Chancellor Kent, a prominent New York lawyer who had died 19 years before. In 1833, Grand Rapids was named the county seat. The rapids in the Grand River provided such a tremendous source of water power that Grand Rapids became the spot along the river that had the most lasting growth and development.

After pioneers began tapping the vast timber resources in the northern part of the county, lumber mills were established along a canal constructed on the east bank of the Grand River (*8*). Along with its tributaries, the river was the prime mover of logs from the outlying areas of the county. It was also the prime transportation network. Steamboats plied their trade both upstream and downstream from the rapids. This mode of transportation diminished when the railroad arrived in 1858. The railroad became the prime mover of people and goods until the airplane and automobile took the passenger business away from the trains.

Another important factor in the growth of Grand Rapids and Kent County was the arrival, in the second half of the 19th century, of large numbers of immigrants, many of them skilled laborers. The first to arrive were the Irish, who helped dig the canals along the river. The Germans arrived next, establishing successful shops and a number of small breweries. The Dutch, who arrived next, greatly influenced the course of the city's history. Finally, in the latter part of the 1880's, a number of Polish families settled in the city.

Because of an abundant supply of raw materials, the transportation facilities, and a good source of labor, Grand Rapids earned the title "Furniture Capital of the World." In 1876, four Grand Rapids furniture makers sent samples to the Centennial Exposition in Philadelphia. The pieces created a sensation. In 1878, Grand Rapids held its first "furniture market," which continued until the 1950's. The county still has a large number of furniture manufacturers, and the mention of

Grand Rapids continues to conjure up an image of quality furniture.

Grand Rapids and its suburbs serve as the major marketing and service center for all of western Michigan. Within the suburban area, there is a strong concentration of large, locally owned businesses, locally headquartered companies, and sizable branch operations of several national corporations (*11*).

The former logging and sawmill operations in the outlying parts of the county have been replaced by dairy and cash-crop farming. A large vegetable and fruit farming industry is an integral part of the agriculture in the county (fig. 1).

Lakes and Streams

Kent County has about 187 lakes and 5 major rivers. The Grand, Rogue, Flat, Thornapple, and Coldwater Rivers all flow through the county. Nearly all the drainage water finds its way to the Grand River, which flows westward into Lake Michigan. Also included in the county's water resources are some artificial lakes, many streams, creeks, gravel pits, wetlands, and ponds. Bodies of water that are more than 40 acres in size make up about 6,975 acres of the survey area.

Transportation Facilities

Air traffic service is provided by several small airports and the Kent County International Airport, southeast of

Figure 1.—Carrots in an area of Palms muck.

Grand Rapids. The county has three interstate highways, one U.S. highway, and eight state highways. Four railroad lines, all freight lines, serve the county. The highways and railroads link Kent County to all points in the state.

Physiography and Relief

The bedrock in Kent County consists of the edges of bowllike formations that fill the Michigan Basin. The oldest rock is Marshall Sandstone, which underlies all of the county and is the uppermost bedrock in the southwestern part. Overlapping the Marshal Sandstone in the central and southeastern parts of the county is the Michigan Formation, which is primarily limestone, gypsum, and dolomite interbedded with shale and sandstone. To the northeast, these rocks are progressively overlapped by Bayport Limestone, Parma Sandstone, and finally by the coal-bearing Saginaw Formation in the furthest northeast part of the county (*4*).

Overlying these rock formations is a mass of glacial drift that was deposited during the Wisconsin glacial period. The county is situated in an area where the Michigan and Saginaw lobes of the Wisconsin ice sheet met. Consequently, a very complex and strongly developed interlobate morainic system developed. The deposits of glacial drift range from less than 10 feet to several hundred feet in thickness within the county. The drift ranges from coarse gravel to fine lacustrine clay. It is the parent material in which many of the soils in the county formed.

The present surface features are, for the most part, the results of glacial action. The landscape is an undulating plain in which valleys have been cut. Outwash material was deposited in the valleys by glacial meltwater streams that were much larger than the rivers and streams in some of the valleys today. As the ice receded and the levels of the ancient glacial lakes dropped, the valleys were incised, so that terraces formed along the length of the Grand Valley. Many of the tributary outwash streams formed extensive fans out into the Grand Valley at various points along its length. These fans are generally graded to terrace surfaces rather than to the present level of drainage.

Three major physiographic regions are recognized in the county (fig. 2). The first of these consists of a number of outwash plains and lake plains in nearly level valleys having rather definite boundaries. The glacial drift is typically thinnest in these areas, and the bedrock is within a few feet of the surface along the lower reaches of Buck and Plaster Creeks, near Wyoming and Grandville. Gypsum formerly was surface mined at these locations. The mining resulted in several manmade lakes (*7*). The largest and most clearly defined of these plains is in an area along the Grand River in the western part of the county. A projection of this plain extends southward through Kelloggsville and across the county line. A second area, which is 1.0 to 2.5 miles wide, is along the Rogue River in the northwestern part of the county. This area ends abruptly about 1.5 miles north of Rockford. A small, nearly level area is along the Montcalm County line north of the Grand Trunk Railroad. In general, the surface of these plains is smooth, but slight rises and depressions occur. The abandoned meltwater channels are filled with organic deposits in some areas, and ice-block kettle lakes are in other areas.

The second physiographic region occurs as hilly morainic belts rising from the nearly level valleys and bordering the several rivers in the county and their tributaries. These belts are characterized by ridges with smooth or rounded slopes, hummocks, and sharp, steep knobs. Along the large rivers, such as the Grand, Flat, Thornapple, and Rogue Rivers, the rolling to hilly belts are 2 to 4 miles wide. Along the small streams, the belts are less than 1 mile wide. These areas generally follow the direction of the streams which they border, but they extend perpendicularly for short distances into the third major physiographic region.

The third region consists of a number of gently sloping to rolling till plains that are generally higher than the hilly morainic belts and outwash valley plains. Most of the best farmland in the county is on these till plains.

The elevation in most of Kent County is 750 to 850 feet above sea level. The major outwash channels and plains, however, range from 600 to 750 feet in elevation. The highest areas are along the north-central county line and in the northeastern part of the county. The highest point, Fisk's Knob, rises to more than 1,060 feet above sea level. Dias Hill rises to more than 1,040 feet above sea level in an area along the south-central county line. The Grand River has an elevation of about 617 feet where it enters the county and of 592 feet where it leaves the county.

Farming

Farming has played a role in the life of the survey area since before the first settlers arrived. The Indians grew corn and other crops along the banks of the Grand River. Farming has been a big part of the county's economy since the decline of the lumbering era late in the 19th century.

About 229,513 acres in the county, or nearly 42 percent of the total land area, is farmland. More than 195,000 acres was used for crops and pasture in 1978 (*18*). Of this total, about 67,000 acres was used for row crops, mostly corn; 16,000 acres for close-grown crops, mainly oats and wheat; 46,800 acres for hay; and 21,000 acres for specialty crops (fig. 3), mainly apples, cherries, peaches, plums, sweet corn, cucumbers, onions, snap beans, cabbage, and celery. The rest was idle cropland or was planted to cover crops. Dairy products and

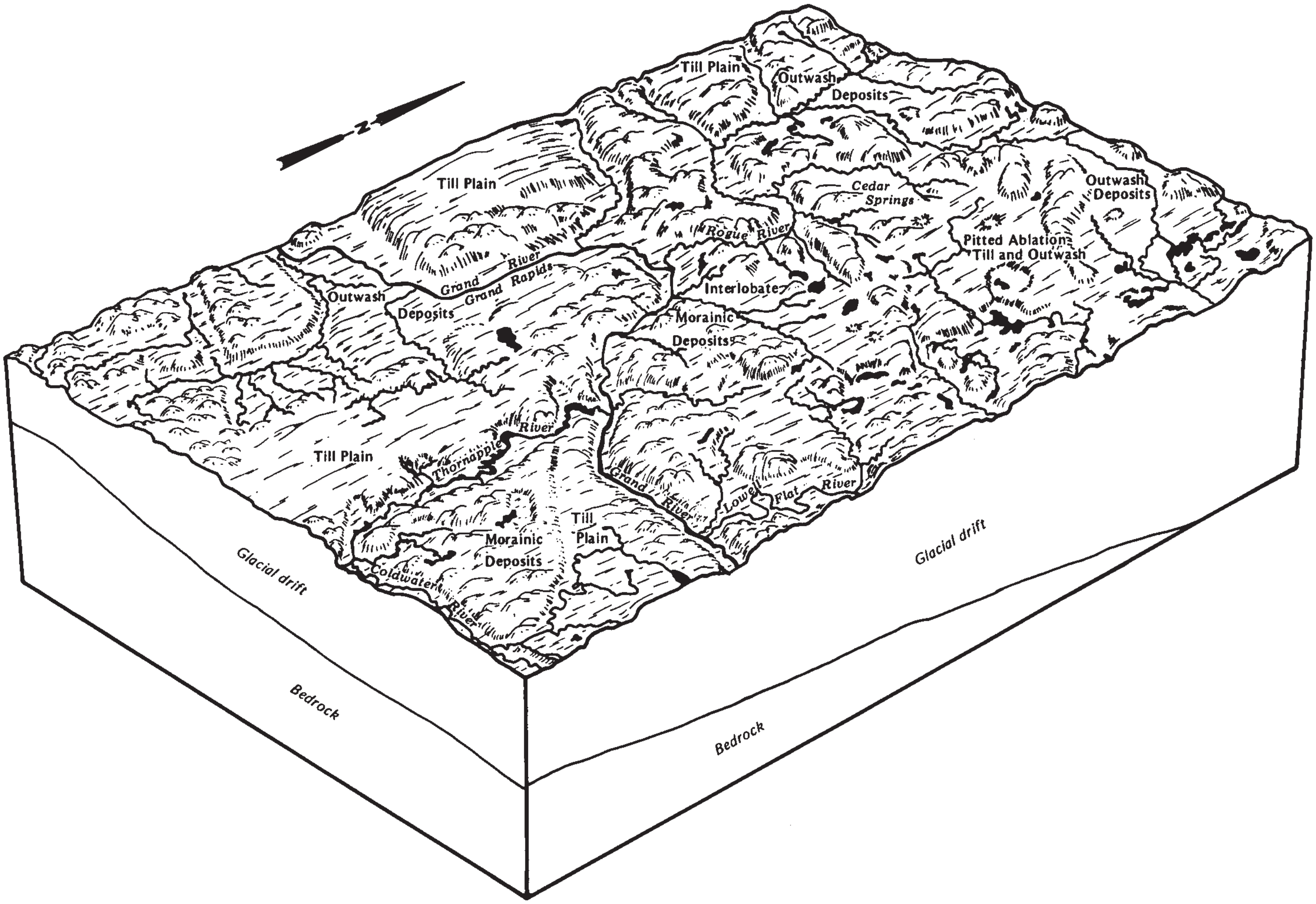

Figure 2.—Physiography of Kent County, Michigan.

livestock also are important parts of the agriculture in the county.

Because of the suitability of many of the soils for cropland, the favorable climate conditions, and the proximity to markets, farming will probably continue to be an important part of the county's economy in spite of the increasing pressures exerted on available farmland by urban sprawl.

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

Figure 3.—Fruit orchard in an area of Kent County.

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 objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

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

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

General Soil Map Units

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

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

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

Some of the boundaries on the general soil map of Kent County do not match those on the maps of adjacent counties, and some of the soil names and descriptions do not fully agree. Differences result from improvements in the classification of soils, particularly modifications or refinements in soil series concepts. Also, some differences result from variations in the intensity of mapping or in the extent of the soils within the counties.

Soil Descriptions

Nearly Level to Gently Rolling, Excessively Drained to Poorly Drained, Sandy and Loamy Soils on Outwash Plains, Terraces, and Till Plains

These soils generally are used as cropland or woodland. In some areas, however, they are idle land. They are fairly well suited to woodland. Seedling mortality and the equipment limitation are the major concerns in managing woodland. The soils generally are fairly well suited to cultivated crops. If cultivated crops are grown, water erosion, soil blowing, droughtiness, and wetness are management concerns.

The well drained soils are fairly well suited and the rest of the soils poorly suited to onsite waste disposal. The soils are generally well suited or fairly well suited to building site development. Wetness, permeability in the underlying material, and the inability of the soils to adequately filter the effluent in septic tank absorption fields are the main limitations.

1. Oakville-Thetford-Granby Association

Nearly level to gently rolling, well drained to poorly drained, sandy soils formed in sandy materials

The Oakville soils in this association are on knolls and ridges. The Thetford and Granby soils are on low flats and in swales and drainageways. Slope ranges from 0 to 12 percent.

This association makes up about 5 percent of the county. It is about 35 percent Oakville soils, 25 percent Thetford soils, 15 percent Granby soils, and 25 percent soils of minor extent (fig. 4).

The Oakville soils are well drained or moderately well drained. Typically, the surface layer is dark grayish brown fine sand about 6 inches thick. The subsoil is loose fine sand about 34 inches thick. The upper part is yellowish brown, and the lower part is brownish yellow. The underlying material to a depth of about 60 inches is light yellowish brown, loose fine sand.

The Thetford soils are somewhat poorly drained. Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsurface layer is yellowish brown and light yellowish brown sand about 13 inches thick. Below this to a depth of more than 60 inches is pale brown, mottled, loose sand that has thin lamellae of dark yellowish brown and brown, mottled, very friable loamy sand.

The Granby soils are poorly drained. Typically, the surface layer is black loamy fine sand about 11 inches thick. The subsoil is about 31 inches thick. It is mottled. The upper part is grayish brown, very friable loamy fine sand; the next part is light brownish gray, very friable fine sand; and the lower part is pale brown, loose sand. The underlying material to a depth of about 60 inches is yellowish brown, mottled sand.

Of minor extent in this association are the very poorly drained Adrian and Houghton soils. These soils generally are in depressions and drainageways.

Most of this association is woodland or idle land. Some areas are cultivated or used for pasture. The major soils are fairly well suited or poorly suited to cultivated crops and are fairly well suited or well suited to hay and pasture. The main management needs are measures that remove excess water, help to control soil

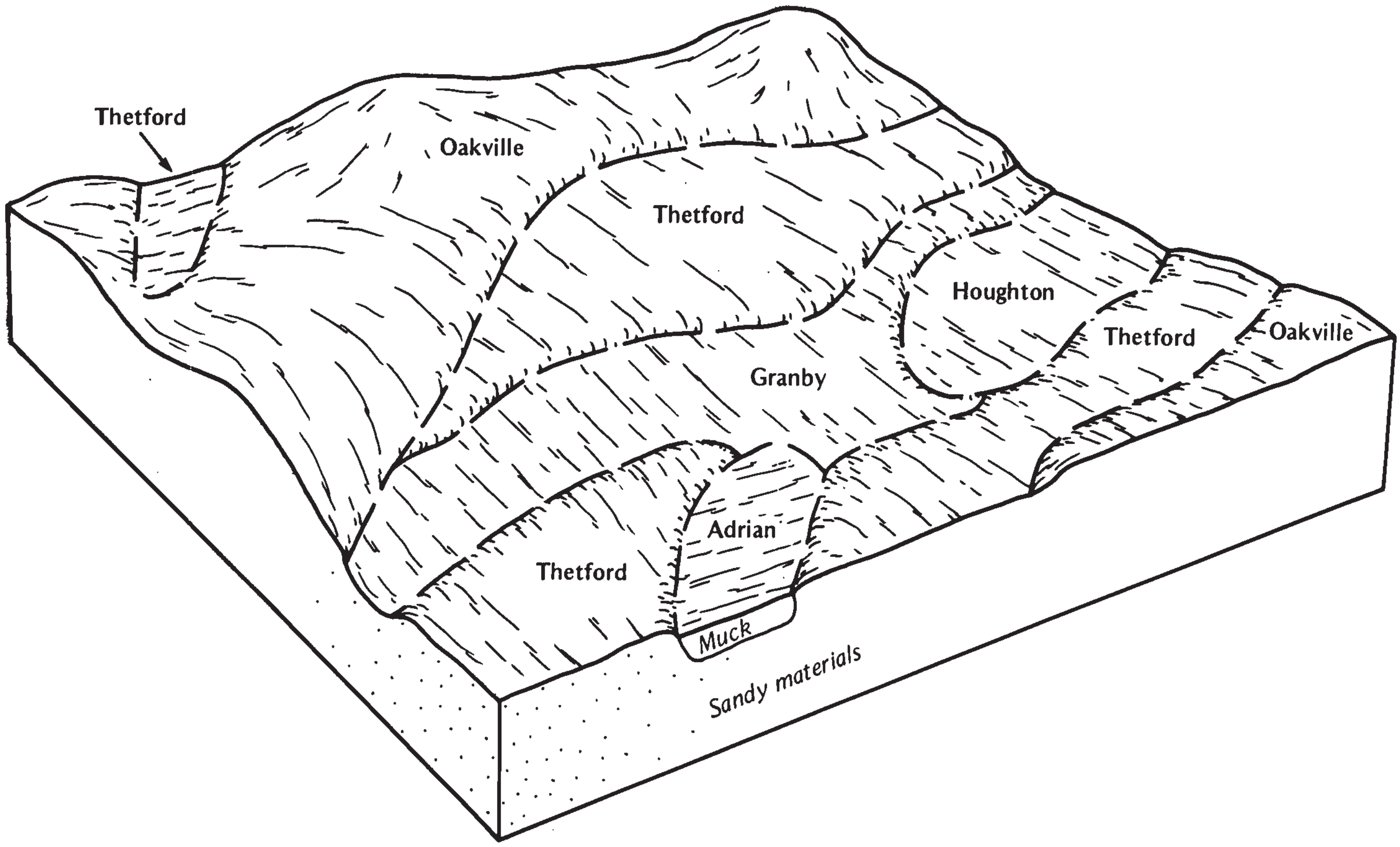

Figure 4.—Pattern of soils and underlying material in the Oakville-Thetford-Granby association.

blowing, increase the content of organic matter, and conserve moisture during midsummer months. The Oakville soils are well suited to woodland, and the Thetford and Granby soils are fairly well suited or poorly suited. The main concerns in managing woodland are seedling mortality and wetness.

The major soils are fairly well suited or poorly suited to building site development and septic tank absorption fields. The wetness and a poor filtering capacity are the major limitations. Also, ponding is a hazard on the Granby soils.

2. Plainfield-Oshtemo-Spinks Association

Nearly level to gently rolling, excessively drained and well drained, sandy and loamy soils formed in sandy and loamy materials

This association has a slope of 0 to 12 percent. It makes up about 10 percent of the county. It is about 30 percent Plainfield soils, 25 percent Oshtemo soils, 25 percent Spinks soils, and 20 percent soils of minor extent (fig. 5).

The Plainfield soils are excessively drained. Typically, the surface layer is very dark grayish brown sand about 9 inches thick. The subsoil is strong brown, loose sand about 20 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown, loose sand.

The Oshtemo soils are well drained. The surface layer is dark brown sandy loam about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 6 inches thick. The subsoil is about 40 inches thick. It is, in sequence downward, dark yellowish brown, friable sandy loam; strong brown, friable sandy clay loam; strong brown, friable gravelly sandy loam; and strong brown coarse sand. The underlying material to a depth of about 60 inches is yellowish brown, loose, calcareous gravelly coarse sand.

The Spinks soils are well drained. Typically, the surface layer is dark brown loamy sand about 12 inches thick. The subsurface layer is yellowish brown loamy sand about 6 inches thick. Below this to a depth of about 60 inches is yellowish brown, loose sand that has thin lamellae of dark brown, friable loamy sand.

Of minor extent in this association are the well drained Metea soils, which have loamy underlying material and are in broad upland areas and on ridges and knolls. Other minor soils are the somewhat poorly drained Wasepi, Tedrow, and Thetford soils on broad flats, along drainageways, and in shallow depressions; the very poorly drained Gilford and poorly drained Granby soils in depressions and drainageways; and the very poorly drained Adrian and Houghton soils in bogs and other depressional areas.

This association is used mainly as pasture or woodland or is idle land. A few areas are used for cultivated crops. The major soils generally are fairly well suited to cultivated crops and well suited to pasture and woodland. The excessively drained Plainfield soils, however, are poorly suited to cultivated crops and pasture. If cultivated crops are grown, soil blowing, water erosion, and droughtiness are the major management concerns. The droughtiness also is a concern in pastured areas. Seedling mortality is the major concern in managing woodland.

The major soils are well suited to most kinds of building site development. They are only fairly well suited to septic tank absorption fields, however, because of a poor filtering capacity, which may result in the pollution of ground water supplies.

3. Chelsea-Thetford-Selfridge Association

Nearly level to gently rolling, somewhat excessively drained and somewhat poorly drained, sandy soils formed in sandy and loamy materials

The Chelsea soils in this association are on the higher knolls and ridges. The Thetford and Selfridge soils are on the lower terraces and in swales. Slope ranges from 0 to 12 percent.

This association makes up about 5 percent of the county. It is about 30 percent Chelsea soils, 25 percent Thetford soils, 20 percent Selfridge soils, and 25 percent soils of minor extent (fig. 6).

The Chelsea soils are somewhat excessively drained. Typically, the surface layer is dark grayish brown loamy fine sand about 9 inches thick. The subsurface layer is yellowish brown loamy fine sand and fine sand about 23

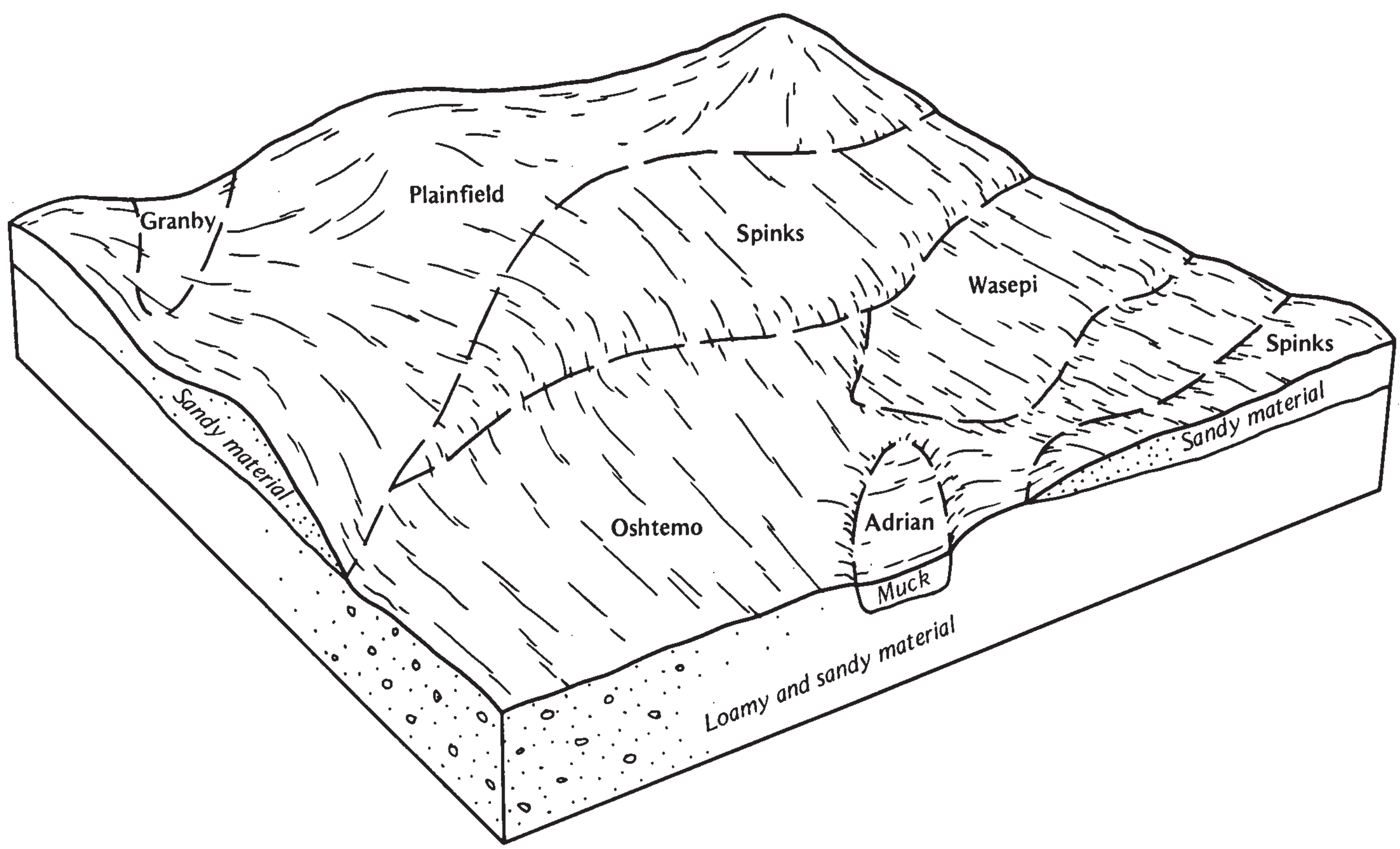

Figure 5.—Pattern of soils and underlying material in the Plainfield-Oshtemo-Spinks association.

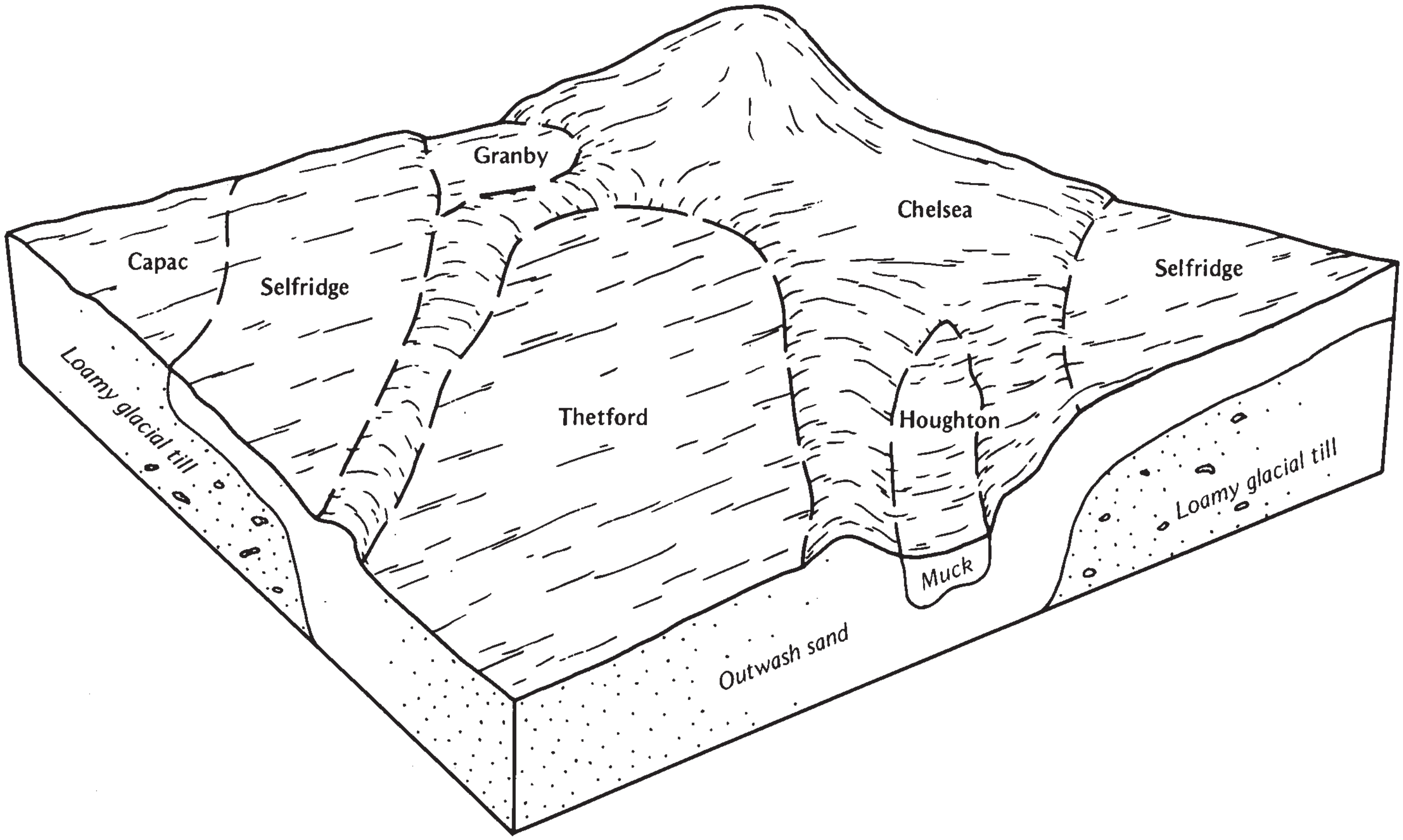

Figure 6.—Pattern of soils and underlying material in the Chelsea-Thetford-Selfridge association.

inches thick. Below this to a depth of about 60 inches is fine sand that has lamellae of loamy fine sand.

The Thetford soils are somewhat poorly drained. Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsurface layer is yellowish brown and light yellowish brown sand about 13 inches thick. Below this to a depth of more than 60 inches is pale brown, mottled, loose sand that has thin lamellae of dark yellowish brown and brown, mottled, very friable loamy sand.

The Selfridge soils are somewhat poorly drained. Typically, the surface layer is dark brown loamy sand about 12 inches thick. The subsoil is about 28 inches thick. It is mottled. The upper part is yellowish brown, very friable loamy sand; the next part is dark yellowish brown, friable sandy loam; and the lower part is brown, firm clay loam. The underlying material to a depth of about 60 inches is calcareous, pinkish gray, mottled, firm loam.

Of minor extent in this association are the well drained Metea soils, which have loamy underlying material and are on knolls and ridges. Other minor soils are the somewhat poorly drained, loamy Capac soils on foot slopes and low knolls and in drainageways; the poorly drained Belleville and Granby soils in depressions and drainageways; and the very poorly drained Gilford and Houghton soils in depressions and bogs.

This association generally is used for cultivated crops or is idle land. A few areas are used as permanent pasture or as woodland. The Chelsea soils are poorly suited to cultivated crops, and the Thetford and Selfridge soils are fairly well suited. If cultivated crops are grown, wetness, soil blowing, and droughtiness are the major management concerns. Mainly because of the wetness and the droughtiness, the major soils are only fairly well suited to pasture. They are fairly well suited to woodland. The equipment limitation caused by wetness and the seedling mortality rate are the main concerns in managing woodland.

The Chelsea soils are well suited to most kinds of building site development. They are only fairly well suited to septic tank absorption fields, however, because of a poor filtering capacity, which may result in the pollution of ground water supplies. The Thetford and Selfridge soils are poorly suited to septic tank absorption fields because of the wetness or the combination of wetness and moderately slow permeability. They are poorly suited to building site development because of the wetness.

Nearly Level to Rolling, Well Drained, Loamy and Sandy Soils on Moraines, Outwash Plains, and Till Plains

These soils generally are used as cropland or pasture. They are well suited to cultivated crops in areas where the slope is less than 12 percent. The steeper soils are poorly suited to cultivated crops and fairly well suited to pasture. Erosion, droughtiness, and soil blowing are the main management concerns.

These soils are well suited or fairly well suited to onsite waste disposal and to building site development. A poor filtering capacity and the slope are the major management concerns.

4. Kalamazoo-Oshtemo-Spinks Association

Nearly level to rolling, well drained, loamy and sandy soils formed in loamy and sandy materials

This association is in upland areas. Slope ranges from 0 to 18 percent.

This association makes up about 1 percent of the county. It is about 30 percent Kalamazoo soils, 25 percent Oshtemo soils, 15 percent Spinks soils, and 30 percent soils of minor extent.

The Kalamazoo soils typically have a surface layer of very dark grayish brown loam about 10 inches thick. The subsoil is about 33 inches thick. It is dark yellowish brown. In sequence downward, it is clay loam, gravelly sandy clay loam, gravelly sandy loam, and gravelly loamy sand. The upper part of the underlying material is dark yellowish brown, calcareous very gravelly sand. The lower part to a depth of about 60 inches is yellowish brown, calcareous gravelly coarse sand.

The Oshtemo soils typically have a surface layer of dark brown sandy loam about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 6 inches thick. The subsoil is about 40 inches thick. It is, in sequence downward, dark yellowish brown, friable sandy loam; strong brown, friable sandy clay loam; strong brown, friable gravelly sandy loam; and strong brown coarse sand. The underlying material to a depth of about 60 inches is yellowish brown, loose, calcareous gravelly coarse sand.

The Spinks soils typically have a surface layer of brown loamy sand about 10 inches thick. The subsurface layer is yellowish brown loamy sand about 6 inches thick. Below this to a depth of about 60 inches is yellowish brown, loose sand that has thin lamellae of dark brown loamy sand.

Of minor extent in this association are the well drained Marlette soils on upland ridges and knolls. These soils are less droughty than the major soils. Other minor soils are the moderately well drained Perrin and Tuscola soils on low ridges and knolls and along drainageways; the somewhat poorly drained Kibbie, Matherton, and Wasepi soils on broad flats, on low ridges and knolls, on foot slopes, and along drainageways; the poorly drained Colwood and Sebewa soils in depressions and drainageways; and the very poorly drained Gilford and Houghton soils in bogs, drainageways, and other depressional areas.

This association is used mainly as cropland or pasture. A few areas are used as woodland. The major soils are well suited or fairly well suited to cultivated crops in areas where the slope is less than 12 percent. The steeper soils are poorly suited to cultivated crops. Droughtiness, water, erosion, and soil blowing are the major management concerns in cultivated areas. The soils are well suited to pasture and woodland. The droughtiness is the major management concern in pastured areas. Seedling mortality and plant competition are the major concerns in managing woodland.

The major soils are well suited or fairly well suited to building site development and septic tank absorption fields. The inability of the Oshtemo and Kalamazoo soils to adequately filter contaminants from septic tank effluent may result in the pollution of ground water supplies.

5. Spinks-Tekenink-Oshtemo Association

Nearly level to rolling, well drained, sandy and loamy soils formed in sandy and loamy materials and in loamy glacial till

The Oshtemo and Spinks soils in this association commonly are slightly lower on the landscape than the Tekenink soils. In some areas, however, they are in the same landscape positions. Slope ranges from 0 to 12 percent.

This association makes up about 6 percent of the county. It is about 35 percent Spinks soils, 30 percent Tekenink soils, 15 percent Oshtemo soils, and 20 percent soils of minor extent.

The Spinks soils typically have a surface layer of dark brown loamy sand about 10 inches thick. The subsurface layer is yellowish brown loamy sand about 6 inches thick. Below this to a depth of about 60 inches is yellowish brown sand that has thin lamellae of dark brown loamy sand.

The Tekenink soils typically have a surface layer of very dark grayish brown fine sandy loam about 9 inches thick. The subsurface layer is yellowish brown fine sandy loam about 3 inches thick. Below this is mixed pale brown and strong brown fine sandy loam about 18 inches thick. The subsoil is brown fine sandy loam about 29 inches thick. The underlying material to a depth of about 60 inches is yellowish brown fine sandy loam.

The Oshtemo soils typically have a surface layer of dark brown sandy loam about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 6 inches thick. The subsoil is about 40 inches thick. It is, in sequence downward, dark yellowish brown, friable sandy loam; strong brown, friable sandy clay loam; strong brown, friable gravelly sandy loam; and strong brown coarse sand. The underlying material to a depth of about 60 inches is yellowish brown gravelly coarse sand.

Of minor extent in this association are the excessively drained Plainfield soils on the tops of knolls, on ridges, and on the breaks to drainageways. Other minor soils are the somewhat poorly drained Teasdale, Thetford, and Metamora soils on broad flats, on low ridges and knolls, on foot slopes, and along drainageways; the poorly drained Lamson soils in depressions and drainageways; and the very poorly drained Adrian and Houghton soils in drainageways, bogs, and other depressional areas.

This association is used mainly for pasture or cultivated crops. A few areas are used as woodland. The major soils are well suited or fairly well suited to cultivated crops and are well suited to hay and pasture and to woodland. If cultivated crops are grown, droughtiness, water erosion, and soil blowing are the major management concerns. The droughtiness also is a major concern in pastured areas. Seedling mortality is the major concern in managing woodland.

The major soils are well suited to building site development and septic tank absorption fields. The inability of some of the soils to adequately filter contaminants from septic tank effluent may result in the pollution of ground water supplies.

Nearly Level to Gently Rolling, Well Drained to Somewhat Poorly Drained, Loamy and Sandy Soils on Till Plains, Outwash Plains, and Moraines

These soils generally are used for cultivated crops, pasture, or orchards. They are well suited to cultivated crops. The main management needs in cultivated areas are measures that help to control water erosion and soil blowing. Measures that remove excess water during wet periods and maintain good soil tilth also are needed.

These soils are poorly suited or generally unsuited to onsite waste disposal and to building site development. Permeability, the depth to the water table, the shrink-swell potential, and the slope are limitations.

6. Ithaca-Rimer-Perrinton Association

Nearly level to gently rolling, well drained to somewhat poorly drained, loamy and sandy soils formed in loamy, sandy, silty, and clayey deposits

The Perrinton soils in this association generally are on the more sloping, higher parts of the landscape. The Rimer and Ithaca soils are nearly level on ridgetops and footslopes and nearly level and undulating in broad upland areas. Slope ranges from 0 to 12 percent.

This association makes up about 15 percent of the county. It is about 40 percent Ithaca soils, 25 percent Rimer soils, 20 percent Perrinton soils, and 15 percent soils of minor extent.

The Ithaca soils are somewhat poorly drained. Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The next 8 inches is mixed pale brown, firm silt loam and yellowish brown, firm clay loam. The subsoil is yellowish brown, mottled, firm clay loam about 15 inches thick. The underlying material to a depth of about 60 inches is brown, mottled, calcareous, firm clay loam.

The Rimer soils are somewhat poorly drained. Typically, the surface layer is very dark gray loamy fine sand about 9 inches thick. The subsurface layer is brown and dark brown loamy fine sand about 13 inches thick. The subsoil is about 21 inches thick. It is mottled. The upper part is dark yellowish brown, friable sandy loam, and the lower part is dark grayish brown, very firm silty clay. The underlying material to a depth of about 60 inches is grayish brown, very firm, calcareous silty clay.

The Perrinton soils are well drained. Typically, the surface layer is very dark grayish brown loam about 5 inches thick. The subsurface layer is pale brown, friable loam about 3 inches thick. The next 12 inches is mixed pale brown and brown, firm loam and reddish brown, firm clay loam. The subsoil is about 19 inches thick. It is reddish brown and firm. The upper part is clay loam, and the lower part is silty clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, firm silty clay loam.

Of minor extent in this association are the well drained, sandy Tustin soils and the moderately well drained Glynwood soils. Both of these soils are on nose slopes, knolls, and ridges. Other minor soils are the somewhat poorly drained, sandy Wasepi soils on foot slopes, along drainageways, and on broad flats; the poorly drained Belleville and Pewamo soils in depressions and drainageways; and the very poorly drained Houghton and Palms soils in bogs and drainageways.

This association is used mainly for cultivated crops or for pasture. Some areas are used as woodland. The major soils are well suited to cultivated crops and well suited or fairly well suited to pasture and woodland. Removing excess water during wet periods and controlling water erosion are the major concerns in managing cultivated areas. Soil blowing and seasonal droughtiness are additional concerns in managing the sandy soils. The compaction caused by grazing during wet periods and the need for water-tolerant forage species are the main concerns in managing pastured areas. The equipment limitation caused by wetness is the main concern in managing woodland.

Mainly because of the wetness and the shrink-swell potential, the major soils are poorly suited to building site development. They are generally unsuited to septic tank absorption fields, mainly because of the wetness and slow permeability.

7. Marlette-Capac-Metamora Association

Nearly level to gently rolling, well drained to somewhat poorly drained, loamy soils formed in loamy deposits

The Marlette soils in this association are generally on the higher, more sloping parts of the landscape. The Capac and Metamora soils are on the lower parts and in nearly level areas. Slope ranges from 0 to 12 percent.

This association makes up about 6 percent of the county. It is about 35 percent Marlette soils, 30 percent Capac soils, 20 percent Metamora soils, and 15 percent soils of minor extent.

The Marlette soils are well drained or moderately well drained. Typically, the surface layer is dark brown loam about 9 inches thick. Below this is about 10 inches of mixed dark yellowish brown, firm clay loam and light brownish gray loam. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 21 inches thick. The underlying material to a depth of about 60 inches is brown, friable, calcareous loam.

The Capac soils are somewhat poorly drained. Typically, the surface layer is dark grayish brown loam about 10 inches thick. The next 3 inches is mixed pale brown, mottled friable fine sandy loam and dark yellowish brown, mottled loam. The next 14 inches is mixed brown and pale brown, mottled, friable loam. Below this is brown, friable clay loam about 11 inches thick. The underlying material to a depth of about 60 inches is brown, mottled, friable, calcareous loam.

The Metamora soils are somewhat poorly drained. Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsurface layer is grayish brown, mottled, friable loamy sand about 7 inches thick. The subsoil is about 22 inches thick. It is mottled. The upper part is brown, friable sandy loam; the next part is brown, firm clay loam; and the lower part is dark yellowish brown, firm clay loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm, calcareous loam.

Of minor extent in this association are the sandy, well drained Boyer, Metea, and Spinks soils on ridges and knolls. Other minor soils are the somewhat poorly drained, sandy Selfridge soils on broad flats, on low ridges and knolls, on foot slopes, and along drainageways; the poorly drained Colwood and Parkhill soils in depressions and drainageways; and the very poorly drained Houghton and Palms soils in bogs, drainageways, and other depressional areas.

This association is used mainly for cultivated crops or orchards. A few areas are used as woodland or permanent pasture. The major soils are well suited to cultivated crops, pasture, and woodland. If the soils are cultivated, controlling soil blowing and water erosion, removing excess water, and maintaining good soil tilth are the main management concerns. The wetness of the Capac and Metamora soils is the main concern in managing pasture. The equipment limitation caused by the wetness of the Capac and Metamora soils is the main concern in managing woodland.

The major soils are poorly suited to building site development and are poorly suited or unsuited to septic tank absorption fields. The wetness is the main limitation. Also, slow permeability is a limitation on sites for septic tank absorption fields.

Gently Rolling to Very Steep, Excessively Drained to Well Drained, Sandy and Loamy Soils on Moraines, Outwash Plains, and Till Plains

These soils are generally used as woodland, cropland, or pasture. In some areas, however, they are idle land. They are well suited or fairly well suited to woodland. Seedling mortality and slope are the major concerns in managing woodland. In cultivated or pastured areas, slope, droughtiness, and soil blowing are the main management concerns.

The gently rolling and rolling soils are suited to building site development, but the steeper soils are poorly suited. The slopes, a poor filtering capacity, and the moderately slow permeability of some of the soils are the major concerns affecting onsite waste disposal.

8. Marlette-Perrinton-Metea Association

Gently rolling to very steep, well drained, loamy and sandy soils formed in loamy, silty, and sandy deposits

This association is on dissected uplands. The less sloping areas generally are on the tops of knolls and ridges and on the foot slopes and in the drainageways between divides. The steeper areas generally are along the major drainageways and streams. Slope ranges from 6 to 45 percent.

This association makes up about 4 percent of the county. It is about 30 percent Marlette soils, 20 percent Perrinton soils, 15 percent Metea soils, and 35 percent soils of minor extent.

The Marlette soils typically have a surface layer of dark brown loam about 9 inches thick. The next 10 inches is mixed dark yellowish brown, firm clay loam and light brownish gray loam. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 21 inches thick. The underlying material to a depth of about 60 inches is brown, friable, calcareous loam.

The Perrinton soils typically have a surface layer of very dark grayish brown loam about 6 inches thick. The subsurface layer is pale brown, friable loam about 3 inches thick. The next 12 inches is mixed pale brown and brown, firm loam and reddish brown, firm clay loam. The subsoil is about 19 inches thick. It is reddish brown and firm. The upper part is clay loam, and the lower part is silty clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, firm silty clay loam.

The Metea soils typically have a surface layer of dark brown loamy sand about 9 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown, loose sand; the next part is brownish yellow, loose sand; and the lower part is brown, friable clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, friable loam.

Of minor extent in this association are the excessively drained Plainfield and moderately well drained Tuscola soils on the tops of ridges and hills, along drainageways, and on nose slopes. Other minor soils are the somewhat poorly drained Capac, Dixboro, Ithaca, Kibbie, and Selfridge soils on broad flats, along drainageways on foot slopes, and in some nearly level areas on ridgetops and divides; the poorly drained Belleville, Colwood, Parkhill, and Pewamo soils in drainageways and depressions; and the very poorly drained Houghton and Palms soils in drainageways, bogs, and other depressional areas.

The less sloping areas in this association are used as cropland or pasture. The more sloping areas are used as pasture or woodland.

The major soils are well suited or fairly well suited to cultivated crops in areas where the slope is less than 12 percent. The steeper soils are poorly suited or unsuited to cultivated crops. The major concerns in managing cultivated areas are erosion and slope. Droughtiness and soil blowing are additional concerns in managing the sandy soils. The major soils are well suited to woodland. Seedling mortality and, in the steeper areas, the equipment limitation are the main concerns in managing woodland.

These less sloping major soils are fairly well suited to building site development, and the steeper soils are poorly suited. All of the major soils are generally unsuited to septic tank absorption fields because of moderately slow permeability or slope.

9. Marlette-Chelsea-Boyer Association

Gently rolling to very steep, somewhat excessively drained and well drained, loamy and sandy soils formed in loamy and sandy deposits

The Marlette soils in this association are generally at the higher elevations. Areas of the Chelsea and Boyer soils commonly are intricately interspersed. The soils are not so steep on the tops of divides and ridges and along the foot slopes and bottoms of drainageways. They are generally steeper along the major drainageways and streams. Slope ranges from 6 to 45 percent.

This association makes up about 20 percent of the county. It is about 30 percent Marlette soils, 20 percent Chelsea soils, 15 percent Boyer soils, and 35 percent soils of minor extent.

The Marlette soils are well drained. Typically, the surface layer is dark brown loam about 9 inches thick. Below this is about 10 inches of mixed dark yellowish brown, firm clay loam and light brownish gray loam. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 21 inches thick. The underlying material to a depth of about 60 inches is brown, friable, calcareous loam.

The Chelsea soils are somewhat excessively drained. Typically, the surface layer is dark grayish brown loamy fine sand about 9 inches thick. The subsurface layer is yellowish brown, very friable loamy fine sand and fine sand about 23 inches thick. Below this to a depth of about 60 inches is light yellowish brown, loose fine sand that has thin lamellae of strong brown, very friable loamy fine sand.

The Boyer soils are well drained. Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsoil is about 16 inches thick. It is strong brown and friable. The upper part is gravelly loamy sand, the next part is gravelly sandy loam, and the lower part is gravelly sandy clay loam. The underlying material to a depth of about 60 inches is yellowish brown, loose gravelly sand and light yellowish brown gravelly coarse sand.

Of minor extent in this association are the well drained Metea soils, which have loamy underlying material, and the excessively drained Plainfield soils. Both of these soils are on the tops and sides of ridges, on nose slopes, and along drainageways. Other minor soils are the somewhat poorly drained Capac, Dixboro, Kibbie, and Wasepi soils on broad flats, on foot slopes, and along drainageways; the poorly drained Lamson, Parkhill, and Sebewa soils in drainageways and depressions; and the very poorly drained Adrian, Gilford, Houghton, and Palms soils in drainageways, bogs, and other depressional areas.

The less sloping major soils vary widely in their suitability for cultivated crops and pasture. The steeper slopes are poorly suited or unsuited to these uses. If cultivated crops are grown, erosion, slope, and soil blowing are the major management concerns.

The less sloping major soils are well suited to building site development, and the steeper soils are fairly well suited or poorly suited. The Marlette soils are unsuited to septic tank absorption fields because of moderately slow permeability, slope, or both of these limitations. The less sloping Chelsea and Boyer soils are well suited to septic tank absorption fields, but the steeper areas of these soils are poorly suited. The inability of the sandy soils to adequately filter contaminants from septic tank effluent may result in the pollution of ground water.

10. Chelsea-Plainfield-Boyer Association

Gently rolling to very steep, excessively drained to well drained, sandy soils formed in sandy and loamy materials

The less sloping areas of this association generally are in drainageways and along the tops of ridges. The steeper areas generally are along the major drainageways and streams. Slope ranges from 6 to 45 percent.

This association makes up about 16 percent of the county. It is about 30 percent Chelsea soils, 30 percent Plainfield soils, 20 percent Boyer soils, and 20 percent soils of minor extent.

The Chelsea soils are somewhat excessively drained. Typically, the surface layer is dark grayish brown loamy fine sand about 9 inches thick. The subsurface layer is yellowish brown, very friable loamy fine sand and fine sand about 23 inches thick. Below this to a depth of about 60 inches is light yellowish brown, loose fine sand that has thin lamellae of strong brown, very friable loamy fine sand.

The Plainfield soils are excessively drained. Typically, the surface layer is very dark grayish brown sand about 9 inches thick. The subsoil is strong brown, loose sand about 20 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown, loose sand.

The Boyer soils are well drained. Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsoil is about 16 inches thick. It is strong brown and friable. The upper part is gravelly loamy sand, the next part is gravelly sandy loam, and the lower part is gravelly sandy clay loam. The underlying material to a depth of about 60 inches is yellowish brown, loose gravelly sand and light yellowish brown gravelly coarse sand.

Of minor extent in this association are the well drained Metea soils, which have loamy underlying material, and the well drained, loamy Tekenink soils. Both of these soils are on the tops and sides of ridges and hills and on the shoulder slopes and foot slopes along drainageways. Other minor soils are the somewhat poorly drained Dixboro, Tedrow, and Wasepi soils on low, broad flats, on foot slopes along drainageways, and in the drainageways; the poorly drained Lamson and Granby soils in depressions and drainageways; and the very poorly drained Gilford, Adrian, Houghton, and Napoleon soils in drainageways, bogs, and other depressional areas.

This association is used mainly as woodland or is idle land. A few areas are used as pasture or cropland. The major soils generally are poorly suited or unsuited to cultivated crops because of droughtiness, soil blowing, water erosion, and slope. The less sloping Boyer soils, however, are fairly well suited to cultivated crops. Erosion, soil blowing, and droughtiness are the main concerns in managing these soils for crops. The less sloping soils are fairly well suited to pasture, but the steeper soils are unsuited. The major soils are fairly well suited or well suited to woodland. Seedling mortality is the major concern in managing woodland. In areas where the slope is more than 18 percent, the equipment limitation and erosion are additional concerns.

The less sloping major soils are generally well suited to building site development. They are fairly well suited to septic tank absorption fields. Because of a poor filtering capacity, the septic tank effluent may pollute ground water supplies. The more sloping soils are poorly suited to building site development and are generally unsuited to septic tank absorption fields.

Nearly Level to Undulating, Well Drained to Poorly Drained, Loamy and Sandy Soils on Till Plains, Lake Plains, Moraines, Glacial Deltas, and Outwash Plains

These soils are generally used as cropland. In some areas they are used as pasture or woodland. They are well suited to cultivated crops. Wetness, soil blowing, and water erosion are the main concerns in managing cultivated areas.

The more poorly drained soils are poorly suited or unsuited to building site development and onsite waste disposal. The well drained soils are well suited or fairly well suited to these uses. The shrink-swell potential, permeability, and wetness are the major management concerns.

11. Metamora-Teasdale-Tekenink Association

Nearly level and undulating, well drained and somewhat poorly drained, loamy soils formed in loamy and sandy materials

Slope ranges from 0 to 6 percent in this association. The steeper areas are along the major drainageways and streams.

The association makes up about 3 percent of the county. It is about 30 percent Metamora soils, 30 percent Teasdale soils, 20 percent Tekenink soils, and 20 percent soils of minor extent.

The Metamora soils are somewhat poorly drained. Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsurface layer is grayish brown, mottled, friable loamy sand about 7 inches thick. The subsoil is about 22 inches thick. It is mottled. The upper part is brown, friable sandy loam; the next part is brown, firm clay loam; and the lower part is dark yellowish brown, firm clay loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm, calcareous loam.

The Teasdale soils are somewhat poorly drained. Typically, the surface layer is dark brown fine sandy loam about 9 inches thick. The subsurface layer is about 12 inches thick. It is mottled. The upper part is yellowish brown, friable fine sandy loam, and the lower part is light yellowish brown, very friable loamy fine sand. The next 5 inches is mixed strong brown, friable loam and light yellowish brown loamy fine sand. The subsoil is about 30 inches thick. It is mottled and friable. The upper part is strong brown loam, and the lower part is yellowish brown fine sandy loam. The underlying material to a depth of about 60 inches is yellowish brown, friable, calcareous fine sandy loam.

The Tekenink soils are well drained. Typically, the surface layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsurface layer is yellowish brown, very friable fine sandy loam about 3 inches thick. The next 18 inches is mixed pale brown and strong brown, friable fine sandy loam. The subsoil is brown, friable fine sandy loam about 29 inches thick. The underlying material to a depth of more than 60 inches is yellowish brown, calcareous, friable fine sandy loam.

Of minor extent in this association are the sandy, well drained Metea, Oakville, Okee, and Spinks soils on upland knolls and ridges; the moderately wet, sandy Oakville soils in nearly level upland areas; the somewhat poorly drained Capac and Dixboro soils on low knolls, on foot slopes, and along drainageways. Capac soils are less droughty than the major soils, and Dixboro soils are sandy. Other minor soils are the poorly drained, nearly level Belleville, Colwood, and Lamson soils in the lower landscape positions and in drainageways and the very poorly drained Napoleon soils in bogs, drainageways, and other depressional areas.

This association generally is used as cropland or pasture. A few areas are used as woodland. The major soils are well suited to cultivated crops, pasture, and woodland. Controlling soil blowing and removing excess water are the main management concerns in cultivated areas. Grazing pastured areas of the Teasdale and Metamora soils when they are too wet can cause compaction. The equipment limitation caused by the wetness of the Teasdale and Metamora soils is the main concern in managing woodland.

The Metamora and Teasdale soils generally are poorly suited to building site development because of wetness and to onsite waste disposal because of wetness, moderately slow permeability, or both of these limitations. The well drained Tekenink soils, however, are well suited to these uses.

12. Kibbie-Dixboro-Thetford Association

Nearly level and undulating, somewhat poorly drained, loamy and sandy soils formed in loamy, silty, and sandy materials

This association is on broad plains, in swales, and on low ridges and knolls. Slope ranges from 0 to 6 percent.

This association makes up about 2 percent of the county. It is about 30 percent Kibbie soils, 25 percent Dixboro soils, 20 percent Thetford soils, and 25 percent soils of minor extent.

The Kibbie soils typically have a surface layer of very dark grayish brown loam about 8 inches thick. The subsurface layer is grayish brown, friable loam about 4 inches thick. The subsoil is about 22 inches thick. It is brown, mottled, and friable. The upper part is silt loam, and the lower part is silty clay loam. The underlying material to a depth of about 60 inches is brown, mottled, friable, stratified very fine sand to silty clay loam.

The Dixboro soils typically have a surface layer of dark brown loamy fine sand about 9 inches thick. The subsurface layer is brown, mottled, very friable loamy fine sand about 7 inches thick. The subsoil is about 15 inches thick. It is mottled. The upper part is yellowish brown, very friable loamy fine sand, and the lower part is yellowish brown and dark yellowish brown, friable fine sandy loam. The underlying material to a depth of about 60 inches is brown, mottled, calcareous, firm, stratified loamy fine sand to sandy loam.

The Thetford soils typically have a surface layer of very dark grayish brown loamy sand about 9 inches thick. The subsurface layer is yellowish brown and light yellowish brown sand about 13 inches thick. Below this to a depth of more than 60 inches is pale brown, mottled, loose sand that has thin lamellae of dark yellowish brown and brown, mottled, very friable loamy sand.

Of minor extent in this association are the well drained Marlette, Metea, Oshtemo, and Spinks soils on low knolls and ridges in broad upland areas. Other minor soils are the moderately well drained Tuscola soils on knolls and ridges and the poorly drained Cohoctah, Colwood, Parkhill, and Sebewa soils in depressions and drainageways.

Most of this association is used as cropland. A few areas are used as pasture or woodland. The major soils are fairly well suited or well suited to cultivated crops and pasture. The main management needs in cultivated areas are measures that remove excess water, help to control water erosion and soil blowing, and reduce droughtiness. The equipment limitation caused by wetness is the main concern in managing woodland.

The major soils are poorly suited to building site development and generally are unsuited to onsite waste disposal because of wetness and moderately slow permeability.

13. Capac-Parkhill-Marlette Association

Nearly level and undulating, well drained to poorly drained, loamy soils formed in loamy and silty deposits

The Marlette soils in this association are in the highest landscape positions. The Capac soils are on foot slopes and in broad areas on the lower parts of the landscape. The nearly level Parkhill soils are in broad areas on the lowest parts of the landscape and are in drainageways and depressions. Slope ranges from 0 to 6 percent.

The association makes up about 2 percent of the county. It is about 40 percent Capac soils, 25 percent Parkhill soils, 20 percent Marlette soils, and 15 percent soils of minor extent.

The Capac soils are somewhat poorly drained. Typically, the surface layer is dark grayish brown loam about 10 inches thick. The next 3 inches is mixed pale brown, mottled friable fine sandy loam and dark yellowish brown, mottled loam. The next layer is mixed brown and pale brown, mottled, friable loam about 14 inches thick. Below this is brown, friable clay loam about 11 inches thick. The underlying material to a depth of about 60 inches is brown, mottled, friable, calcareous loam.

The Parkhill soils are poorly drained. Typically, the surface layer is very dark gray loam about 8 inches thick. The subsoil is gray, friable silt loam about 5 inches thick. The underlying material to a depth of about 60 inches is multicolored, friable silt loam.

The Marlette soils are well drained or moderately well drained. Typically, the surface layer is dark brown loam about 9 inches thick. The next 10 inches is mixed dark yellowish brown, firm clay loam and light brownish gray loam. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 21 inches thick. The underlying material to a depth of about 60 inches is brown, friable, calcareous loam.

Of minor extent in this association are the somewhat excessively drained Chelsea and well drained Metea soils on the nose slopes of the steeper breaks and on the highest knolls and ridges. Metea soils are sandy. Other minor soils are the somewhat poorly drained, sandy Tedrow, Dixboro, and Selfridge soils on the toe slopes along drainageways; the poorly drained, alluvial Cohoctah soils in drainageways; and the very poorly drained Houghton and Palms soils in bogs, drainageways, and other depressional areas.

This association is used mainly as cropland. A few areas are used as woodland or permanent pasture. The major soils are well suited to cultivated crops, pasture, and woodland. Controlling erosion and removing excess water are the main management concerns in cultivated areas. Overgrazing pastured areas can increase the erosion hazard, and grazing when the soils are wet can cause compaction. The windthrow hazard, the equipment limitation caused by wetness, and seedling mortality are the main concerns in managing woodland.

Because of wetness and the shrink-swell potential, the major soils are poorly suited or unsuited to building site development. They are poorly suited to septic tank absorption fields because of wetness and moderately slow permeability.

Nearly Level, Very Poorly Drained to Somewhat Poorly Drained, Mucky and Loamy Soils in Bogs or on Flood Plains

These soils are used mainly for recreation areas or wildlife habitat. If adequately drained, they are suited to specialty crops and cultivated crops. They are unsuited to building site development and onsite waste disposal. The main management needs in cultivated areas are measures that remove excess water, that help to control flooding and soil blowing, that help to control subsidence after a drainage system is installed, and that overcome the equipment limitation caused by the instability of the organic soils.

14. Houghton-Cohoctah-Ceresco Association

Nearly level, somewhat poorly drained to very poorly drained, mucky and loamy soils formed in herbaceous organic material or loamy alluvial deposits

This association is on flood plains along the major streams and rivers and in basinlike areas. Slope is less than 2 percent.

This association makes up about 5 percent of the county. It is about 30 percent Houghton soils, 25 percent Cohoctah soils, 20 percent Ceresco soils, and 25 percent soils of minor extent.

The Houghton soils are very poorly drained. Typically, the surface layer is black muck about 7 inches thick. Below this to a depth of about 60 inches is very dark brown, dark brown, and very dark grayish brown muck.

The Cohoctah soils are poorly drained. Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The underlying material to a depth of about 60 inches is mottled. It is dark gray sandy loam in the upper part, dark gray loam in the next part, and grayish brown fine sandy loam in the lower part.

The Ceresco soils are somewhat poorly drained. Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsurface layer is dark brown, mottled, friable fine sandy loam about 5 inches thick. The next 6 inches is brown, mottled fine sandy loam. Below this is very dark grayish brown, mottled fine sandy loam about 13 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown, mottled, loose gravelly sand and grayish brown, stratified fine sand, very fine sand, and silt.

Of minor extent in this association are the well drained Boyer, Marlette, Oakville, and Perrinton soils on uplands, terraces, and small islands. Other minor soils are the moderately well drained Abscota, Oakville, and Covert soils on the lower terraces and the very poorly drained, mineral Sloan soils are on the first bottoms of the flood plains and in abandoned channels and meander scars.

This association generally supports a cover of natural vegetation, including trees. It is used mainly for recreation areas or wildlife habitat. Some areas are drained and are used for cultivated crops. Specialty crops, such as lettuce, carrots, onions, and sod, are the most common crops on the organic soils. Many of the cultivated areas of alluvial soils are used for cash crops.

Unless adequately drained, the major soils are unsuited or poorly suited to cultivated crops. If adequately drained, they are fairly well suited or well suited to cultivated crops and to pasture. They are well suited or fairly well suited to woodland. The main management needs in cultivated areas are measures that remove excess water, provide adequate drainage outlets, help to control flooding and soil blowing, help to control subsidence after a drainage system is installed, and help to overcome the equipment limitation. Measures that control flooding and prevent the compaction caused by grazing when the soils are too wet are needed in pastured areas. The equipment limitation, seedling mortality, and the windthrow hazard are the main concerns in managing woodland.

The major soils are unsuited to building site development and onsite waste disposal because of the wetness, the flooding, and the instability of the organic soils.

Broad Land Use Considerations

Each year, a considerable acreage in the county is developed for residential, commercial, and industrial uses. Deciding what land should be used for urban development is a very important issue. The general soil map is suitable for broad land use planning, but it is not suitable for selecting a site for a specific use.

Areas where the soils are severely limited as sites for residential and other urban uses are extensive. Urban development is severely limited by a seasonal high water table and moderately slow permeability in large parts of the Ithaca-Rimer-Perrinton, Marlette-Capac-Metamora, Kibbie-Dixboro-Thetford, and Capac-Parkhill-Marlette associations; by flooding, ponding, and the instability of organic soils in the Houghton-Cohoctah-Ceresco association; by a seasonal high water table in some parts of the Oakville-Thetford-Granby, Chelsea-Thetford-Selfridge, and Metamora-Teasdale-Tekenink associations; and by the slope in parts of the Marlette-Perrinton-Metea, Marlette-Chelsea-Boyer, and Chelsea-Plainfield-Boyer associations.

Some soils in the county can be developed for urban uses. These include the less sloping, well drained soils in the Oakville-Thetford-Granby, Plainfield-Oshtemo-Spinks, Kalamazoo-Oshtemo-Spinks, Spinks-Tekenink-Oshtemo, and Metamora-Teasdale-Tekenink associations.

The Spinks-Tekenink-Oshtemo, Ithaca-Rimer-Perrinton, Marlette-Capac-Metamora, Metamora-Teasdale-Tekenink, Kibbie-Dixboro-Thetford, and Capac-Parkhill-Marlette associations are better suited to farming than the other associations. Their suitability should be considered when broad land use decisions are made. A considerable acreage of these associations already is being used for building sites, golf courses, and other nonfarm uses.

Some of the soils in the county are well suited to farming but are poorly suited to nonfarm uses. The soils on the Capac-Parkhill-Marlette association are examples. The wetness of the Capac and Parkhill soils limits farm uses, but it can be overcome by installing a drainage system and by shaping the surface. It cannot be overcome so easily on sites for nonfarm uses.

Most of the soils in the county are well suited or fairly well suited to woodland. Many are well suited to parks and other recreational areas. Undrained areas of Houghton and other poorly drained or very poorly drained soils, which provide habitat for many species of wildlife, are good nature study areas.

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 underlying material, 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 underlying material. 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, Marlette loam, 2 to 6 percent slopes, is one of several phases in the Marlette series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Owosso-Marlette sandy loams, 2 to 6 percent slopes, is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Dumps 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.

Some of the boundaries on the detailed soil maps of Kent County do not match those on the maps of adjacent counties, and some of the soil names and descriptions do not fully agree. Differences result from improvements in the classification of soils, particularly modifications or refinements in soil series concepts. Also, some differences result from variations in the intensity of mapping or in the extent of the soils within the counties.

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

2B—Oakville fine sand, moderately wet, 0 to 4 percent slopes. This nearly level and undulating, moderately well drained soil is on terraces and concave foot slopes. Individual areas are broad and elongated or are irregular in shape. They range from 2 to 250 acres in size.

Typically, the surface layer is dark brown, very friable fine sand about 8 inches thick. The subsoil is fine sand about 27 inches thick. The upper part is strong brown and very friable, and the lower part is yellowish brown, mottled, and loose. The underlying material to a depth of about 60 inches is light yellowish brown, mottled, loose fine sand. In a few areas the subsoil has brittle, dark reddish brown chunks. In some areas it has thin bands of loamy sand. In other areas it is not mottled in the lower part.

Included with this soil in mapping are small areas of the somewhat poorly drained Selfridge and Thetford soils in narrow drainageways and small depressions. Selfridge soils have loamy material below a depth of 20 inches and are less droughty than the Oakville soil. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Oakville soil, and available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 3 to 6 feet late in fall, in spring, and during other excessively wet periods.

Most of the acreage of this soil is idle land or woodland (fig. 7). Some areas are used as cropland. A few are used for building site development.

This soil is poorly suited to such crops as corn, but winter wheat, oats, and hay can be grown. The major management concerns are droughtiness and soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, covers crops, green manure crops, and regular additions of organic material increase the available water capacity and reduce the susceptibility to soil blowing. Growing small grain crops that are planted in the fall or early in spring makes good use of the available soil moisture. Irrigating when soil moisture levels are low can increase productivity.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

This soil is well suited to woodland. The equipment limitation and seedling mortality are the major management concerns. The sandy surface layer can affect equipment trafficability during dry periods. Seedling mortality can be as much as 50 percent in dry years. It can be controlled by special harvest methods that leave some mature trees to provide shade and protection from the wind. Planting stock that is containerized or is larger than usual, special site preparation, or reinforcement planting may be needed.

Because of the wetness, this soil is only fairly well suited to building site development. Buildings with basements can be constructed on well compacted fill material, which raises the site. Artificial drainage lowers the water table. Because of the wetness and a poor filtering capacity, the soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies. Special construction methods, such as filling or mounding with suitable soil material, may be needed to raise the site above the water table and to increase the filtering capacity.

The land capability classification is IVs. The Michigan soil management group is 5.3a.

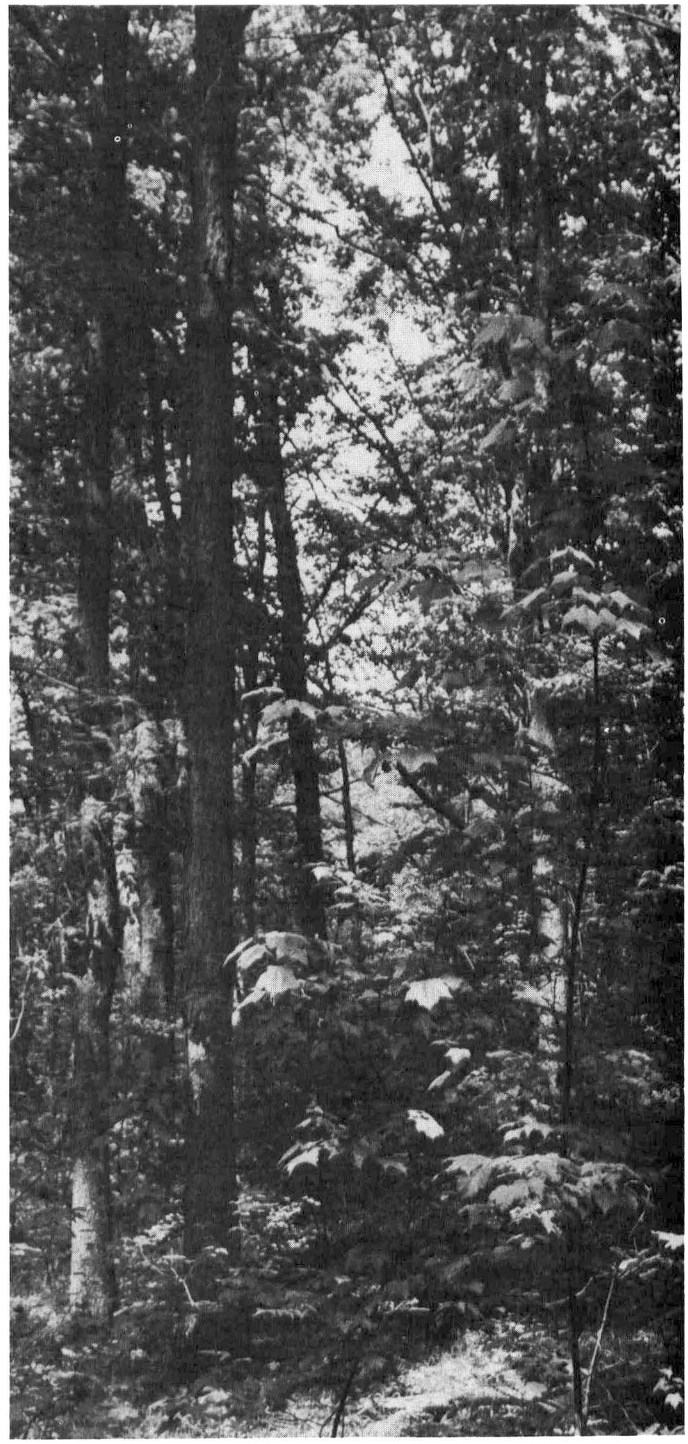

Figure 7.—A stand of oak and aspen on Oakville fine sand, moderately wet, 0 to 4 percent slopes.

3B—Covert sand, 0 to 4 percent slopes. This nearly level and undulating, moderately well drained soil is on broad plains and the slightly convex parts of low knolls. Individual areas are irregular in shape and range from 2 to 75 acres in size.

Typically, about 2 inches of black, decomposed leaf litter is on the surface. The surface layer is brown, loose sand about 6 inches thick. The subsoil is loose sand about 19 inches thick. The upper part is dark reddish brown and has dark reddish brown chunks, and the lower part is strong brown and mottled. The underlying material to a depth of about 60 inches is brownish yellow, mottled, loose sand. In some areas the subsoil is not so red and does not have dark reddish brown chunks.

Included with this soil in mapping are small areas of the Granby, Grattan, and Pipestone soils. Granby soils are poorly drained and are in drainageways and low areas. Grattan soils are excessively drained and are on the tops of ridges and slight rises. Pipestone soils are somewhat poorly drained and are in slight depressions and along the sides of drainageways. Included soils make up 2 to 10 percent of the unit.

Permeability is rapid in the Covert soil, and available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 2.0 to 3.5 feet late in fall, in spring, and during other excessively wet periods.

Most areas of this soil are used as woodland. Some areas are used as pasture or cropland. A few areas are used for building site development.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are droughtiness and soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material increase the available water capacity and reduce the susceptibility to soil blowing. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing. Growing small grain crops that are planted in the fall or early in spring makes good use of the available soil moisture. Irrigating when soil moisture levels are low can increase productivity.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

This soil is well suited to woodland. Seedling mortality is the major management concern. It can be controlled by special harvest methods that leave some mature trees to provide shade and protection from the wind. Planting stock that is containerized or is larger than usual, special site preparation, such as furrowing and applying herbicide, and reinforcement planting may be necessary.

Because of the wetness, this soil is poorly suited to building site development. Buildings with basements can be constructed on well compacted fill material, which raises the site. Artificial drainage lowers the water table. Because of the wetness and a poor filtering capacity, the soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies. Special construction methods, such as filling or mounding with suitable soil material, may be needed to raise the site above the water table and to increase the filtering capacity.

The land capability classification is IVs. The Michigan soil management group is 5a.

4B—Perrin gravelly loamy sand, 0 to 4 percent slopes. This nearly level and gently sloping, moderately well drained soil is on broad flats and the concave sides of low knolls and ridges. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable gravelly loamy sand about 9 inches thick. The subsoil is about 29 inches thick. The upper part is brown, very friable gravelly loamy sand; the next part is strong brown, friable gravelly sandy loam; and the lower part is dark brown, mottled, friable gravelly sandy loam. The underlying material to a depth of about 60 inches is mottled, loose gravelly sand. It is light yellowish brown in the upper part and grayish brown and calcareous in the lower part. In some areas on the top of small knolls, the soil is better drained and is not mottled in the subsoil. In a few small areas, it does not have the loamy subsoil. In a few small areas along the Coldwater River, it is underlain by silty, less permeable material at a depth of about 40 inches.

Included with this soil in mapping are small areas of Wasepi and Gilford soils. Wasepi soils are somewhat poorly drained and are on lower parts of side slopes and in drainageways. Gilford soils are very poorly drained and are in low spots. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Perrin soil and very rapid in the lower part. Available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 2.0 to 3.5 feet during excessively wet periods.

Most areas of this soil are pastured or are used as building sites. Some of the acreage is cropland, woodland, or idle land. Small gravel pits are in some areas.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Droughtiness and soil blowing are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, helps to control soil blowing and conserves moisture. Also, cover crops, green manure crops, and regular additions of organic material increase the available water capacity and help to control soil blowing. Irrigating when moisture levels are low can increase productivity.

This soil is well suited to pasture. A cover of pasture plants or hay is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. Seedling mortality is the major management concern. It can be controlled by special harvest methods that leave some mature trees to provide shade and protection from the wind. Planting stock that is larger than usual or is containerized, special site preparation, such as furrowing and applying herbicide, and reinforcement planting may be necessary.

Because of the wetness, this soil is only fairly well suited to building site development. Buildings with basements can be constructed on well compacted fill material, which raises the site. Artificial drainage lowers the water table. Because of the wetness and a poor filtering capacity, the soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies. Special construction methods, such as filling or mounding with suitable soil material, may be needed to raise the site above the water table and to increase the filtering capacity.

The land capability classification is IIIs. The Michigan soil management group is 4a.

5—Algansee loamy fine sand. This nearly level, somewhat poorly drained soil is on the first bottoms of the flood plains along small streams and creeks and on benches and terraces above the first bottoms of the flood plains along the major streams and rivers. It is occasionally flooded. Individual areas are broad or narrow and elongated. They range from 2 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 8 inches thick. The underlying material to a depth of about 60 inches is multicolored, mottled, and stratified. The upper part is fine sand and loamy fine sand, the next part is very fine sandy loam, and the lower part is fine sand. In some areas the surface layer is loam or silt loam. In other areas gravelly sand and gravel are in the underlying material.

Included with this soil in mapping are small areas of the poorly drained Cohoctah and Glendora soils in slight depressions and abandoned drainageways. These soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Algansee soil, and available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet during excessively wet periods.

Most of the acreage of this soil is idle land or woodland. A few areas are used as pasture or cropland.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. Wetness, flooding, soil blowing, and droughtiness are the major management concerns. A subsurface drainage system and surface drains are effective in removing excess water. Draining some areas is difficult because drainage outlets are not readily available. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, helps to control soil blowing and increases the available water capacity. Cover crops, green manure crops, and regular additions of organic material also help to control soil blowing and increase the available water capacity. Irrigating when soil moisture levels are low can increase productivity.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. A good surface drainage system lowers the water table and removes floodwater. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. The forage species that can tolerate the wetness should be selected for planting.

This soil is fairly well suited to woodland. The major management concern is the equipment limitation. The seasonal high water table can affect equipment trafficability. The trees should be harvested only during dry periods or during periods when the ground is frozen.

Because of the wetness and the flooding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is IIIw. The Michigan soil management group is L-4c.

6—Glendora loamy sand. This nearly level, poorly drained soil is on the first bottoms of flood plains. It is dominantly on the narrow flood plains, but it also is in shallow abandoned drainageways and meander scars along the major rivers. It is frequently flooded. Individual areas are narrow or broad and elongated. They range from 5 to 530 acres in size.

Typically, the surface layer is very dark brown, very friable loamy sand about 7 inches thick. The underlying material to a depth of about 60 inches is grayish brown, light brownish gray, and pale brown, mottled, stratified fine sand, sand, and gravelly sand. In some areas the soil is dominantly loamy rather than sandy. In other areas the surface layer is muck less than 16 inches thick.

Included with this soil in mapping are small areas of the somewhat poorly drained Algansee and Ceresco soils on the slightly higher knolls and natural levees. Also included are small areas of the moderately well drained Abscota and Landes soils on the higher benches, terraces, and natural levees. Ceresco and Landes soils are loamy. Included soils make up as much as 15 percent of the unit.

Permeability is rapid in the Glendora soil, and available water capacity is low. Surface runoff is very slow. The seasonal high water table is near the surface during excessively wet periods.

Most of the acreage is idle land covered by brush or is woodland. A few areas are used as cropland. Because of the flooding and the wetness, this soil generally is unsuited to pasture and cultivated crops. Draining the soil is difficult because the water table is often near the water level in the adjacent streams.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. The use of motorized equipment should be limited to periods when the soil is relatively dry or frozen. Because of droughtiness, the loss of planted or natural tree seedlings can be in excess of 50 percent. Harvest methods that do not isolate the remaining trees or leave them widely spaced help to prevent windthrow. Windthrown trees should be periodically removed.

Because of the wetness and the flooding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is VIw. The Michigan soil management group is L-4c.

7—Cohoctah loam. This nearly level, poorly drained soil is on the first bottoms of the flood plains along streams and rivers and in depressions, shallow abandoned drainageways, and meander scars. It is frequently flooded. Individual areas are narrow or broad and elongated. They range from 2 to 250 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 10 inches thick. The underlying material to a depth of about 60 inches is mottled. It is dark gray sandy loam in the upper part, dark gray loam in the next part, and grayish brown fine sandy loam in the lower part. In some areas the underlying material has more clay. In other areas the surface layer is calcareous. In places it is muck less than 16 inches thick.

Included with this soil in mapping are small areas of the somewhat poorly drained Algansee, Ceresco, and Shoals soils on the slightly higher knolls and ridges. Also included are small areas of the moderately well drained Abscota and Landes soils on the higher parts of bottom land and on levees. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Cohoctah soil, and available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near the surface during excessively wet periods.

Most of the acreage is idle land covered by brush or is woodland. A few areas are used as cropland. Because of the frequent flooding, the wetness, and tilth, this soil is unsuited to cultivated crops. Draining the soil is difficult because the water table is often near the water level in the adjacent streams.

This soil is poorly suited to pasture. In areas where one can be installed, a surface drainage system reduces the wetness. The pasture plants that can tolerate the wetness should be selected for planting. Operating equipment during excessively wet periods alters soil structure and can result in compaction. Proper stocking rates, pasture rotation, and restricted use during wet periods are needed.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the main management concerns. The use of equipment should be limited to periods when the soil is relatively dry or frozen. Because of the wetness and the flooding, the loss of planted or natural tree seedlings can be in excess of 50 percent. Harvest methods that do not isolate the remaining trees or leave them widely spaced help to prevent windthrow. Windthrown trees should be periodically removed.

Because of the wetness and the flooding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is Vw. The Michigan soil management group is L-2c.

9B—Rimer loamy fine sand, 0 to 4 percent slopes. This nearly level and undulating, somewhat poorly drained soil is on concave and uneven slopes on low knolls and ridges. Individual areas are irregular in shape and range from 2 to 80 acres in size.

Typically, the surface layer is very dark gray, friable loamy fine sand about 9 inches thick. The subsurface layer is brown and dark brown loamy fine sand about 13 inches thick. The subsoil is about 21 inches thick. It is mottled. The upper part is dark yellowish brown, friable sandy loam, and the lower part is dark grayish brown, very firm silty clay. The underlying material to a depth of about 60 inches is grayish brown, very firm, calcareous silty clay. In some areas the sandy upper part of the soil is less than 20 inches thick, and in other areas it is more than 40 inches thick. In some places iron, aluminum, and organic matter have accumulated in the upper part of the subsoil. In other places the upper part of the profile is sandy loam.

Included with this soil in mapping are small areas of the poorly drained Belleville and Pewamo soils in drainageways and depressions. Also included are Blount and Tedrow soils in landscape positions similar to those of the Rimer soil. Blount soils are less droughty and Tedrow soils more droughty than the Rimer soil. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the upper part of the Rimer soil and very slow in the lower part. Available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 1.0 to 2.5 feet in winter, in spring, and during other excessively wet periods.

Most areas of this soil are used as pasture or cropland. Some of the acreage is woodland or idle land.

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion, wetness, and soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, helps to control water erosion and soil blowing and increases the amount of water available for plant growth. Wind stripcropping, buffer strips, vegetative barriers, field windbreaks, cover crops, and green manure crops also help to control soil blowing. If drainage outlets are available, a subsurface drainage system is effective in reducing the wetness. Suitable filtering material may be needed around the tile to keep fine sand and silt from flowing into the tile lines.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. The pasture plants that can tolerate the wetness should be selected for planting. Proper stocking rates, pasture rotation, and restricted grazing during wet periods and prolonged dry periods help to keep the pasture in good condition.

This soil is fairly well suited to woodland. The major management concern is the equipment limitation. Heavy equipment tends to form ruts when the soil is wet. The equipment should be used only when the soil is relatively dry or frozen.

Because of the high water table and a high shrink-swell potential in the lower layers, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the high water table and the very slow permeability in the clayey lower part. Buildings can be constructed on suitable well compacted fill material, which raises the site. Subsurface drains lower the water table. If the foundation reaches to the lower clayey material, widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. All sanitary systems should be connected to municipal sewerage systems.

The land capability classification is IIe. The Michigan soil management group is 4/Ib.

10—Landes loam. This nearly level, moderately well drained soil is in the higher areas on flood plains. It is occasionally flooded. Individual areas are narrow or broad and elongated. They range from 5 to 75 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. The subsurface layer also is very dark grayish brown, friable loam. It is about 6 inches thick. The subsoil is about 17 inches thick. The upper part is dark brown friable loam, and the lower part is dark yellowish brown, loose sand. The underlying material to a depth of about 60 inches is yellowish brown, loose gravelly sand and sand. In some areas it is loamy.

Included with this soil in mapping are small areas of the somewhat poorly drained Ceresco and poorly drained Cohoctah soils in meander scars. These soils make up about 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Landes soil and rapid in the lower part. Available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 4 to 6 feet during the spring.

Most areas of this soil are used as cropland or pasture. Some support native vegetation.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The wetness and the flooding are the major management concerns. A surface and subsurface drainage system is effective in removing excess water. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, can increase the organic matter content and the available water capacity. Cover crops, green manure crops, and regular additions of organic material increase the available water capacity and reduce the susceptibility to soil blowing.

This soil is well suited to pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the flooding and the wetness, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is IIIw. The Michigan soil management group is L-2a.

11B—Owosso-Marlette sandy loams, 2 to 6 percent slopes. These gently sloping or undulating, well drained soils are on the tops, side slopes, and foot slopes of knolls and ridges. The Owosso soil is on the lower side slopes and foot slopes, and the Marlette soil is on the tops and upper side slopes of the knolls and ridges. Individual areas are irregular in shape and range from 3 to 120 acres in size. They are 50 to 60 percent Owosso soil and 35 to 45 percent Marlette soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical at the scale used.

Typically, the Owosso soil has a surface layer of dark brown, friable sandy loam about 10 inches thick. The subsurface layer is yellowish brown sandy loam about 12 inches thick. Below this is about 14 inches of mixed strong brown, firm clay loam and pale brown sandy loam. The subsoil is brown, firm clay loam about 6 inches thick. The underlying material to a depth of about 60 inches is brown, very firm, calcareous clay loam.

Typically, the Marlette soil has a surface layer of dark grayish brown, friable sandy loam about 8 inches thick. Below this is about 10 inches of mixed yellowish brown, friable sandy loam and brown, firm clay loam. The subsoil is brown, firm clay loam about 20 inches thick. The underlying material to a depth of about 60 inches is brown, firm, calcareous silty clay loam.

Included with these soils in mapping are small areas of Metamora, Metea, Oshtemo, and Spinks soils. The somewhat poorly drained, nearly level Metamora soils are in drainageways and low areas. Metea, Oshtemo, and Spinks soils are in landscape positions similar to those of the Owosso soil. They are more droughty than the Owosso and Marlette soils. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Owosso soil and moderately slow in the lower part. It is moderately slow in the Marlette soil. Available water capacity is high in both soils. Surface runoff is slow on the Owosso soil and medium on the Marlette soil.

Most areas of these soils are used for cultivated crops, orchards, or pasture. Some are used for woodland or building site development.

These soils are well suited to such crops as corn, oats, winter wheat, and hay. Specialty crops, such as strawberries, also grow well. Water erosion, soil blowing, and tilth are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to prevent excessive soil loss and maintain good tilth and the organic matter content. Tilling when the soil is excessively wet can alter soil structure and can result in compaction and the formation of clods.

These soils are well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates and pasture rotation help to keep the pasture in good condition.

These soils are well suited to woodland. No major management concerns affect planting or harvesting.

These soils are well suited to building site development. They are poorly suited to septic tank absorption fields because of the moderately slow permeability. Special construction methods, such as enlarging the absorption fields or installing alternating drain fields, help to overcome this limitation.

The land capability classification is IIe. The Michigan soil management groups are 3/2a and 2.5a.

11C—Owosso-Marlette sandy loams, 6 to 12 percent slopes. These moderately sloping or gently rolling, well drained soils are on the tops, side slopes, and foot slopes of knolls and ridges. The Owosso soil is on the lower side slopes and foot slopes, and the Marlette soil is on the tops and upper side slopes of the knolls and ridges. Individual areas are irregular in shape and range from 3 to 120 acres in size. They are 50 to 60 percent Owosso soil and 35 to 45 percent Marlette soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical at the scale used.

Typically, the Owosso soil has a surface layer of dark brown, friable sandy loam about 8 inches thick. The subsurface layer is yellowish brown sandy loam about 10 inches thick. Below this is about 12 inches of mixed yellowish brown, friable sandy loam and strong brown, firm sandy clay loam. The subsoil is brown, firm clay loam about 6 inches thick. The underlying material to a depth of about 60 inches is brown, very firm, calcareous clay loam.

Typically, the Marlette soil has a surface layer of dark grayish brown, friable sandy loam about 6 inches thick. Below this is about 8 inches of mixed yellowish brown, friable sandy loam and brown, firm clay loam. The subsoil is brown, firm clay loam about 20 inches thick. The underlying material to a depth of about 60 inches is brown, firm, calcareous silty clay loam.

Included with these soils in mapping are small areas of Metamora, Metea, Oshtemo, and Spinks soils. The somewhat poorly drained, nearly level Metamora soils are in drainageways and low areas. Metea, Oshtemo, and Spinks soils are in landscape positions similar to those of the Owosso soil. They are more droughty than the Owosso and Marlette soils. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Owosso soil and moderately slow in the lower part. It is moderately slow in the Marlette soil. Available water capacity is high in both soils. Surface runoff is slow on the Owosso soil and medium on the Marlette soil.

Most areas of these soils are used for cultivated crops, orchards, or pasture. Some areas are used for woodland or building site development.

These soils are fairly well suited to such crops as corn, oats, winter wheat, and hay. Water erosion, soil blowing, and tilth are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to prevent excessive soil loss and maintain good tilth and the organic matter content. Tilling when the soil is excessively wet can alter soil structure and can result in compaction and the formation of clods.

These soils are well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates and pasture rotation help to keep the pasture in good condition.

These soils are well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope, these soils are only fairly well suited to building site development. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. The soils are poorly suited to septic tank absorption fields because of the slope and the moderately slow permeability. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly. Special construction methods, such as enlarging the absorption fields or installing alternating drain fields, may be needed because of the moderately slow permeability.

The land capability classification is IIIe. The Michigan soil management groups are 3/2a and 2.5a.

12B—Tustin loamy fine sand, 2 to 6 percent slopes. This undulating, well drained soil is on the tops and uneven side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 85 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 8 inches thick. The subsoil is about 35 inches thick. The upper part is yellowish brown, very friable loamy fine sand; the next part is strong brown, firm clay loam; and the lower part is brown, very firm silty clay loam. The underlying material to a depth of about 60 inches is brown, firm, calcareous silty clay loam. In some areas the sandy upper part of the soil is less than 20 inches thick. In a few areas the subsoil is mottled. In places the upper part of the soil is sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount, Ithaca, and Rimer soils and small areas of the moderately well drained Glynwood soils. Also included are small areas of Perrinton and Spinks soils. Blount, Ithaca, and Rimer soils are in the lower landscape positions and in drainageways. Glynwood and Perrinton soils are in the higher landscape positions. They are less droughty than the Tustin soil. Spinks soils are more droughty than the Tustin soil. Also, they are slightly higher on the landscape or are in similar landscape positions. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the upper part of the Tustin soil and slow in the lower part. Available water capacity is moderate. Surface runoff is slow.

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

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion and soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of other material help to control soil blowing and water erosion and increase the available water capacity. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing.

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

This soil is fairly well suited to woodland. Seedling mortality is the main management concern. It can be controlled by special harvest methods that leave some mature trees to provide shade and protection from the wind. Planting stock that is larger than usual or is containerized, special site preparation, such as furrowing and applying herbicide, and reinforcement planting may be needed.

Because of the shrink-swell potential, this soil is only fairly well suited to buildings with basements. Widening the foundation trenches and then backfilling with suitable coarse material to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. The soil is generally unsuited to septic tank absorption fields because of the slow permeability. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIIe. The Michigan soil management group is 4/1a.

12C—Tustin loamy fine sand, 6 to 12 percent slopes. This gently rolling, well drained soil is on the uneven side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 30 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 8 inches thick. The subsoil is about 35 inches thick. The upper part is yellowish brown, very friable loamy fine sand; the next part is strong brown, firm clay loam; and the lower part is brown, very firm silty clay loam. The underlying material to a depth of about 60 inches is calcareous, brown, firm silty clay loam. In places the sandy upper part of the soil is less than 20 inches thick. In a few areas the subsoil is mottled. In some areas the upper part of the soil is sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount, Ithaca, and Rimer soils and small areas of the moderately well drained Glynwood soils. Also included are small areas of Perrinton and Spinks soils. Blount, Ithaca, and Rimer soils are in the lower landscape positions and in drainageways. Blount and Ithaca soils are not sandy in the upper part. Glynwood and Perrinton soils are in the higher landscape positions. They are not so droughty as the Tustin soil. Spinks soils are more droughty than the Tustin soil. Also, they are slightly higher on the landscape or are in similar landscape positions. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the upper part of the Tustin soil and slow in the lower part. Available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are pastured. Some areas are used as cropland or woodland.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are water erosion and soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material help to control water erosion and soil blowing and increase the available water capacity. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing.

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

This soil is fairly well suited to woodland. Seedling mortality is the main management concern. It can be controlled by special harvest methods that leave some mature trees to provide shade and protection from the wind. Planting stock that is larger than usual or is containerized, special site preparation, such as furrowing and applying herbicide, and reinforcement planting may be needed.

Because of the shrink-swell potential and the slope, this soil is poorly suited to buildings with basements. Widening the foundation trenches and then backfilling with suitable material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. The buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas. The soil is generally unsuited to septic tank absorption fields because of the slow permeability. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IVe. The Michigan soil management group is 4/1a.

13A—Metamora sandy loam, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is in broad areas on slight rises and concave side slopes along drainageways. Individual areas are irregular in shape and range from 2 to 80 acres in size.

Typically, the surface layer is very dark grayish brown, friable sandy loam about 9 inches thick. The subsurface layer is grayish brown, mottled, friable loamy sand about 7 inches thick. The subsoil is about 22 inches thick. It is mottled. The upper part is brown, friable sandy loam, the next part is brown, firm clay loam, and the lower part is dark yellowish brown, firm clay loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm, calcareous loam. In some areas the depth to the underlying material is more than 40 inches. In other areas the upper part of the subsoil has no gray mottles.

Included with this soil in mapping are small areas of Owosso and Parkhill soils. Owosso soils are well drained and are in the higher or more sloping areas. Parkhill soils are poorly drained and are in drainageways and low spots. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Metamora soil and moderately slow in the lower part. Available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet in winter, in spring, and during other excessively wet periods.

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

This soil is well suited to such crops as corn, oats, winter wheat, and hay. Wetness and soil blowing are the major management concerns. If drainage outlets are available, a subsurface drainage system is effective in reducing the wetness. Suitable filtering material may be needed around the tile to keep silt from flowing into the tile lines. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control soil blowing and improve tilth.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. The species that can tolerate the wetness should be selected for planting. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to woodland. The major management concern is the equipment limitation. Heavy equipment tends to form ruts when the soil is wet. The equipment should be used only when the soil is relatively dry or frozen.

Because of the wetness, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness and the moderately slow permeability. Buildings can be constructed on well compacted fill material, which raises the site. A surface or subsurface drainage system removes excess water. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIw. The Michigan soil management group is 3/2b.

14—Shoals loam. This nearly level, somewhat poorly drained soil is on broad flats on flood plains. It is occasionally flooded. Individual areas are irregularly shaped or elongated and range from 2 to 70 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The underlying material to a depth of about 60 inches is mottled, friable loam. It is brown in the upper part, grayish brown in the next part, and light brownish gray in the lower part. In some areas the surface layer is calcareous. In other areas the subsoil contains less clay.

Included with this soil in mapping are small areas of the moderately well drained Abscota and Landes soils. These soils are on the higher knolls and ridges. They are more droughty than the Shoals soil. Also included are small areas of the poorly drained Cohoctah and very poorly drained Sloan soils in shallow depressions, meander scars, and elongated swales. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Shoals soil, and available water capacity is high. Surface runoff is very slow. The seasonal high water table is at a depth of 0.5

foot to 1.5 feet in winter, in spring, and during other excessively wet periods.

Most of the acreage of this soil is woodland or idle land. Some areas are used as cropland.

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are flooding, wetness, and tilth. A surface drainage system enables crops to be planted after floodwater recedes. If drainage outlets are available, a subsurface drainage system is effective in reducing the wetness. Suitable filtering material may be needed around the tile to keep fine sand and silt from flowing into the tile lines. Tilling when the soil is excessively wet can alter soil structure and can result in compaction and the formation of clods. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the soil surface, cover crops, and green manure crops improve tilth.

This soil is well suited to pasture. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition. If possible, a surface drainage system should be installed to reduce the wetness. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is well suited to woodland. The major management concern is the equipment limitation. Heavy equipment tends to form ruts when the soil is wet. The equipment should be used only when the soil is relatively dry or frozen.

Because of the wetness and the flooding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is IIw. The Michigan soil management group is L-2c.

15—Sloan loam. This nearly level, very poorly drained soil is in narrow or broad, elongated areas and meander scars on flood plains. It is frequently flooded. Individual areas range from 2 to 160 acres in size.

Typically, the surface layer is very dark gray, friable loam about 10 inches thick. The subsurface layer is very dark grayish brown, mottled loam about 6 inches thick. The underlying material to a depth of about 60 inches is gray, mottled, firm, stratified loam and silty clay loam. In some places the surface layer is calcareous. In other places the subsoil has less clay. In some areas the surface layer is muck less than 16 inches thick.

Included with this soil in mapping are small areas of the somewhat poorly drained Algansee, Ceresco, and Shoals soils on the slightly higher ridges and knolls. Also included are small areas of the moderately well drained Abscota and Landes soils on some of the higher rises and on narrow levees. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate or moderately slow in the Sloan soil, and available water capacity is high. Surface runoff is very slow. The seasonal high water table is near or above the surface during excessively wet periods.

Most of the acreage of this soil is idle land covered by brush or is woodland. Some areas are used as cropland.

Because of the frequent flooding, this soil is generally unsuited to cultivated crops. It is poorly suited to pasture. A surface drainage system can reduce the wetness in some areas. Proper stocking rates, pasture rotation, and restricted use during wet periods are needed. The forage species that can tolerate the wetness should be selected for planting. Using equipment when the soil is excessively wet alters soil structure and can result in compaction.

This soil is well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the main management concerns. Equipment should be used only when the soil is relatively dry or frozen. Because of the wetness and the flooding, the loss of planted or natural tree seedlings can be in excess of 50 percent. Special harvest methods and site preparation may be needed to control plant competition. Harvest methods that do not isolate the remaining trees or leave them widely spaced help to prevent windthrow. Windthrown trees should be periodically removed.

Because of the wetness and the flooding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is Vw. The Michigan soil management group is L-2c.

16—Ceresco loam. This nearly level, somewhat poorly drained soil is on flood plains. It is slightly above the first bottoms of large flood plains or on the first bottoms along the smaller streams. It is occasionally flooded. Individual areas are narrow or broad and elongated. They range from 2 to 160 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 10 inches thick. The subsurface layer is dark brown, mottled, friable fine sandy loam about 5 inches thick. Below this is brown, mottled fine sandy loam about 6 inches thick. The next 13 inches is very dark grayish brown, mottled fine sandy loam. The underlying material to a depth of about 60 inches is dark grayish brown, mottled, loose gravelly sand and grayish brown, stratified fine sand, very fine sand, and silt. In some areas the subsoil has more clay. In other areas the soil is sandy throughout. In places the surface layer is calcareous.

Included with this soil in mapping are small areas of the poorly drained Cohoctah and very poorly drained Sloan soils in the slightly lower landscape positions and in meander scars. Also included are small areas of the moderately well drained Abscota and Landes soils in the slightly higher landscape positions and on natural levees. Abscota soils are more droughty than the Ceresco soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid or moderate in the Ceresco soil, and available water capacity is moderate. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 2 feet during excessively wet periods.

Most of the acreage of this soil is woodland or idle land. Some areas are used as cropland or as pasture.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are flooding, wetness, and tilth. A surface drainage system enables crops to be planted after floodwater recedes. If drainage outlets are available, a subsurface drainage system is effective in reducing the wetness. Suitable filtering material is needed around the tile to keep fine sand and silt from flowing into the tile lines. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops improve tilth.

This soil is well suited to pasture. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition. If possible, a surface drainage system should be installed to reduce the wetness. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is well suited to woodland. The major management concern is the equipment limitation. Heavy equipment tends to form ruts when the soil is wet. The equipment should be used only when the soil is relatively dry or frozen.

Because of the wetness and the flooding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is IIIw. The Michigan soil management group is L-2c.

17B—Chelsea loamy fine sand, 0 to 6 percent slopes. This nearly level and undulating, somewhat excessively drained soil is on ridgetops, on knolls, and on broad plains characterized by slight rises. Individual areas are irregular in shape and range from 2 to 640 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 9 inches thick. The subsurface layer is yellowish brown loamy fine sand and fine sand about 23 inches thick. Below this to a depth of about 60 inches is light yellowish brown, loose fine sand that has thin lamellae of strong brown, very friable loamy fine sand. In some places the total thickness of the loamy fine sand lamellae is more than 6 inches. In other places the soil has no lamellae. In some areas the content of pebbles and cobbles throughout the profile is more than 20 percent. In other areas the soil contains coarse sand. In places bright mottles are within a depth of 30 inches.

Included with this soil in mapping are small areas of the well drained Metea soils on low knolls and ridges. These soils have loamy material in the lower part of the subsoil and are less droughty than the Chelsea soil. Also included are the somewhat poorly drained, nearly level Thetford soils in drainageways and in the lower landscape positions. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Chelsea soil, and available water capacity is low. Surface runoff is slow.

Most of the acreage of this soil is woodland or idle land. Some areas are used for cultivated crops or building site development.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are droughtiness and soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material increase the available water capacity and reduce the susceptibility to soil blowing. Growing small grain crops that are planted in the fall or early in spring makes good use of the available soil moisture. Irrigating when soil moisture levels are low can increase productivity.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

This soil is well suited to woodland. Seedling mortality is the major management concern. It can be controlled by special harvest methods that leave some mature trees to provide shade and protection from the wind. Planting stock that is larger than usual or is containerized, special site preparation, such as furrowing and applying herbicide, and reinforcement planting may be needed. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem.

This soil is well suited to building site development and fairly well suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IVs. The Michigan soil management group is 5a.

17C—Chelsea loamy fine sand, 6 to 12 percent slopes. This greatly rolling, somewhat excessively drained soil is on the uneven side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 105 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 9 inches thick. The subsurface layer is yellowish brown, very friable loamy fine sand and fine sand about 23 inches thick. Below this to a depth of about 60 inches is light yellowish brown, loose fine sand that has thin lamellae of strong brown, very friable loamy fine sand. In some places the total thickness of the loamy fine sand lamellae is more than 6 inches. In other places the soil has no lamellae. In some areas the content of pebbles and cobbles is more than 20 percent throughout the soil. In other areas bright mottles are within 30 inches of the surface.

Included with this soil in mapping are small areas of the well drained Metea soils on the tops of knolls and ridges. These soils have loamy material in the lower part of the subsoil and are less droughty than the Chelsea soil. Also included are small areas of the somewhat poorly drained Thetford soils in drainageways and low spots. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Chelsea soil, and available water capacity is low. Surface runoff is slow.

Most of the acreage of this soil is woodland or idle land. Some areas are used for cultivated crops, pasture, or building site development.

Because of droughtiness and the hazard of soil blowing, this soil is generally unsuited to cultivated crops. It is poorly suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Selection of deep-rooted forage species for planting helps to overcome the droughtiness. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. Seedling mortality is the major management concern. It can be controlled by special harvest methods that leave some mature trees to provide shade and protection from the wind. Planting stock that is larger than usual or is containerized, special site preparation, such as furrowing and applying herbicide, and reinforcement planting may be needed. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem.

This soil is fairly well suited to building site development and poorly suited to septic tank absorption fields. The slope is a limitation on building sites, and the slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope can help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is VIs. The Michigan soil management group is 5a.

17D—Chelsea loamy fine sand, 12 to 18 percent slopes. This rolling, somewhat excessively drained soil is on the uneven side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 125 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 7 inches thick. The subsurface layer is about 21 inches thick. It is yellowish brown and very friable. The upper part is loamy fine sand, and the lower part is fine sand. Below this to a depth of about 60 inches is light yellowish brown, loose fine sand that has thin lamellae of strong brown, very friable loamy fine sand. In some places the total thickness of the loamy fine sand lamellae is more than 6 inches. In other places the soil has no lamellae. In some areas the content of pebbles and cobbles is more than 20 percent throughout the soil.

Included with this soil in mapping are small areas of the well drained Marlette and Metea soils on the tops of knolls and ridges. These soils are less droughty than the Chelsea soil. They make up 5 to 15 percent of the unit.

Permeability is rapid in the Chelsea soil, and available water capacity is low. Surface runoff is slow.

Most of the acreage is woodland or idle land. Some areas are pastured. This soil is unsuited to cultivated crops and pasture, mainly because of the slope, droughtiness, and the hazards of water erosion and soil blowing.

This soil is well suited to woodland. Seedling mortality is the major management concern. It can be controlled by special harvest methods that leave some mature trees to provide shade and protection from the wind. Special site preparation, such as furrowing along the contour and applying herbicide, helps to control plant competition. Reinforcement planting may be necessary.

This soil is poorly suited to building site development and septic tank absorption fields. The slope is a limitation on sites for buildings. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is VIIs. The Michigan soil management group is 5a.

17E—Chelsea loamy fine sand, 18 to 45 percent slopes. This steep and very steep, somewhat excessively drained soil is on the side slopes of ridges and hills. Individual areas are irregularly shaped or long and narrow and range from 2 to 50 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 5 inches thick. The subsurface layer is about 21 inches thick. It is yellowish brown and very friable. The upper part is loamy fine sand, and the lower part is fine sand. Below this to a depth of about 60 inches is light yellowish brown, loose fine sand that has thin lamellae of strong brown, very friable loamy fine sand. In some places the total thickness of the loamy fine sand lamellae is more than 6 inches. In other places the soil has no lamellae.

Included with this soil in mapping are small areas of Marlette soils on the tops of knolls and ridges. These soils are less droughty than the Chelsea soil. They make up 5 to 15 percent of the unit.

Permeability is rapid in the Chelsea soil, and available water capacity is low. Surface runoff is rapid.

Most areas are used as woodland. Some of the acreage is pasture or idle land. This soil is unsuited to cultivated crops and pasture because of droughtiness, the slope, and the hazard of water erosion.

This soil is well suited to woodland. Erosion, the equipment limitation, and seedling mortality are the main management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, and culverts. Caution is needed if ordinary crawler tractors are to be operated safely on these slopes. Special harvest methods that leave some mature trees to provide shade and protection from the wind can help to control seedling mortality. Reinforcement planting may be needed.

Because of the slope, this soil is generally unsuited to building site development and septic tank absorption fields.

The land capability classification is VIIs. The Michigan soil management group is 5a.

18B—Glynwood loam, 2 to 6 percent slopes. This undulating, moderately well drained soil is on the uneven side slopes of knolls and low ridges. Individual areas are irregular in shape and range from 2 to 380 acres in size.

Typically, the surface layer is dark brown, friable loam about 9 inches thick. The subsurface layer is brown, friable loam about 2 inches thick. The subsoil is about 24 inches thick. It is mottled. The upper part is dark yellowish brown, firm and very firm silty clay loam; the next part is brown, very firm silty clay; and the lower part is dark yellowish brown, very firm silty clay loam. The underlying material to a depth of about 60 inches is brown, mottled, very firm, calcareous silty clay loam. In a few places the surface layer is sandy loam. In some areas the subsoil does not have gray mottles. In other areas the soil is underlain by sand below a depth of 40 inches.

Included with this soil in mapping are small areas of Blount, Pewamo, Rimer, and Tustin soils. Blount soils are somewhat poorly drained and are in the slightly lower landscape positions. Pewamo soils are poorly drained and are in drainageways and low spots. Rimer soils are somewhat poorly drained and are on slight rises. They are sandy in the upper part. Tustin soils are well drained and are on the tops of some knolls and ridges. Included soils make up 5 to 15 percent of the unit.

Permeability is slow in the Glynwood soil, and available water capacity is high. Surface runoff is medium. The seasonal high water table is at a depth of 2.0 to 3.5 feet in winter, in spring, and during other excessively wet periods.

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

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion and tilth. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and improve tilth. The soil tends to puddle and crust after heavy rains. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Restricted grazing during wet periods helps to prevent compaction and helps to keep the pasture in good condition.

This soil is fairly well suited to woodland. Seedling mortality is the main management concern. It can be controlled by special harvest methods that leave some mature trees to provide shade and protection from the wind.

Because of the wetness and the shrink-swell potential, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness and the slow permeability. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains reduce the wetness and help to control shrinking and swelling. Buildings can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIe. The Michigan soil management group is 1.5a.

18C—Glynwood loam, 6 to 12 percent slopes. This gently rolling, moderately well drained soil is on the uneven side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 135 acres in size.

Typically, the surface layer is dark brown, friable loam about 9 inches thick. The subsoil is about 24 inches thick. It is mottled. The upper part is dark yellowish brown, firm silty clay loam; the next part is brown, very firm silty clay; and the lower part is dark yellowish brown, very firm silty clay loam. The underlying material to a depth of about 60 inches is brown, mottled, very firm, calcareous silty clay loam. In a few places the surface layer is sandy loam. In some areas the subsoil does not have gray mottles. In other areas the soil is underlain by sand below a depth of 40 inches.

Included with this soil in mapping are small areas of Blount and Tustin soils. Blount soils are somewhat poorly drained and are in nearly level areas and drainageways. Tustin soils are well drained and are on the tops of some knolls and ridges. They have a sandy surface layer. Included soils make up 5 to 15 percent of the unit.

Permeability is slow in the Glynwood soil, and available water capacity is high. Surface runoff is rapid. The seasonal high water table is at a depth of 2.0 to 3.5 feet in winter, in spring, and during other excessively wet periods.

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

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion and tilth. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to slow runoff, control water erosion, and improve tilth. In low areas the soil tends to puddle and crust after heavy rains. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Restricted grazing during wet periods helps to prevent compaction and helps to keep the pasture in good condition.

This soil is fairly well suited to woodland. Seedling mortality is the main management concern. It can be controlled by special harvest methods that leave some mature trees to provide shade and protection from the wind.

Because of the slope, the wetness, and the shrink-swell potential, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness, the slow permeability, and the slope. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains reduce the wetness and help to control shrinking and swelling. Buildings can be constructed on well compacted fill material, which raises the site. They should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIIe. The Michigan soil management group is 1.5a.

19A—Blount loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on broad plains. Individual areas are irregular in shape and range from 2 to 40 acres in size.

Typically, the surface layer is dark brown, friable loam about 8 inches thick. The subsoil is about 15 inches thick. It is mottled and very firm. The upper part is yellowish brown silty clay loam, and the lower part is dark grayish brown silty clay. The underlying material to a depth of about 60 inches is grayish brown, mottled, very firm, calcareous silty clay loam. In places the upper part of the subsoil has no gray mottles. In many areas as much as 20 inches of sand or loamy sand is in the upper part of the profile. In some areas strata of fine sand and silt are in the subsoil and underlying material.

Included with this soil in mapping are small areas of the poorly drained Belleville, Colwood, and Pewamo soils in depressions and drainageways and small areas of Rimer soils on low knolls and low ridges. Rimer soils have a sandy surface layer. Included soils make up 5 to 15 percent of the unit.

Permeability is slow or moderately slow in the Blount soil, and available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet in winter, in spring, and during other excessively wet periods. Most areas of this soil are used as cropland. Some of the acreage is woodland, pasture, or idle land.

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are wetness and tilth. If adequate outlets are available, a subsurface drainage system is effective in reducing the wetness. The soil tends to puddle and crust after heavy rains. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops improve tilth.

This soil is well suited to pasture. The pasture plants that can tolerate the wetness should be selected for planting. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to prevent compaction and help to keep the pasture in good condition.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. Because the soil is wet and sticky, the use of equipment is limited during wet periods. When the soil is wet, the equipment tends to form ruts along roads. It should be used only when the soil is relatively dry or frozen. Special site preparation and applications of herbicide help to control seedling mortality. Because of the windthrow hazard, stands should be thinned carefully if they are thinned at all. Logging roads and skid trails should be designed so that windthrown trees can be periodically removed.

Because of the wetness and the shrink-swell potential, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness and the slow permeability. Buildings can be constructed on well compacted fill material, which raises the site. A surface or subsurface drainage system lowers the water table on building sites. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIw. The Michigan soil management group is 1.5b.

19B—Blount loam, 2 to 6 percent slopes. This undulating, somewhat poorly drained soil is on the uneven side slopes of low knolls and low ridges and in narrow drainageways between the ridges. Individual areas are irregular in shape and range from 2 to 1,000 acres in size.

Typically, the surface layer is dark brown, friable loam about 7 inches thick. The subsoil is about 16 inches thick. It is mottled and very firm. The upper part is yellowish brown silty clay loam, and the lower part is dark grayish brown silty clay. The underlying material to a depth of about 60 inches is grayish brown, mottled, very firm, calcareous silty clay loam. In places the upper part of the subsoil has no gray mottles. In many areas as much as 20 inches of sand or loamy sand is in the upper part of the profile. In some areas thin layers of fine sand and silt are in the subsoil and underlying material.

Included with this soil in mapping are small areas of the poorly drained Belleville and Pewamo soils and small areas of Rimer soils. Belleville and Pewamo soils are in depressions and drainageways. Rimer soils are in landscape positions similar to those of the Blount soil. They have a sandy surface layer. Also included are some small areas of the moderately well drained Saylesville soils and the poorly drained Colwood soils. Saylesville soils are higher on the landscape than the Blount soil. Colwood soils are in depressions and drainageways. Included soils make up 5 to 12 percent of the unit.

Permeability is slow or moderately slow in the Blount soil, and available water capacity is high. Surface runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet in winter, in spring, and during other excessively wet periods.

Most areas of this soil are used as cropland. Some of the acreage is woodland, pasture, or idle land.

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion, wetness, and tilth. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion, slow runoff, increase the rate of water infiltration, help to prevent crusting, and improve tilth. If adequate drainage outlets are available, a subsurface drainage system is effective in reducing the wetness. The soil tends to puddle and crust after heavy rains. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to prevent compaction and help to keep the pasture in good condition. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. Because the soil is wet and sticky, the use of equipment is limited during wet periods. When the soil is wet, the equipment tends to form ruts along roads. It should be used only when the soil is relatively dry or frozen. Special site preparation and applications of herbicide help to control seedling mortality. Because of the windthrow hazard, stands should be thinned carefully if they are thinned at all. Logging roads and skid trails should be designed so that windthrown trees can be periodically removed.

Because of the wetness and the shrink-swell potential, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness and the slow permeability. Buildings can be constructed on well compacted fill material, which raises the site. A surface or subsurface drainage system lowers the water table on building sites. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIe. The Michigan soil management group is 1.5b.

20—Houghton muck. This nearly level, very poorly drained soil is in bogs, drainageways, depressions, and potholes on uplands (fig. 8). It is subject to ponding. Individual areas are round, elongated, or irregularly shaped and range from 2 to 450 acres in size.

Typically, the surface layer is black, friable muck about 7 inches thick. Below this to a depth of about 60 inches is very dark brown, dark brown, and very dark grayish brown muck.

Included with this soil in mapping are small areas of Edwards and Adrian soils. These soils are in landscape positions similar to those of the Houghton soil. Edwards soils are underlain by marl and Adrian soils by sandy material. Also included are small areas of the poorly drained Cohoctah soils, which are subject to flooding. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow to moderately rapid in the Houghton soil, and available water capacity is high.

Figure 8.—A typical area of Houghton muck in an abandoned river channel. Boyer and Oshtemo soils are on the hills in the foreground.

Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during excessively wet periods.

Most areas of this soil are used as cropland or pasture. Many are used for vegetable crops. Some are used as woodland or support native vegetation.

If drained, this soil is fairly well suited to such crops as corn, carrots, celery, onions, and peppers. Wetness, soil blowing, and subsidence are the major management concerns. A subsurface drainage system or open ditches help to remove excess water. Draining many areas is difficult, however, because drainage outlets are not readily available. Controlled drainage improves soil stability and reduces the extent of subsidence. Wind stripcropping, windbreaks, buffer strips, and cover crops help to control soil blowing. The use of equipment is limited during wet periods.

This soil is poorly suited to pasture. Grazing when the soil is wet can destroy forage plants.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. The use of heavy planting and harvesting equipment is limited by the wetness and by low strength. Ordinary crawler tractors and rubber-tired skidders generally cannot be used. Special harvesting equipment is needed during most of the year. The equipment should be used only when the soil is frozen. The windthrow hazard can be reduced by special harvest methods that do not isolate the remaining trees or leave them widely spaced. Windthrown trees should be periodically removed.

Because of wetness, subsidence, and low strength, this soil is unsuited to septic tank absorption fields and building site development.

The land capability classification is IIIw. The Michigan soil management group is Mc.

22B—Oshtemo sandy loam, 0 to 6 percent slopes. This nearly level and undulating, well drained soil is on broad plains and on the convex side slopes of knolls and low ridges. Individual areas are irregular in shape and range from 2 to 160 acres in size.

Typically, the surface layer is dark brown, friable sandy loam about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 6 inches thick. The subsoil is about 40 inches thick. It is, in sequence downward, dark yellowish brown, friable sandy loam; strong brown, friable sandy clay loam; strong brown, friable gravelly sandy loam; and strong brown, loose coarse sand. The underlying material to a depth of about 60 inches is yellowish brown, loose, calcareous gravelly coarse sand. In some areas the depth to calcareous gravelly coarse sand is less than 40 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Wasepi and very poorly drained Gilford soils in drainageways and small depressions. Also included are small areas of the excessively drained Plainfield soils. These soils are in landscape positions similar to those of the Oshtemo soil. They are more droughty than the Oshtemo soil. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Oshtemo soil and very rapid in the lower part. Available water capacity is moderate. Surface runoff is slow.

Most areas of this soil are used as cropland or pasture. Some are used for woodland or building site development.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Specialty crops, including apples, potatoes, and green beans, are grown in some areas. Droughtiness and soil blowing are the major management concerns. Returning crop residue to the soil, regularly adding other organic material, and growing cover crops and green manure crops improve the available water capacity and help to control soil blowing. Wind stripcropping and field windbreaks also are effective in controlling soil blowing. If specialty crops are grown, additional water is needed during the growing season.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

This soil is well suited to building site development. It is only fairly well suited to septic tank absorption fields because of a poor filtering capacity. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IIIs. The Michigan soil management group is 3a.

22C—Oshtemo sandy loam, 6 to 12 percent slopes. This gently rolling, well drained soil is on ridgetops, knolls, and convex side slopes. Individual areas are irregular in shape and range from 2 to 125 acres in size.

Typically, the surface layer is dark brown, friable sandy loam about 7 inches thick. The subsurface layer is yellowish brown, friable sandy loam about 5 inches thick. The subsoil is about 36 inches thick. It is, in sequence downward, dark yellowish brown, friable sandy loam; strong brown, friable sandy loam; strong brown, friable gravelly sandy loam; and strong brown, loose coarse sand. The underlying material to a depth of about 60 inches is brown, loose gravelly coarse sand. In some areas the depth to calcareous gravelly coarse sand is less than 40 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Wasepi and very poorly drained Gilford soils in drainageways and small depressions. Also included are small areas of the excessively drained Plainfield soils. These soils are in landscape positions similar to those of the Oshtemo soil. They are more droughty than the Oshtemo soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Oshtemo soil and very rapid in the lower part. Available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are pastured. Some are used for cultivated crops, woodland, or building site development.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Specialty crops, including apples, potatoes, and green beans, are grown in some areas. Water erosion, soil blowing, and droughtiness are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and conserve moisture. If specialty crops are grown, additional water is needed during the growing season.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

This soil is fairly well suited to building site development and poorly suited to septic tank absorption fields. The slope is a limitation on building sites, and a poor filtering capacity and the slope are limitations on sites for septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IIIe. The Michigan soil management group is 3a.

23A—Thetford loamy sand, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is in swales and on broad plains characterized by slight rises. Individual areas are irregularly shaped or elongated and range from 2 to 65 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loamy sand about 9 inches thick. The subsurface layer is yellowish brown and light yellowish brown sand about 13 inches thick. Below this to a depth of more than 60 inches is pale brown, mottled, loose sand that has thin lamellae of dark yellowish brown and brown, mottled, very friable loamy sand. In some areas the upper part of the subsoil has no gray mottles. In other areas it does not have lamellae. In a few areas it has brittle, dark reddish brown chunks.

Included with this soil in mapping are small areas of the poorly drained Granby soils in the lower positions on the landscape. Also included are Selfridge soils in landscape positions similar to those of the Thetford soil. These soils have loamy material below a depth of 20 inches and are less droughty during dry periods than the Thetford soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Thetford soil, and available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 2 feet late in winter, in spring, and during excessively wet periods.

Most areas of this soil are used as cropland or woodland. Some of the acreage is pasture or idle land.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are wetness, droughtiness, and soil blowing. If adequate drainage outlets are available, a subsurface drainage system is effective in removing excess water. Suitable filtering material is needed around the tile to keep fine sand from flowing into the tile lines. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops increase the available water capacity and reduce the susceptibility to soil blowing. Wind stripcropping, vegetative barriers, and field windbreaks also help to control soil blowing.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during wet and extremely dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. The major management concern is the equipment limitation. Heavy equipment tends to form ruts when the soil is dry or excessively wet. The equipment should be used only when the soil is moist and friable or is frozen.

Because of the wetness, this soil is poorly suited to building site development and is generally unsuited to septic tank absorption fields. A surface or subsurface drainage system lowers the water table on building sites. The buildings can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIIw. The Michigan soil management group is 4b.

24A—Abscota loamy sand, 0 to 3 percent slopes. This nearly level, moderately well drained soil is on large flats and natural levees along rivers and streams. It is occasionally flooded. Individual areas are irregularly shaped or narrow and elongated and range from 2 to 200 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loamy sand about 5 inches thick. The subsoil is very friable loamy sand about 9 inches thick. The upper part is yellowish brown, and the lower part is light yellowish brown. The underlying material to a depth of about 60 inches is multicolored, loose sand. In places the surface layer or subsoil is loam or silt loam.

Included with this soil in mapping are small areas of the well drained Oakville soils on knolls and ridges. These soils are not subject to flooding. Also included are small areas of the somewhat poorly drained Algansee, Ceresco, and Shoals soils in the slightly lower landscape positions and in areas adjacent to the natural levees and small areas of the poorly drained Cohoctah and Glendora and very poorly drained Sloan and Houghton soils in narrow channels and meander scars on the lowest parts of the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Abscota soil, and available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 2.5 to 5.0 feet during spring and during other excessively wet periods.

Most of the acreage of this soil is pasture or idle land. Some areas are used as cropland or woodland.

This soil is poorly suited to most crops, but such crops as winter wheat, oats, and hay can be grown. Droughtiness, soil blowing, and the occasional flooding are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops conserve moisture and reduce the hazard of soil blowing. Wind stripcropping and vegetative barriers also help to control soil blowing. Irrigating when soil moisture levels are low can increase productivity.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. The equipment limitation and seedling mortality are the main management concerns. Heavy equipment tends to form ruts when the soil is wet. Seedling mortality can be controlled by special harvest methods that leave some mature trees to provide shade and protection from the wind. Planting stock that is larger than usual or is containerized, special site preparation, such as furrowing and applying herbicide, and reinforcement planting may be needed.

Because of the wetness and flooding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is IVs. The Michigan soil management group is L-4a.

25B—Oakville fine sand, 0 to 6 percent slopes. This nearly level and undulating, well drained soil is on ridgetops, knolls, and short, uneven side slopes. Individual areas are irregular in shape and range from 2 to 115 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sand about 6 inches thick. The subsoil is loose fine sand about 34 inches thick. The upper part is yellowish brown, and the lower part is brownish yellow. The underlying material to a depth of about 60 inches is light yellowish brown, loose fine sand. In some areas lamellae of loamy fine sand are in the subsoil. In other areas bright mottles are within a depth of 30 inches.

Included with this soil in mapping are small areas of Metea soils on knolls and ridges. These soils are more droughty than the Oakville soil. Also included are the somewhat poorly drained Tedrow soils in shallow depressions and drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Oakville soil, and available water capacity is low. Surface runoff is slow.

Most of the acreage of this soil is woodland or idle land. Some areas are used for cultivated crops or building site development.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are droughtiness and soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material increase the available water capacity and reduce the susceptibility to soil blowing. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing. Growing small grain crops that are planted in the fall or early in spring makes good use of the available soil moisture. Irrigating when soil moisture levels are low can increase productivity.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

This soil is well suited to woodland. The equipment limitation and seedling mortality are the main management concerns. The sandy surface layer can affect equipment trafficability during dry periods. Heavy equipment tends to form ruts. Special site preparation, such as furrowing before planting or applying herbicide, helps to control seedling mortality. Special harvest methods that leave some mature trees to provide shade and protection from the wind also help to control seedling mortality. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem. Reinforcement planting may be necessary.

This soil is well suited to building site development. It is only fairly well suited to septic tank absorption fields because of a poor filtering capacity. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IVs. The Michigan soil management group is 5.3a.

25C—Oakville fine sand, 6 to 12 percent slopes. This moderately sloping or gently rolling, well drained soil is on the uneven side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 900 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sand about 6 inches thick. The subsoil is loose fine sand about 34 inches thick. The upper part is yellowish brown, and the lower part is brownish yellow. The underlying material to a depth of about 60 inches is light yellowish brown fine sand. In some areas thin lamellae of loamy fine sand are in the subsoil.

Included with this soil in mapping are small areas of Marlette soils on the tops of the knolls and ridges. These soils are less droughty than the Oakville soil. Also included are the somewhat poorly drained Tedrow soils in shallow depressions and drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Oakville soil, and available water capacity is low. Surface runoff is slow.

Most of the acreage of this soil is woodland or idle land. Some areas are used for cultivated crops or building site development.

Crop production generally is not practical on this soil because of droughtiness. Soil blowing and water erosion also are major management concerns.

This soil is poorly suited to pasture. Selection of deep-rooted forage species for planting helps to overcome the droughtiness. Proper stocking rates, pasture rotation, and restricted use during dry periods are needed.

This soil is well suited to woodland. The equipment limitation and seedling mortality are the main management concerns. The sandy surface layer can affect equipment trafficability during dry periods. Heavy equipment tends to form ruts. Special site preparation, such as furrowing before planting or applying herbicide, helps to control seedling mortality. Special harvest methods that leave some mature trees to provide shade and protection from the wind also help to control seedling mortality. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem. Reinforcement planting may be necessary.

This soil is fairly well suited to building site development and poorly suited to septic tank development. The slope is a limitation for building sites, and a poor filtering capacity and the slope are limitations on sites for septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is VIs. The Michigan soil management group is 5.3a.

25D—Oakville fine sand, 12 to 18 percent slopes. This rolling, well drained soil is on the uneven side slopes of knolls and ridges. Individual areas are irregularly shaped or long and narrow and range from 2 to 300 acres in size.

Typically, the surface layer is dark brown, very friable fine sand about 5 inches thick. The subsoil is fine sand about 28 inches thick. The upper part is strong brown and very friable, the next part is light yellowish brown and loose, and the lower part is pale brown and loose. The underlying material to a depth of about 60 inches is very pale brown fine sand. In some areas thin lamellae of loamy fine sand are in the subsoil.

Included with this soil in mapping are small areas of Marlette soils on the tops of the knolls and ridges. These soils are less droughty than the Oakville soil. Also included are the somewhat poorly drained Tedrow soils in shallow depressions and drainageways. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Oakville soil, and available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Some are used for pasture or building site development. This soil is unsuited to cultivated crops because of slope, droughtiness, and the hazards of soil blowing and water erosion.

This soil is poorly suited to pasture. Operating machinery on the contour minimizes the equipment limitation caused by the slope. Selection of deep-rooted species for planting forage helps to overcome the droughtiness. Limited stocking rates, pasture rotation, and restricted use during dry periods are needed.

This soil is well suited to woodland. The equipment limitation and seedling mortality are the main management concerns. The sandy surface layer can affect equipment trafficability during dry periods. Heavy equipment tends to form ruts. Special harvest methods that leave some mature trees to provide shade and protection from the wind help to control seedling mortality. Furrowing or applying herbicide also helps to control seedling mortality. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem. Reinforcement planting may be needed.

Because of the slope, this soil is poorly suited to building site development. It is poorly suited to septic tank absorption fields because of the slope and a poor filtering capacity. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is VIs. The Michigan soil management group is 5.3a.

25E—Oakville fine sand, 18 to 45 percent slopes. This steep and very steep, well drained soil is on the side slopes of ridges. Individual areas are irregularly shaped or long and narrow and range from 2 to 300 acres in size.

Typically, the surface layer is dark brown, very friable fine sand about 4 inches thick. The subsoil is yellowish brown, loose fine sand about 21 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown, loose fine sand. In some areas thin lamellae of loamy fine sand are in the subsoil.

Included with this soil in mapping are small areas of Marlette and Metea soils on the tops of knolls and ridges. These soils are less droughty than the Oakville soil. They make up 5 to 15 percent of the unit.

Permeability is rapid in the Oakville soil, and available water capacity is low. Surface runoff is rapid.

Most areas are used as woodland. Some of the acreage is abandoned pasture or is used for building site development. This soil is unsuited to cultivated crops and pasture because of droughtiness, the equipment limitation caused by slope, and the hazard of water erosion.

This soil is well suited to woodland. Erosion, the equipment limitation, and seedling mortality are the main management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, and culverts. Caution is needed if ordinary crawler tractors and rubber-tired skidders are operated on these slopes. Special site preparation, such as applying herbicide, and special harvest methods that leave some mature trees to provide shade and protection from the wind reduce the seedling mortality rate.

Because of the slope, this soil is generally unsuited to septic tank absorption fields and building site development.

The land capability classification is VIIs. The Michigan soil management group is 5.3a.

26—Adrian muck. This nearly level, very poorly drained soil is in bogs, drainageways, and depressions on uplands. It is subject to ponding. Individual areas are round, elongated, or irregularly shaped and range from 2 to 150 acres in size.

Typically, the surface layer is black, friable muck about 7 inches thick. Below this is dark reddish brown and black muck about 20 inches thick. The underlying material to a depth of about 60 inches is light brownish gray, loose sand. In some areas the thickness of the organic layers is less than 16 inches, and in other areas it is more than 51 inches.

Included with this soil in mapping are small areas of Edwards soils. These soils are in landscape positions similar to those of the Adrian soil. They are underlain by marl. They make up 5 to 10 percent of the unit.

Permeability is moderately slow to moderately rapid in the layers of muck in the Adrian soil and rapid in the underlying sand. Available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during excessively wet periods.

Most areas of this soil are used as cropland. Many are used for shallow-rooted vegetable crops. Some are used as woodland or pasture or support native vegetation.

This soil is poorly suited to crops. If a drainage system is installed, however, such crops as corn, carrots, celery, onions, peppers, and hay can be grown. Wetness, soil blowing, and subsidence are the major management concerns. A subsurface drainage system helps to remove excess water. Draining many areas is difficult, however, because drainage outlets are not readily available. Filtering material is needed around subsurface drains to keep sand from plugging the tile lines. Controlled drainage improves soil stability and reduces the extent of subsidence. Windbreaks, buffer strips, and cover crops help to control soil blowing. The use of equipment is limited during wet periods.

This soil is poorly suited to pasture. Grazing when the soil is wet can destroy forage plants.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. The use of heavy planting and harvesting equipment is limited by the wetness and by low strength. Ordinary crawler tractors and rubber-tired skidders generally cannot be used. Special harvesting equipment is needed. The equipment should be used only when the soil is frozen. The windthrow hazard can be reduced by special harvest methods and selective cuttings that do not isolate the remaining trees or leave them widely spaced. Windthrown trees should be periodically removed.

Because of the wetness, this soil is unsuited to septic tank absorption fields and building site development.

The land capability classification is IVw. The Michigan soil management group is M/4c.

27B—Wasepi loamy sand, 0 to 4 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is in broad areas characterized by slight rises. It also is on the concave side slopes of low knolls and ridges. Individual areas are irregular in shape and range from 2 to 120 acres in size.

Typically, the surface layer is very dark brown, friable loamy sand about 8 inches thick. The subsoil is about 17 inches thick. It is yellowish brown, mottled, and friable. The upper part is gravelly loamy sand, the next part is gravelly sandy clay loam, and the lower part is gravelly sandy loam. The underlying material to a depth of about 60 inches is light brownish gray, mottled, loose gravelly coarse sand. In some areas it is loamy. In a few areas the soil is better drained and has no gray mottles in the subsoil.

Included with this soil in mapping are small areas of Gilford and Matherton soils. Gilford soils are very poorly drained and are in drainageways and the lower positions on the landscape. Matherton soils are in landscape positions similar to those of the Wasepi soil. They have a loamy surface layer. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Wasepi soil and very rapid in the lower part. Available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 2 feet in winter, in spring, and during other excessively wet periods.

Most areas of this soil are used as pasture or cropland. Some of the acreage is idle land or woodland.

This soil is fairly well suited to such crops as oats, winter wheat, and hay. Droughtiness, wetness, and soil blowing are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops conserve moisture and help to control soil blowing. A subsurface drainage system is effective in removing excess water. Irrigating when soil moisture levels are low can increase productivity.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during wet or prolonged dry periods help to keep the pasture in good condition.

This soil is fairly well suited to woodland. The major management concern is the equipment limitation. Heavy equipment forms ruts when the soil is wet. The equipment should be used only when the soil is relatively dry or frozen.

Because of the wetness, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness and a poor filtering capacity. A surface or subsurface system lowers the water table on building sites. The buildings can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIIs. The Michigan soil management group is 4b.

28—Gilford fine sandy loam. This nearly level, very poorly drained soil is on flats and in drainageways and low areas. It is subject to ponding. Individual areas are irregular in shape and range from 2 to 40 acres in size.

Typically, the surface layer is black, friable fine sandy loam about 11 inches thick. The subsoil is mottled sandy loam about 17 inches thick. The upper part is dark grayish brown and very friable, the next part is grayish brown and friable, and the lower part is dark grayish brown and friable. The underlying material to a depth of about 60 inches is grayish brown and loose. It is loamy sand in the upper part and gravelly sand in the lower part. In some areas the surface layer is muck. In other areas the upper part of the subsoil has more clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Wasepi and Thetford soils on slight ridges and low knolls. These soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Gilford soil and very rapid in the lower part. Available water capacity is moderate. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during excessively wet periods.

Most areas of this soil are used as woodland. Some are used as cropland.

If drained, this soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are wetness and soil blowing. A subsurface drainage system is effective in removing excess water. Draining many areas is difficult, however, because drainage outlets are not readily available. Suitable filtering material is needed around the tile in some areas to keep fine sand from flowing into the tile lines. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control soil blowing and increase the available water capacity.

This soil is poorly suited to pasture. Restricted grazing during wet periods is needed. The pasture plants that can tolerate the wetness should be selected for planting. If possible, a surface drainage system should be installed to remove excess water.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the main management concerns. Heavy equipment should be used only when the soil is frozen or relatively dry. Special harvest methods that leave some mature trees to provide shade and protection from the wind help to control seedling mortality. Special harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is IIIw. The Michigan soil management group is 4c.

29B—Plainfield sand, 0 to 6 percent slopes. This nearly level and undulating, excessively drained soil is on ridgetops, knolls, and short, uneven side slopes. Individual areas are irregular in shape and range from 2 to 420 acres in size.

Typically, the surface layer is very dark grayish brown, very friable sand about 9 inches thick. The subsoil is strong brown, loose sand about 20 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown, loose sand. In some areas thin bands of loamy sand are in the subsoil. In a few areas, especially in the northeastern part of the county, the content of pebbles and cobbles is more than 15 percent throughout the profile.

Included with this soil in mapping are small areas of the well drained Tekenink soils. These soils are in landscape positions similar to those of the Plainfield soil. They have a loamy surface layer and are less droughty than the Plainfield soil. Also included are small areas of the somewhat poorly drained Tedrow soils in drainageways and in nearly level areas on the lower parts of the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Plainfield soil, and available water capacity is low. Surface runoff is slow.

Most of the acreage of this soil is woodland or idle land. Some areas are used for cultivated crops or building site development.

This soil is poorly suited to most crops. Such crops as winter wheat, oats, and hay, however, can be grown. Droughtiness and soil blowing are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, increases the available water capacity and reduces the susceptibility to soil blowing. Irrigating when soil moisture levels are low can increase productivity.

This soil is poorly suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Selection of deep-rooted forage species for planting helps to overcome the droughtiness. Limited stocking rates, pasture rotation, and restricted use during dry periods are needed.

This soil is well suited to woodland. The equipment limitation and seedling mortality are the major management concerns. Heavy equipment tends to form ruts in the soil. Special harvest methods that leave some mature trees to provide shade and protection from wind help to control seedling mortality. Containerized planting stock and special site preparation, such as furrowing or applying herbicide, may be necessary to achieve a better survival rate. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem.

This soil is well suited to building site development. It is only fairly well suited to septic tank absorption fields because of a poor filtering capacity. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IVs. The Michigan soil management group is 5.3a.

29C—Plainfield sand, 6 to 12 percent slopes. This moderately sloping or gently rolling, excessively drained soil is on the uneven side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 160 acres in size.

Typically, the surface layer is very dark grayish brown, very friable sand about 9 inches thick. The subsoil is strong brown, loose sand about 20 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown, loose sand. In some areas thin layers of loamy sand are in the subsoil. In a few areas, especially in the northeastern part of the county, the content of pebbles and cobbles is more than 15 percent throughout the profile.

Included with this soil in mapping are small areas of the well drained Marlette soils on ridgetops and the upper side slopes. These soils have a loamy surface layer and are less droughty than the Plainfield soil. Also included are small areas of the somewhat poorly drained Tedrow soils in drainageways and small depressions. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Plainfield soil, and available water capacity is low. Surface runoff is slow.

Most of the acreage is woodland or idle land. Some areas are used for cultivated crops or building site development. Because of droughtiness and the hazards of soil blowing and water erosion, this soil is unsuited to cultivated crops. It is poorly suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Selection of deep-rooted forage species for planting helps to overcome the droughtiness. Limited stocking rates, pasture rotation, and restricted use during dry periods are needed.

This soil is well suited to woodland. The equipment limitation and seedling mortality are the major management concerns. Heavy equipment tends to form ruts in the soil. Special harvest methods that leave some mature trees to provide shade and protection from the wind reduce the seedling mortality rate. Containerized planting stock and special site preparation, such as furrowing or applying herbicide, may be necessary to achieve a better survival rate. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem.

This soil is fairly well suited to building site development and poorly suited to septic tank absorption fields. The slope is a limitation on sites for buildings. A poor filter capacity and the slope are limitations on sites for septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is VIs. The Michigan soil management group is 5.3a.

29D—Plainfield sand, 12 to 18 percent slopes. This rolling or strongly sloping, excessively drained soil is on uneven slopes on ridges and knolls. Individual areas are irregularly shaped or elongated and range from 2 to 320 acres in size.

Typically, the surface layer is black, very friable sand about 2 inches thick. The subsurface layer is very dark grayish brown, very friable sand about 1 inch thick. The subsoil is loose sand about 20 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The underlying material to a depth of about 60 inches is very pale brown, loose sand. In some areas thin layers of loamy sand are in the subsoil. In a few areas, especially in the northeastern part of the county, the content of pebbles and cobbles is more than 15 percent throughout the profile. In places accumulations of iron, aluminum, and organic matter are in the subsoil.

Included with this soil in mapping are small areas of the well drained Marlette soils on ridgetops and the upper side slopes. These soils have a loamy surface layer and are less droughty than the Plainfield soil. They make up 5 to 15 percent of the unit.

Permeability is rapid in the Plainfield soil, and available water capacity is low. Surface runoff is medium.

Most of the acreage of this soil is woodland or idle land. Some areas are pastured or are used for building site development. Because of the slope, droughtiness, and the hazards of soil blowing and water erosion, this soil is generally unsuited to cultivated crops and pasture.

This soil is well suited to woodland. The equipment limitation and seedling mortality are the major management concerns. Heavy equipment tends to form ruts in the soil. Special harvest methods that leave some mature trees to provide shade and protection from the wind reduce the seedling mortality rate. Containerized planting stock and special site preparation, such as furrowing on the contour and applying herbicide, help to control plant competition and seedling mortality.

This soil is poorly suited to building site development and septic tank absorption fields. The slope is a limitation on sites for buildings. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is VIIs. The Michigan soil management group is 5.3a.

29E—Plainfield sand, 18 to 45 percent slopes. This steep and very steep, excessively drained soil is on the side slopes of ridges. Individual areas are irregularly shaped or long and narrow and range from 2 to 275 acres in size.

Typically, the surface layer is black, very friable sand about 1 inch thick. The subsurface layer is dark grayish brown, very friable sand about 1 inch thick. The subsoil is strong brown, loose sand about 16 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The underlying material to a depth of about 60 inches is very pale brown, loose sand. In some areas thin layers of loamy sand are in the subsoil. In a few areas, especially in the northeastern part of the county, the content of pebbles and cobbles is more than 15 percent throughout the profile.

Included with this soil in mapping are small areas of the well drained Marlette and Tekenink soils on ridgetops and the upper side slopes. These soils have a loamy surface layer and are less droughty than the Plainfield soil. They make up 5 to 15 percent of the unit.

Permeability is rapid in the Plainfield soil, and available water capacity is low. Surface runoff is medium or rapid.

Most areas are used as woodland. Some of the acreage is pasture or idle land. This soil is unsuited to cultivated crops and pasture because of droughtiness, the equipment limitation caused by slope, and the hazard of water erosion.

This soil is well suited to woodland. The erosion hazard, the equipment limitation, and seedling mortality are the main management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, and culverts. Caution is needed if ordinary crawler tractors and rubber-tired skidders are operated on these slopes. Containerized planting stock and special site preparation, such as furrowing on the contour and applying herbicide, may be necessary to control seedling mortality. Special harvest methods that leave some mature trees to provide shade and protection from the wind also help to control seedling mortality.

Because of the slope, this soil is generally unsuited to septic tank absorption fields and building site development.

The land capability classification is VIIs. The Michigan soil management group is 5.3a.

30B—Spinks loamy sand, 0 to 6 percent slopes. This nearly level and undulating, well drained soil is on ridgetops and slightly convex slopes on plains. Individual areas are irregular in shape and range from 2 to 500 acres in size.

Typically, the surface layer is dark brown, very friable loamy sand about 10 inches thick. The subsurface layer is yellowish brown, loose loamy sand about 6 inches thick. Below this to a depth of about 60 inches is yellowish brown, loose sand that has thin lamellae of dark brown, friable loamy sand. In places a sandy loam subsoil is directly below the surface layer. In some areas the total thickness of the lamellae is less than 6 inches.

In other areas the soil has no lamellae. In some places, especially in the northeastern part of the county, the content of pebbles and cobbles is more than 20 percent throughout the profile. In other places the soil has layers of very fine sand and silt.

Included with the soil in mapping are small areas of Metea soils on low knolls and ridges. These soils are moderately slowly permeable in the lower part of the subsoil. Also included are small areas of the somewhat poorly drained Wasepi and Thetford soils in drainageways and in nearly level areas on the lower parts of the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Spinks soil, and available water capacity is low. Surface runoff is slow.

Most areas of this soil are pastured. Some are used as woodland, cropland, or building sites.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are droughtiness and soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, regular additions of other organic material, cover crops, and green manure crops increase the available water capacity and reduce the susceptibility to soil blowing. Wind stripcropping, vegetative barriers, and windbreaks also help to control soil blowing. Irrigating when soil moisture levels are low can increase productivity.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

This soil is well suited to woodland. Seedling mortality is the major management concern. Special site preparation, such as furrowing and applying herbicide, reduces the seedling mortality rate. Containerized or oversized planting stock and special harvest methods that leave some mature trees to provide shade and protection from the wind may be necessary to achieve a better survival rate. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem.

This soil is well suited to building site development and septic tank absorption fields. No major management concerns affect these uses.

The land capability classification is IIIs. The Michigan soil management group is 4a.

30C—Spinks loamy sand, 6 to 12 percent slopes. This gently rolling, well drained soil is on the convex slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 60 acres in size.

Typically, the surface layer is dark brown, very friable loamy sand about 10 inches thick. The subsurface layer is yellowish brown, loose loamy sand about 6 inches thick. Below this to a depth of about 60 inches is yellowish brown, loose sand that has thin lamellae of dark brown, friable loamy sand. In some areas a sandy loam subsoil is directly below the surface layer. In other areas the total thickness of the loamy sand lamellae is less than 6 inches. In some places, especially the northeastern part of the county, the content of pebbles and cobbles is more than 20 percent throughout the profile. In other places layers of very fine sand and silt are below the surface soil.

Included with this soil in mapping are small areas of Metea soils on low knolls and ridges. These soils are loamy and moderately slowly permeable in the lower part of the subsoil. Also included are small areas of the somewhat poorly drained Wasepi and Thetford soils in drainageways and small depressions. Included soils make up to 15 percent of the unit.

Permeability is moderately rapid in the Spinks soil, and available water capacity is low. Surface runoff is slow.

Most areas of this soil are pastured. Some are used as woodland, cropland, or building sites.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are droughtiness, water erosion, and soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material help to control water erosion and soil blowing and increase the available water capacity. Wind stripcropping, vegetative barriers, and windbreaks also help to control soil blowing. Additional water may be needed during the summer.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

This soil is well suited to woodland. Seedling mortality is the major management concern. Special site preparation, such as furrowing or applying herbicide, reduces the seedling mortality rate. Containerized or oversized planting stock and special harvest methods that leave some mature trees to provide shade and protection from the wind may be necessary to achieve a better survival rate. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem.

Because of the slope, this soil is only fairly well suited to building site development and septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly.

The land capability classification is IIIe. The Michigan soil management group is 4a.

30D—Spinks loamy sand, 12 to 18 percent slopes. This rolling, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 50 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy sand about 6 inches thick. The subsurface layer is light yellowish brown, loose loamy sand about 15 inches thick. Below this to a depth of about 60 inches is light yellowish brown, loose sand that has thin bands of dark brown, friable loamy sand. In some areas a sandy loam subsoil is directly below the surface layer. In other areas the total thickness of the loamy sand lamellae is less than 6 inches. In some places, especially the northeastern part of the county, the content of pebbles and cobbles is more than 20 percent throughout the profile. In other places layers of very fine sand and silt are below the surface soil.

Included with this soil in mapping are small areas of Metea soils on the tops of ridges and knolls. These soils are loamy and moderately slowly permeable in the lower part of the subsoil. Also included are small areas of the somewhat poorly drained Wasepi and Thetford soils in drainageways and small depressions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Spinks soil, and available water capacity is low. Surface runoff is medium.

Most areas of this soil are used as woodland or pasture. Some are used as cropland or building sites.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are water erosion, soil blowing, droughtiness, and the equipment limitation caused by slope. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and regular additions of other organic material help to control water erosion and soil blowing and increase the available water capacity.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

This soil is well suited to woodland. Seedling mortality is the management concern. Special harvest methods that leave some mature trees to provide shade and protection from the wind reduce the seedling mortality rate. Containerized or oversized planting stock may be necessary to achieve a better survival rate. Special site preparation, such as furrowing on the contour and applying herbicide, help to control plant competition.

Because of the slope, this soil is poorly suited to building site development and septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly.

The land capability classification is IVe. The Michigan soil management group is 4a.

31—Wallkill silt loam. This nearly level, very poorly drained soil is in upland depressions, in the lowest landscape positions in meander scars and abandoned channels on flood plains, and around the margins of organic soils adjacent to uplands. It is subject to flooding. Individual areas are irregular in shape and range from 2 to 30 acres in size.

Typically, the surface layer is very dark brown, friable silt loam about 12 inches thick. The next 23 inches is mottled. It is, in sequence downward, dark grayish brown, friable silt loam; very dark grayish brown, friable silt loam; and very dark grayish brown, firm loam. The next layer is black and very dark brown, friable muck about 12 inches thick. Below this to a depth of about 60 inches is dark grayish brown, friable silt loam. In some places the subsoil contains more clay or less clay. In other places marl is below the layers of muck.

Included with this soil in mapping are small areas of the poorly drained Cohoctah and Parkhill soils and small areas of Sloan soils. All of the included soils are along the margins and in the shallower parts of depressions and drainageways. They are not underlain by muck. They make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Wallkill soil and moderately slow to moderately rapid in the lower part. Available water capacity is high. Surface runoff is slow. The seasonal high water table is near the surface during wet periods.

Most of the acreage of this soil is idle land covered by brush or is woodland. Some areas are used as cropland or pasture.

If drained, this soil is fairly well suited to such crops as corn and winter wheat. The flooding, however, remains a management concern. It can be overcome by a good surface drainage system, which allows the crops to be planted after the floodwater recedes. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods. Cover crops, regular additions of crop residue and organic matter, and conservation tillage systems that leave crop residue on the surface help to maintain tilth.

This soil is poorly suited to pasture. The flooding is the major management concern. Proper stocking rates, pasture rotation, and restricted use during wet periods are necessary.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the main management concerns. The kind of equipment that can be used and the period of use are severely limited. The equipment should be used only when the soil is relatively dry or frozen. The expected loss of seedlings is more than 50 percent. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Windthrown trees should be periodically removed.

Because of the wetness and the flooding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is IIIw. The Michigan soil management group is L-2c.

32—Palms muck. This nearly level, very poorly drained soil is in bogs, along drainageways, and in depressions on uplands. It is subject to ponding. Individual areas are round, elongated, or irregularly shaped and range from 5 to 1,600 acres in size.

Typically, the surface layer is black muck about 9 inches thick. The subsurface layer is dark reddish brown and black, friable muck about 33 inches thick. The underlying material to a depth of about 60 inches is gray, firm silty clay loam. In some areas the thickness of the organic layers is less than 16 inches, and in other areas it is more than 51 inches thick. In places the underlying material is clay or silty clay.

Included with this soil in mapping are small areas of Edwards soils. These soils are underlain by marl. Also included are small areas of the poorly drained Cohoctah soils, which are subject to flooding. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow to moderately rapid in the layers of muck in the Palms soil and moderately slow or moderate in the underlying material. Available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during excessively wet periods.

Most areas of this soil are used as cropland. Many are used for vegetable crops. Some are used as woodland or pasture.

If drained, this soil is fairly well suited to such crops as corn, carrots, celery, onions, and peppers. Wetness, soil blowing, and subsidence are the major management concerns. A subsurface drainage system or open ditches help to remove excess water. Draining many areas is difficult, however, because drainage outlets are not readily available. Controlled drainage improves soil stability and reduces the extent of subsidence. Wind stripcropping, windbreaks, vegetative barriers, buffer strips, and cover crops help to control soil blowing. The use of equipment is limited during wet periods.

This soil is poorly suited to pasture. Grazing when the soil is wet can destroy forage plants.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. The use of heavy planting and harvesting equipment is limited by the wetness and by low strength. The windthrow hazard can be reduced by special harvest methods that do not isolate the remaining trees or leave them widely spaced. Windthrown trees should be periodically removed.

Because of the wetness, this soil is unsuited to septic tank absorption fields and building site development.

The land capability classification is IIIw. The Michigan soil management group is M/3c.

36B—Marlette loam, 2 to 6 percent slopes. This undulating, well drained soil is on the tops and convex side slopes of low knolls and ridges. Individual areas are irregular in shape and range from 2 to 345 acres in size.

Typically, the surface layer is dark brown, friable loam about 9 inches thick. The next 10 inches is mixed dark yellowish brown, firm clay loam and light brownish gray loam. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 21 inches thick. The underlying material to a depth of about 60 inches is brown, friable, calcareous loam. In some small areas sand is below a depth of 40 inches. In places the upper part of the subsoil has gray mottles.

Included with this soil in mapping are small areas of Capac, Metea, Oshtemo, and Parkhill soils. Capac soils are somewhat poorly drained and are in narrow drainageways and the lower areas. Metea and Oshtemo soils are in landscape positions similar to those of the Marlette soil. They are more droughty than the Marlette soil. Metea soils have a sandy surface layer. Parkhill soils are poorly drained and are in narrow drainageways and on some of the lowest parts of the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Marlette soil, and available water capacity is high. Surface runoff is medium.

Most areas of this soil are used for cultivated crops or orchards. Some are used as pasture, woodland, or building sites.

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion and tilth. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help control water erosion and improve tilth. The soil tends to puddle and crust after heavy rains. Tilling when the soil is too wet can alter soil structure and can result in soil compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of the moderately slow permeability. Special construction methods, such as enlarging the absorption fields or alternating drain fields, help to overcome this limitation.

The land capability classification is IIe. The Michigan soil management group is 2.5a.

36C—Marlette loam, 6 to 12 percent slopes. This gently rolling, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 160 acres in size.

Typically, the surface layer is dark brown, friable loam about 8 inches thick. The next 10 inches is mixed dark yellowish brown, firm clay loam and light brownish gray loam. The subsoil is dark yellowish brown, firm clay loam about 21 inches thick. The underlying material to a depth of about 60 inches is brown, friable, calcareous loam. In some small areas sand is below a depth of 40 inches. In places the upper part of the subsoil has gray mottles.

Included with this soil in mapping are small areas of Capac, Metea, Oshtemo, and Parkhill soils. Capac soils are somewhat poorly drained and are in narrow drainageways and the lower areas. Metea and Oshtemo soils are in landscape positions similar to those of the Marlette soil. They are more droughty than the Marlette soil. Metea soils have a sandy surface layer. Parkhill soils are poorly drained and are in narrow drainageways and on some of the lowest parts of the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Marlette soil, and available water capacity is high. Surface runoff is medium.

Most areas of this soil are used for cultivated crops or orchards. Some are used as pasture, woodland, or building sites.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion and tilth. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops slow runoff, help to control water erosion, and improve tilth. In areas where it is feasible, contour farming also slows runoff and helps to control water erosion. In the lower areas, where water tends to puddle after heavy rains, crusting is a problem. Tilling when the soil is too wet can alter soil structure and can result in soil compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope, this soil is only fairly well suited to building site development. It is poorly suited to septic tank absorption fields because of the slope and the moderately slow permeability. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. Also, special construction methods, such as enlarging the absorption fields or alternating drain fields, are needed to overcome the moderately slow permeability.

The land capability classification is IIIe. The Michigan soil management group is 2.5a.

36D—Marlette loam, 12 to 18 percent slopes. This strongly sloping or rolling, well drained soil is on the convex side slopes of ridges, knolls, and breaks to streams and drainageways. Individual areas are irregularly shaped or elongated and range from 2 to 110 acres in size.

Typically, the surface layer is dark brown, friable loam about 7 inches thick. The next 5 inches is mixed dark yellowish brown, firm clay loam and light brownish gray loam. The subsoil is dark yellowish brown, firm clay loam about 15 inches thick. The underlying material to a depth of about 60 inches is brown, friable, calcareous loam. In some small areas sand is below a depth of 40 inches.

Included with this soil in mapping are small areas of Boyer and Spinks soils. These soils are in landscape positions similar to those of the Marlette soil. They have a sandy surface layer and are more droughty than the Marlette soil. Also included are areas of the somewhat poorly drained Capac soils in drainageways and around depressions and small seepy areas of the poorly drained Parkhill soils along breaks to the Grand River. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Marlette soil, and available water capacity is high. Surface runoff is rapid.

Most areas of this soil are used for orchards or pasture. Some are used as cropland or woodland.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are water erosion, tilth, and the equipment limitation caused by slope. Cover crops and green manure crops, slow runoff. In areas where it is feasible, contour farming also slows runoff. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, slows runoff, helps to control water erosion, and improves tilth. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods. A permanent cover of vegetation, such as perennial grasses, helps to control runoff and water erosion in orchards.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in slowing runoff and controlling water erosion. Proper stocking rates and pasture rotation help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope, this soil is poorly suited to building site development. It is poorly suited to septic tank absorption fields because of the slope and the moderately slow permeability. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing distribution lines across the slope help to ensure that septic tank absorption fields function properly. Also, special construction methods, such as enlarging the absorption fields, are needed to overcome the moderately slow permeability.

The land capability classification is IVe. The Michigan soil management group is 2.5a.

36E—Marlette loam, 18 to 25 percent slopes. This steep, well drained soil is on the convex side slopes of ridges, hills, and breaks to streams and drainageways. Individual areas are long and narrow or irregularly shaped and range from 2 to 80 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 6 inches thick. The next 5 inches is mixed dark yellowish brown, firm clay loam and light brownish gray loam. The subsoil is dark yellowish brown, firm clay loam about 15 inches thick. The underlying material to a depth of about 60 inches is brown, friable, calcareous loam. In some small areas sand is below a depth of 40 inches.

Included with this soil in mapping are areas of Boyer, Capac, and Chelsea soils. Boyer soils and the somewhat excessively drained Chelsea soils are in landscape positions similar to those of the Marlette soil. They have a sandy surface layer and are more droughty than the Marlette soil. Capac soils are somewhat poorly drained and are in drainageways and the lower landscape positions. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Marlette soil, and available water capacity is high. Surface runoff is very rapid.

Most areas of this soil are used as woodland. Some are used for orchards or pasture.

This soil is unsuited to cultivated crops because of the equipment limitation caused by slope, the hazard of water erosion, and tilth. A permanent cover of vegetation, such as perennial grasses, helps to control runoff and water erosion in orchards.

This soil is poorly suited to pasture. A permanent cover of vegetation is effective in controlling water erosion. Operating equipment along the contour of the land can minimize the equipment limitation caused by slope.

This soil is well suited to woodland. Erosion and the equipment limitation are the main management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, and culverts. Ordinary crawler tractors and rubber-tired skidders can be operated on these slopes, but caution is needed.

Because of the slope, this soil is generally unsuited to septic tank absorption fields and building site development.

The land capability classification is VIe. The Michigan soil management group is 2.5a.

36F—Marlette loam, 25 to 45 percent slopes. This very steep, well drained soil is on the convex side slopes of ridges and breaks to streams and drainageways. Individual areas are long and narrow and range from 2 to 50 acres in size.

Typically, the surface layer is very dark brown, friable loam about 5 inches thick. The next 6 inches is mixed dark yellowish brown, firm clay loam and light brownish gray loam. The subsoil is dark yellowish brown, firm clay loam about 16 inches thick. The underlying material to a depth of about 60 inches is brown, friable, calcareous loam. In some areas sand is below a depth of 40 inches.

Included with this soil in mapping are small areas of Boyer soils and the somewhat excessively drained Chelsea soils. Both of these soils are in landscape positions similar to those of the Marlette soil. They have a sandy surface layer and are more droughty than the Marlette soil. Also included, near the major watercourses, are small areas of calcareous, cemented conglomerate called tufa. Included areas make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Marlette soil, and available water capacity is high. Surface runoff is very rapid.

Most areas are used as woodland. Some small areas are used for orchards or pasture. This soil is unsuited to cultivated crops and pasture because of the very steep slope.

This soil is well suited to woodland. Erosion and the equipment limitation are the main management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, and culverts. Caution is needed if ordinary crawler tractors and rubber-tired skidders are operated on these slopes.

Because of the slope, this soil is generally unsuited to septic tank absorption fields and building site development.

The land capability classification is VIIe. The Michigan soil management group is 2.5a.

37B—Capac loam, 0 to 4 percent slopes. This nearly level and undulating, somewhat poorly drained soil is on short or long, convex slopes on low knolls and ridges. Individual areas are irregular in shape and range from 2 to 1,015 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 10 inches thick. The next 3 inches is mixed pale brown, mottled, friable fine sandy loam and dark yellowish brown, mottled loam. Below this is about

14 inches of mixed brown and pale brown, mottled, friable loam and about 11 inches of brown, friable clay loam. The underlying material to a depth of about 60 inches is brown, mottled, friable, calcareous loam. In some small areas the subsoil is not so gray. In places the content of clay is lower throughout the profile.

Included with this soil in mapping are small areas of the poorly drained Parkhill soils in drainageways and small depressions. Also included are areas of Selfridge soils in landscape positions similar to those of the Capac soil or on low slopes next to drainageways. These soils have a sandy surface layer. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Capac soil, and available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet in winter, in spring, and during other excessively wet periods.

Most areas of this soil are used for cultivated crops or orchards. Some are used as woodland or pasture.

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are wetness, water erosion, and tilth. If drainage outlets are available, subsurface drainage tile is effective in reducing the wetness. Suitable filtering material may be needed around the tile to keep fine sand and silt from flowing into the tile lines. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion, improve tilth, and help to prevent crusting after heavy rainfall. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Restricted grazing during wet periods helps to prevent compaction. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is well suited to woodland. The major concern is the equipment limitation. Heavy equipment tends to form ruts when the soil is wet. The equipment limitations should be used only when the soil is relatively dry or frozen.

Because of the wetness, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness and the moderately slow permeability. A surface or subsurface drainage system lowers the water table on building sites. The buildings can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIw. The Michigan soil management group is 2.5b.

38—Parkhill loam. This nearly level, poorly drained soil is on flats and in drainageways and low areas. It is subject to ponding. Individual areas are irregular in shape and range from 4 to 150 acres in size.

Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsoil is gray, friable silt loam about 5 inches thick. The underlying material to a depth of about 60 inches is multicolored, friable silt loam. In some areas the surface layer and upper part of the subsoil are sandy loam. In other areas the underlying material is gravelly sand.

Included with this soil in mapping are small areas of Belleville, Capac, and Houghton soils. Belleville soils are in landscape positions similar to those of the Parkhill soil. They have a sandy surface layer. Capac soils are somewhat poorly drained and are on the side slopes of slight ridges and knolls. Houghton soils are very poorly drained and are in the lowest positions on the landscape. They are organic throughout. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Parkhill soil, and available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during excessively wet periods.

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

If drained, this soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are wetness and tilth. If adequate drainage outlets are available, a subsurface drainage system is effective in removing excess water. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops improve tilth and increase the rate of water infiltration.

This soil is poorly suited to pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to prevent compaction and help to maintain the pasture. The pasture plants that can tolerate the wetness should be selected for planting. If possible, a surface drainage system should be installed to remove excess water.

This soil is well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. Equipment should be used only when the soil is frozen or relatively dry. Special harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness, this soil is unsuited to septic tank absorption fields and building site development.

The land capability classification is IIw. The Michigan soil management group is 2.5c.

39B—Arkport loamy very fine sand, 1 to 6 percent slopes. This nearly level and gently sloping or undulating, well drained soil is on low knolls and foot slopes along drainageways and at the head of the drainageways. Individual areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is dark brown, very friable loamy very fine sand about 9 inches thick. The subsurface layer is yellowish brown, very friable loamy very fine sand about 8 inches thick. Below this to a depth of about 60 inches is pale brown and very pale brown, very friable loamy very fine sand that has thin lamellae of yellowish brown, friable very fine sandy loam. In some places the lower part of the subsoil is coarser in texture or is fine sand or very fine sand that has no lamellae of finer textured material. In other places it has gray mottles. In some areas the subsoil contains more clay.

Included with this soil in mapping are small areas of Dixboro, Marlette, and Oakville soils. The somewhat poorly drained Dixboro soils are in drainageways and in nearly level areas on the lower parts of the landscape. Marlette soils are in the higher landscape positions. They have a loamy surface layer and are not so droughty as the Arkport soil. Included soils make up 7 to 15 percent of the unit.

Permeability is moderately rapid in the Arkport soil, and available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are used as cropland. Some are used as pasture or woodland. Some of the acreage is idle land or is used for building site development.

This soil is well suited to such crops as corn, oats, winter wheat, and hay. Water erosion and soil blowing are the major management concerns. Contour farming and contour stripcropping slow runoff. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control erosion and soil blowing and conserve moisture. Wind stripcropping, vegetative barriers, buffer strips, and field windbreaks also help to control soil blowing. Irrigating when soil moisture levels are low can increase productivity.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling erosion. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. Seedling mortality is the main management concern. It can be controlled by special site preparation, such as furrowing and applying herbicide. Containerized stock may be necessary to achieve a better survival rate. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem.

This soil is well suited to building site development and septic tank absorption fields. No major management concerns affect these uses.

The land capability classification is IIe. The Michigan soil management group is 3a-s.

39C—Arkport loamy very fine sand, 6 to 12 percent slopes. This sloping or gently rolling, well drained soil is on concave foot slopes and short, uneven side slopes, particularly along drainageways and at the head of the drainageways. Individual areas are irregular in shape and range from 5 to 35 acres in size.

Typically, the surface layer is dark brown, very friable loamy very fine sand about 8 inches thick. The subsurface layer is yellowish brown, very friable loamy very fine sand about 8 inches thick. Below this to a depth of about 60 inches is pale brown and very pale brown, very friable loamy very fine sand that has thin lamellae of yellowish brown, friable very fine sandy loam. In some places the lower part of the subsoil is less than 24 inches thick. In other places it is coarse textured or is fine sand or very fine sand that has no lamellae of finer textured material. In some areas it has gray mottles. In other places the subsoil contains more clay.

Included with this soil in mapping are small areas of Dixboro and Marlette soils. The somewhat poorly drained Dixboro soils are in drainageways and in nearly level areas on the lower parts of the landscape. Marlette soils are in the higher landscape positions. They have a loamy surface layer and are not so droughty as the Arkport soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Arkport soil, and available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are pastured. Some are used as cropland or woodland. A few are idle land or are used for building site development.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Water erosion and soil blowing are the major management concerns. Contour farming and contour stripcropping slow runoff and reduce the susceptibility to water erosion. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and conserve moisture. Wind stripcropping, vegetative barriers, buffer strips, and field windbreaks also help to control soil blowing.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. Seedling mortality is the main management concern. It can be controlled by special site preparation, such as furrowing and applying herbicide. Containerized stock may be necessary to achieve a better survival rate. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem.

Because of the slope, this soil is only fairly well suited to building site development and septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly.

The land capability classification is IIIe. The Michigan soil management group is 3a-s.

40B—Matherton loam, 0 to 4 percent slopes. This nearly level and undulating, somewhat poorly drained soil is on flats and the concave slopes of knolls and ridges. Individual areas are irregularly shaped or elongated and range from 2 to 70 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 8 inches thick. The subsurface layer is grayish brown, mottled, friable loam about 4 inches thick. The subsoil is about 18 inches thick. It is mottled. The upper part is brown, firm clay loam; the next part is dark yellowish brown, friable sandy clay loam; and the lower part is dark yellowish brown, friable sandy loam. The underlying material to a depth of about 60 inches is light yellowish brown, loose, calcareous gravelly sand. In places the surface layer is sand or loamy sand.

Included with this soil in mapping are small areas of Capac, Kalamazoo, and Sebewa soils. Capac soils are in landscape positions similar to those of the Matherton soil. They are not so droughty as the Matherton soil. Kalamazoo soils are well drained and are in the higher positions on the landscape. Sebewa soils are poorly drained and are in drainageways and low spots. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Matherton soil and very rapid in the lower part. Available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet during excessively wet periods.

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

This soil is well suited to such crops as corn, oats, winter wheat, and hay. Wetness and tilth are the major management concerns. A subsurface drainage system is effective in removing excess water. Suitable filtering material may be needed around the tile to keep fine sand and silt from plugging the tile lines. Tilling when the soil is too wet can alter soil structure and can result in the formation of clods.

This soil is well suited to pasture. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is well suited to woodland. The major management concern is the equipment limitation. Heavy equipment tends to form ruts when the soil is wet. The equipment should be used only when the soil is relatively dry or frozen.

Because of the wetness, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness and a poor filtering capacity. A surface or subsurface drainage system lowers the water table on building sites. Buildings can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIw. The Michigan soil management group is 3/5b.

41B—Kibbie loam, 0 to 4 percent slopes. This nearly level and undulating, somewhat poorly drained soil is on flats and the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 70 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 8 inches thick. The subsurface layer is grayish brown, friable loam about 4 inches thick. The subsoil is about 22 inches thick. It is brown, mottled, and friable. The upper part is silt loam, and the lower part is silty clay loam. The underlying material to a depth of about 60 inches is brown, mottled, friable, stratified very fine sand to silty clay loam. In some places the subsoil does not have gray mottles in the upper part. In other places the underlying material is not stratified and is clay loam.

Included with this soil in mapping are small areas of the poorly drained Colwood soils in drainageways and low spots. These soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Kibbie soil, and available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet during excessively wet periods.

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

This soil is well suited to such crops as corn, oats, winter wheat, and hay. Water erosion, tilth, and wetness are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control erosion and maintain tilth. A subsurface drainage system is effective in removing excess water. Suitable filtering material may be needed around the tile to keep sand and silt from plugging the tile lines. Tilling when the soil is too wet can alter soil structure and can result in the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Restricted grazing during wet periods helps to prevent damage to the plants and helps keep the pasture in good condition. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is well suited to woodland. The major management concern is the equipment limitation. Heavy equipment tends to form ruts when the soil is wet. The equipment should be used only when the soil is relatively dry or frozen.

Because of the wetness, this soil is generally unsuited to septic tank absorption fields and building site development.

The land capability classification is IIe. The Michigan soil management group is 2.5b-s.

42B—Tedrow loamy fine sand, 0 to 4 percent slopes. This nearly level and undulating, somewhat poorly drained soil is on flats and the concave side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 165 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loamy fine sand about 7 inches thick. The subsoil is about 23 inches thick. It is yellowish brown. The upper part is very friable loamy fine sand, and the lower part is mottled, loose fine sand. The underlying material to a depth of about 60 inches is pale brown and light yellowish brown, mottled, loose fine sand. In some areas the surface layer is sand. In other areas thin loamy bands are in the subsoil. In a few places gravel is in the underlying material.

Included with this soil in mapping are small areas of Capac, Granby, Oakville, and Selfridge soils. Capac and Selfridge soils are in landscape positions similar to those of the Tedrow soil. Capac soils have a loamy surface layer. Selfridge soils are not so droughty as the Tedrow soil during dry periods. Granby soils are poorly drained and are in low spots and drainageways. Oakville soils are well drained and are on knolls and ridges. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Tedrow soil, and available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet in winter, in spring, and during other excessively wet periods.

Most of the acreage of this soil is pastured or is idle land. Some areas are used as woodland.

This soil is fairly well suited to such crops as corn, winter wheat, and hay. The major management concerns are droughtiness, soil blowing, and wetness. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material increase the available water capacity and reduce the susceptibility to soil blowing. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing. If drainage outlets are available, a subsurface drainage system is effective in removing excess water. Suitable filtering material may be needed around the tile to keep fine sands from flowing into the tile lines.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during wet and extremely dry periods help to keep the pasture in good condition.

This soil is fairly well suited to woodland. The major management concern is the equipment limitation. Heavy equipment tends to form ruts when the soil is dry or excessively wet. The equipment should be used only when the soil is moist and friable or is frozen.

Because of the wetness, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness and a poor filtering capacity. A surface or subsurface drainage system lowers the water table on building sites. Buildings can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIIs. The Michigan soil management group is 5b.

43—Granby loamy fine sand. This nearly level, poorly drained soil is on flats and in drainageways and low areas. It is subject to ponding. Individual areas are irregular in shape and range from 2 to 180 acres in size.

Typically, the surface layer is black, very friable loamy fine sand about 11 inches thick. The subsoil is about 31 inches thick. It is mottled. The upper part is grayish brown, very friable loamy fine sand; the next part is light brownish gray, very friable fine sand; and the lower part is pale brown, loose sand. The underlying material to a depth of about 60 inches is yellowish brown, mottled sand. In places the surface layer is muck. In some areas the subsoil has thin layers of fine sand and silt. In other areas it has more clay in the upper part.

Included with this soil in mapping are areas of the somewhat poorly drained Pipestone and Tedrow soils on the sides and foot slopes of small ridges and low knolls. These soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Granby soil, and available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during excessively wet periods.

Most areas of this soil are used as woodland. Some are used as cropland.

If drained, this soil is poorly suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are wetness, droughtiness, and soil blowing. A subsurface drainage system is effective in removing excess water; however, locating drainage outlets is difficult in some areas. Suitable filtering material may be needed around the tile to keep fine sand from flowing into the tile lines. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control soil blowing and increase the available water capacity during dry periods.

This soil is poorly suited to pasture. If possible, a surface drainage system should be installed to reduce the wetness. The pasture plants that can tolerate the wetness should be selected for planting. Proper stocking rates, pasture rotation, and restricted grazing when the soil is wet are needed.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. The use of heavy equipment should be restricted to periods when the soil is frozen or dry. Special harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness, this soil is unsuited to septic tank absorption fields and building site development.

The land capability classification is IVw. The Michigan soil management group is 5c.

44—Edwards muck. This nearly level, very poorly drained soil is in bogs, along drainageways, and in depressions on uplands. It is subject to ponding. Individual areas are round, elongated, or irregularly shaped and range from 2 to 50 acres in size.

Typically, the surface layer is black, friable muck about 13 inches thick. The subsurface layer is very dark grayish brown muck about 17 inches thick. The underlying material to a depth of about 60 inches is white marl. In some areas the depth to marl is less than 16 inches, and in other areas it is more than 51 inches.

Included with this soil in mapping are small areas of the poorly drained Palms soils. These soils are underlain by loamy material. They make up 5 to 15 percent of the unit.

Permeability is moderately slow to moderately rapid in the layers of muck in the Edwards soil. Available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during excessively wet periods.

Most areas of this soil are used as cropland. Many are used for vegetable crops. Some are pastured or support native vegetation. Some are mined for marl, which is used as liming material.

This soil is poorly suited to most crops. If a drainage system is installed, however, such crops as corn, carrots, celery, onions, peppers, and hay can be grown. Wetness, soil blowing, and subsidence are the major management concerns. A subsurface drainage system is effective in removing excess water. Draining many areas is difficult, however, because drainage outlets are not readily available. Also, a subsurface drainage system is not economical in areas where the organic material is less than 20 inches thick. Controlled drainage improves soil stability and reduces the extent of subsidence. Field windbreaks, buffer strips, and cover crops help to control soil blowing. The use of equipment is limited during wet periods.

This soil is poorly suited to pasture. Grazing when the soil is wet can destroy forage plants.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. The use of heavy planting and harvesting equipment is limited by the wetness and by low strength. The equipment should be used only when the soil is frozen. The windthrow hazard can be reduced by special harvest methods that do not isolate the remaining trees or leave them widely spaced. Windthrown trees should be periodically removed.

Because of the wetness, this soil is unsuited to septic tank absorption fields and building site development.

The land capability classification is IVw. The Michigan soil management group is M/mc.

45B—Perrinton loam, 2 to 6 percent slopes. This gently sloping or undulating, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 510 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 5 inches thick. The subsurface layer is pale brown loam about 3 inches thick. The next 12 inches is mixed brown and pale brown, firm loam and reddish brown, firm clay loam. The subsoil is about 19 inches thick. It is reddish brown and firm. The upper part is clay loam, and the lower part is silty clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, firm silty clay loam. In some small areas gray mottles are in the lower part of the subsoil and in the underlying material. In some areas the upper part of the soil is sand or loamy sand less than 20 inches thick. In some small areas the soil is underlain by sand below a depth of 20 inches.

Included with this soil in mapping are areas of Oakville and Tustin soils on the tops of knolls and ridges and on the lower parts of convex side slopes along breaks to drainageways. These soils have a sandy surface layer and are more droughty than the Perrinton soil. Also included are the somewhat poorly drained Ithaca and Rimer soils in drainageways. Rimer soils are sandy in the upper part. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Perrinton soil, and available water capacity is high. Surface runoff is medium.

Most areas of this soil are used for cultivated crops or orchards. Some are used as pasture or woodland.

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion and tilth. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and improve tilth. The soil tends to puddle and crust after heavy rains. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Restricted grazing during extremely wet periods helps to prevent compaction and helps to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the shrink-swell potential in the subsoil and underlying material, this soil is only fairly well suited to building site development. It is generally unsuited to septic tank absorption fields because of the moderately slow permeability. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIe. The Michigan soil management group is 1.5a.

45C—Perrinton loam, 6 to 12 percent slopes. This gently rolling, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 190 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 5 inches thick. The subsurface layer is pale brown, friable loam about 3 inches thick. The next 12 inches is mixed pale brown, firm loam and reddish brown, firm clay loam. The subsoil is about 19 inches thick. It is reddish brown and firm. The upper part is clay loam, and the lower part is silty clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, firm silty clay loam. In some areas gray mottles are in the lower part of the subsoil and in the underlying material. In other areas the upper part of the soil is sand or loamy sand less than 20 inches thick. In some small areas the soil is underlain by sand below a depth of 20 inches.

Included with this soil in mapping are small areas of Oakville and Tustin soils on the tops of knolls and ridges and along the lower parts of convex side slopes. These soils have a sandy surface layer and are more droughty than the Perrinton soil. Also included are the somewhat poorly drained Ithaca and Rimer soils in drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Perrinton soil, and available water capacity is high. Surface runoff is medium.

Most areas of this soil are used as cropland or woodland. Some are used for orchards or pasture.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion and tilth. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops slow runoff, reduce the susceptibility to erosion, and improve tilth. In areas where it is feasible, farming on the contour also slows runoff and helps to control water erosion. In the lower areas the soil tends to puddle and crust after heavy rains. Tilling when the soil is wet can alter soil structure and can result in compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Restricted grazing during extremely wet periods helps to prevent compaction and helps to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope and the shrink-swell potential in the subsoil and underlying material, this soil is only fairly well suited to building site development. It is generally unsuited to septic tank absorption fields because of the moderately slow permeability. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIIe. The Michigan soil management group is 1.5a.

45D—Perrinton loam, 12 to 18 percent slopes. This strongly sloping or rolling, well drained soil is on the convex side slopes of knolls, ridges, and breaks to streams and drainageways. Individual areas are irregularly shaped or elongated and range from 2 to 90 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 4 inches thick. The subsurface layer is pale brown, friable loam about 3 inches thick. The next 10 inches is mixed brown and pale brown, firm loam and reddish brown, firm clay loam. The subsoil is about 19 inches thick. It is reddish brown and firm. The upper part is clay loam, and the lower part is silty clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, firm silty clay loam. In some areas a layer of sand or sandy loam is in the upper part of the profile. Some areas along the base of the slopes are seepy. In some small areas the soil is underlain by sand below a depth of 20 inches.

Included with this soil in mapping are small areas of Ithaca, Oakville, and Rimer soils. Oakville soils are on the tops of ridges and on the foot slopes along breaks to drainageways. They have a sandy surface layer and are more droughty than the Perrinton soil. The somewhat poorly drained Ithaca and Rimer soils and the poorly drained Pewamo soils are in drainageways. Also included are areas where escarpments are common along breaks to drainageways. Included areas make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Perrinton soil, and available water capacity is high. Surface runoff is rapid.

Most areas of this soil are used as pasture or woodland. Some of the acreage is cropland, is used for orchards, or is idle land.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are water erosion, the equipment limitation caused by slope, and tilth. In areas where it is feasible, farming on the contour minimizes the equipment limitation, slows runoff, and reduces the susceptibility to water erosion. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops slow runoff, help to control water erosion, and improve tilth. In the lower areas the soil tends to puddle and crust after heavy rains. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods (fig. 9). A cover of permanent vegetation, such as perennial grasses, helps to control runoff and erosion in orchards.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in slowing runoff and controlling water erosion. Restricted grazing during extremely wet periods helps to prevent compaction and helps to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope and the shrink-swell potential in the subsoil and underlying material, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the moderately slow permeability and the slope. Buildings should be designed so that they conform to the natural slope of the land. In many areas land shaping is necessary. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IVe. The Michigan soil management group is 1.5a.

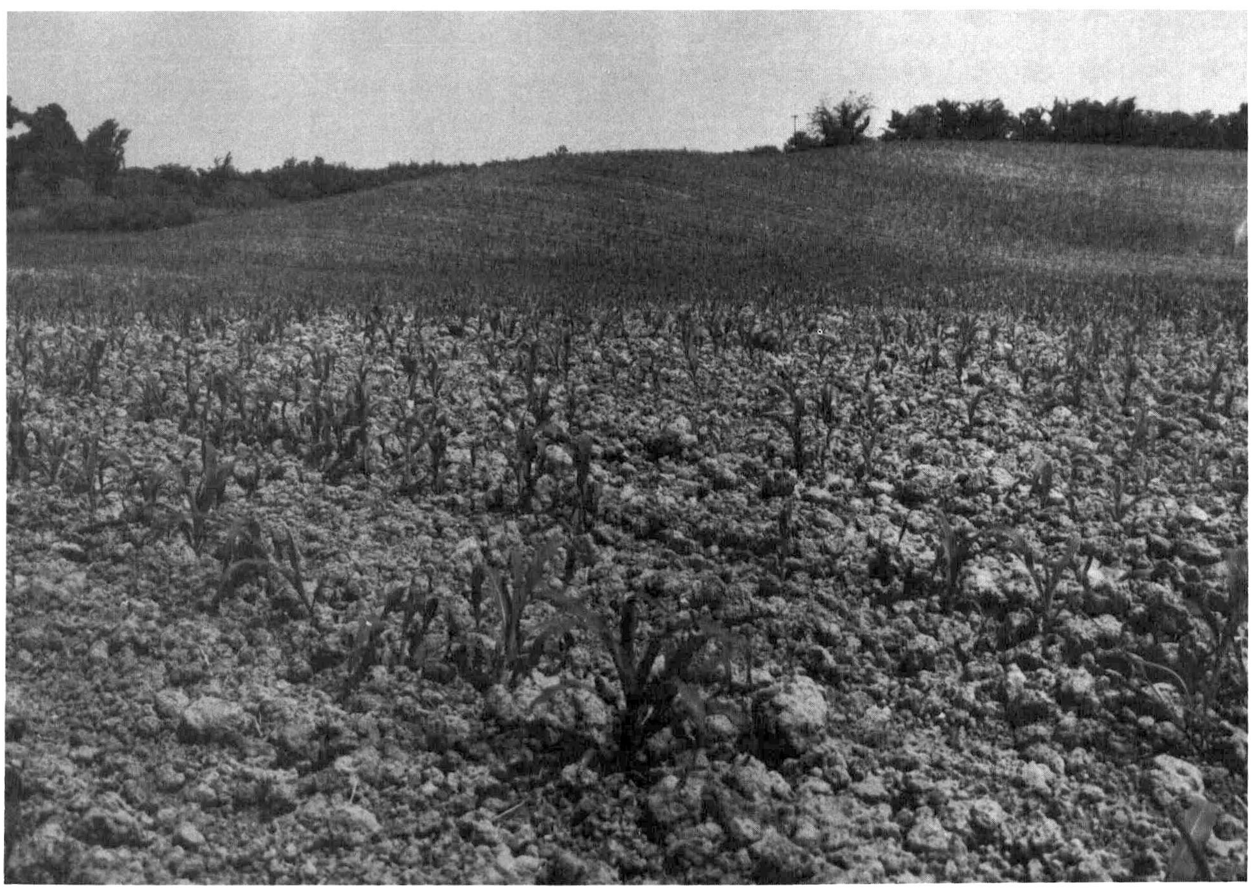

Figure 9.—Clods formed in an area of Perrinton loam, 12 to 18 percent slopes.

45E—Perrinton loam, 18 to 25 percent slopes. This steep, well drained soil is on the convex side slopes of ridges and along breaks to streams and drainageways. Individual areas are irregularly shaped or long and narrow and range from 2 to 90 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 3 inches thick. The subsurface layer is pale brown, friable loam about 3 inches thick. The next 10 inches is mixed brown and pale brown, firm loam and reddish brown, firm clay loam. The subsoil is about 17 inches thick. It is reddish brown and firm. The upper part is clay loam, and the lower part is silty clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, firm silty clay loam. In some areas the upper part of the soil is sand or sandy loam as much as 40 inches thick. In other areas the soil is underlain by sandy material below a depth of 20 inches. Some areas along the base of the slopes are seepy.

Included with this soil in mapping are small areas of Oakville soils on the tops of ridges and along the foot slopes adjacent to drainageways. These soils have a sandy surface layer and are more droughty than the Perrinton soil. Also included are small areas of the somewhat poorly drained Ithaca and Rimer and poorly drained Pewamo soils in drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Perrinton soil, and available water capacity is high. Surface runoff is rapid.

Most areas are used as woodland. Some are used as pasture. This soil is unsuited to row crops because of the equipment limitation caused by slope. Water erosion and tilth are other major management concerns.

This soil is poorly suited to pasture. A cover of pasture plants may be effective in controlling water erosion. If it is feasible, reseeding pasture on the contour can minimize the equipment limitation caused by slope.

This soil is well suited to woodland. Erosion and the equipment limitation are the major management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, and culverts. Caution is needed if ordinary crawler tractors and rubber-tired skidders are operated on these slopes.

Because of the slope, this soil is generally unsuited to septic tank absorption fields and building site development.

The land capability classification is VIe. The Michigan soil management group is 1.5a.

45F—Perrinton loam, 25 to 40 percent slopes. This very steep, well drained soil is on the convex side slopes of ridges and along breaks to streams and drainageways. Individual areas are irregularly shaped and narrow and range from 2 to 20 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 2 inches thick. The subsurface layer is pale brown, friable loam about 3 inches thick. The next 8 inches is mixed brown and pale brown, firm loam and reddish brown, firm clay loam. The subsoil is about 17 inches thick. It is reddish brown and firm. The upper part is clay loam, and the lower part is silty clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, firm silty clay loam. In some areas the upper part of the soil is sand or sandy loam as much as 40 inches thick. In other areas the soil is underlain by sandy material below a depth of 20 inches. Some areas along the base of the slopes are seepy.

Included with this soil in mapping are small areas of Oakville soils on the tops of ridges and the foot slopes along drainageways. These soils have a sandy surface layer and are more droughty than the Perrinton soil. Also included are small areas of the somewhat poorly drained Ithaca and Rimer and poorly drained Pewamo soils in drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Perrinton soil, and available water capacity is high. Surface runoff is very rapid.

Most areas are used as woodland. This soil is unsuited to cultivated crops and pasture because of the slope. The major management concerns are water erosion and the equipment limitation caused by slope.

This soil is well suited to woodland. Erosion and the equipment limitation are the major management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, and culverts. Extreme caution is needed if ordinary crawler tractors and rubber-tired skidders are operated on these slopes. Special logging methods, such as yarding the logs uphill with a cable, may be needed to minimize the use of rubber-tired and crawler tractors.

Because of the slope, this soil is generally unsuited to septic tank absorption fields and building site development.

The land capability classification is VIIe. The Michigan soil management group is 1.5a.

46B—Ithaca loam, 1 to 6 percent slopes. This nearly level and gently sloping or undulating, somewhat poorly drained soil is on the uneven side slopes of low knolls and ridges. Individual areas are irregular in shape and range from 2 to 120 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 9 inches thick. The next 8 inches is mixed pale brown, firm silt loam and yellowish brown, firm clay loam. The subsoil is yellowish brown, mottled, firm clay loam about 15 inches thick. The underlying material to a depth of about 60 inches is brown, mottled, calcareous, firm clay loam. In some places as much as

20 inches of loamy sand or sand is on the surface. In other places thin layers of fine sand and silt are in the subsoil and underlying material.

Included with this soil in mapping are small areas of the well drained Perrinton soils, the poorly drained Pewamo soils, and the somewhat poorly drained Rimer soils. Perrinton soils are on the tops of knolls and ridges and on the more sloping parts of the landscape. Pewamo soils are in depressions and drainageways. Rimer soils are in landscape positions similar to those of the Ithaca soil. They have a sandy surface layer. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Ithaca soil, and available water capacity is high. Surface runoff is medium. The seasonal high water table is at a depth of 1 to 2 feet during excessively wet periods.

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

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion, wetness, and tilth. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and improve tilth. A subsurface drainage system is effective in reducing the wetness. The soil tends to puddle and crust after heavy rains. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Restricted grazing during wet periods helps to prevent compaction and helps to keep the pasture in good condition. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is well suited to woodland. The major management concern is the equipment limitation. Heavy equipment tends to form ruts when the soil is wet. The equipment should be used only when the soil is relatively dry or frozen.

Because of the wetness and the shrink-swell potential in the subsoil and underlying material, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness and the moderately slow permeability. A surface or subsurface drainage system lowers the water table on building sites. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. Buildings can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIe. The Michigan soil management group is 1.5b.

47—Pewamo loam. This nearly level, poorly drained soil is on flats and in drainageways and low areas. It is subject to ponding. Individual areas are irregular in shape and range from 2 to 80 acres in size.

Typically, the surface soil is about 16 inches thick. It is friable. The upper part is very dark grayish brown loam about 10 inches thick, and the lower part is very dark gray silty clay loam. The subsoil is about 20 inches thick. It is mottled. The upper part is gray, friable silty clay loam, and the lower part is gray, firm silty clay. The underlying material to a depth of about 60 inches is gray, mottled, firm, calcareous silty clay loam. In places the surface layer is muck. In some small areas the calcareous underlying material is within 10 to 20 inches of the surface. In some areas the soil is underlain by sand below a depth of 40 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount, Rimer, and Ithaca soils. Blount and Ithaca soils are on the slightly higher parts of the landscape. Blount soils are south of the Grand River, and Ithaca soils are north of the Grand River. Rimer soils are on small ridges and knolls. They have a sandy surface layer. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Pewamo soil, and available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during excessively wet periods.

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

If drained, this soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are wetness and tilth. A subsurface drainage system is effective in reducing the wetness; however, locating drainage outlets is difficult in some areas. The soil tends to puddle and crust after heavy rains. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of large clods. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops improve tilth and increase the rate of water infiltration.

This soil is poorly suited to pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to prevent compaction and help to maintain the pasture. The pasture plants that can tolerate the wetness should be selected for planting. If possible, a surface drainage system should be installed to reduce the wetness.

This soil is well suited to woodland. Seedling mortality, the equipment limitation, and the windthrow hazard are the major management concerns. Because the soil is wet and sticky, the use of equipment is limited during wet periods. When the soil is wet, logging roads tend to become slippery and ruts form quickly. The equipment should be used only when the soil is relatively dry or frozen. Special harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness and the moderately slow permeability, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is IIw. The Michigan soil management group is 1.5c.

48B—Metea loamy sand, 2 to 6 percent slopes. This undulating, well drained soil is on the tops and convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 100 acres in size.

Typically, the surface layer is dark brown, very friable loamy sand about 9 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown, loose sand; the next part is brownish yellow, loose sand; and the lower part is brown, friable clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, friable loam. In places the sandy material is more than 40 inches thick. In a few areas the underlying material is clayey. In some areas sand is below the loamy underlying material.

Included with this soil in mapping are small areas of Chelsea, Marlette, and Selfridge soils. Chelsea soils are somewhat excessively drained and are on the tops of some knolls. They are sandy throughout. Marlette soils are on the tops of some knolls and ridges. They are loamy throughout. Selfridge soils are somewhat poorly drained and are in drainageways and low spots. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the upper part of the Metea soil and moderately slow in the lower part. Available water capacity is moderate. Surface runoff is slow.

Most areas of this soil are used for cultivated crops or orchards. Some are used for pasture, woodland, or building site development.

This soil is fairly well suited to such crops as corn, winter wheat, oats, asparagus, and hay. Water erosion, soil blowing, and droughtiness are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and conserve moisture (fig. 10). Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing. Deep-rooted specialty crops, such as asparagus, are not affected by the droughtiness in the upper layers of the soil.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

This soil is well suited to woodland. Seedling mortality is the major management concern. It can be controlled by special site preparation, such as furrowing and applying herbicide, and by special harvest methods that leave some mature trees to provide shade and protection from the wind. Containerized or oversized planting stock may be necessary to achieve a better survival rate.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of the moderately slow permeability in the loamy subsoil and underlying material. Special construction methods, such as enlarging the absorption fields or installing alternating drain fields, help to overcome this limitation.

The land capability classification is IIIe. The Michigan soil management group is 4/2a.

48C—Metea loamy sand, 6 to 12 percent slopes. This gently rolling, well drained soil is on the convex slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 40 acres in size.

Typically, the surface layer is dark brown, very friable loamy sand about 9 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown, loose sand; the next part is brownish yellow, loose sand; and the lower part is brown, friable clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, friable loam. In places the sandy material is more than 40 inches thick. In a few areas the underlying material is clayey. In some areas sand is below the loamy underlying material.

Included with this soil in mapping are small areas of Chelsea, Marlette, and Selfridge soils. Chelsea soils are somewhat excessively drained and are on the tops of some knolls. They are sandy throughout and are more droughty than the Metea soil. Marlette soils are on the tops of some knolls and ridges. They are loamy throughout and are less droughty than the Metea soil. Selfridge soils are somewhat poorly drained and are in drainageways and low spots. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the upper part of the Metea soil and moderately slow in the lower part. Available water capacity is moderate. Surface runoff is slow.

Most areas of this soil are used as cropland or pasture. Some are used for woodland or orchards.

This soil is fairly well suited to such crops as corn, winter wheat, oats, asparagus, and hay. Water erosion, soil blowing, and droughtiness are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and conserve moisture. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing. Deep-rooted specialty crops, such

Figure 10.—No-till corn in an area of Metea loamy sand, 2 to 6 percent slopes.

as asparagus, are not affected by the droughtiness in the upper layers of the soil.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

This soil is well suited to woodland. Seedling mortality is the major management concern. It can be controlled by special site preparation, such as furrowing and applying herbicide, and by special harvest methods that leave some mature trees to provide shade and protection from the wind. Containerized or oversized planting stock may be necessary to achieve a better survival rate.

Because of the slope, this soil is only fairly well suited to building site development. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. The soil is poorly suited to septic tank absorption fields because of the slope and the moderately slow permeability in the loamy subsoil and underlying material. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly. Special construction methods, such as enlarging the absorption fields or installing alternating drain fields, help to overcome the moderately slow permeability.

The land capability classification is IIIe. The Michigan soil management group is 4/2a.

48D—Metea loamy sand, 12 to 18 percent slopes. This strongly sloping or rolling, well drained soil is on the side slopes of ridges and knolls. Individual areas are elongated or irregularly shaped and range from 2 to 40 acres in size.

Typically, the surface layer is dark brown, very friable loamy sand about 8 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown, loose sand; the next part is brownish yellow, loose sand; and the lower part is brown, friable clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, friable loam. In places the sandy material is more than 40 inches thick. In a few areas the underlying material is clayey. In some areas sand is below the loamy underlying material.

Included with this soil in mapping are small areas of Chelsea and Marlette soils. Chelsea soils are somewhat excessively drained and are on the tops of some knolls. They are sandy throughout and are more droughty than the Metea soil. Marlette soils are on the tops and upper side slopes of some knolls and ridges. They are loamy throughout and are less droughty and less permeable than the Metea soil. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the upper part of the Metea soil and moderately slow in the lower part. Available water capacity is moderate. Surface runoff is medium.

Most of the acreage of this soil is pasture or idle land. Some areas are used as woodland or cropland.

This soil is poorly suited to most crops, but such crops as winter wheat, oats, and hay can be grown. Water erosion, soil blowing, and droughtiness are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to prevent excessive soil loss and conserve moisture. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks help to control soil blowing. Close-growing crops and grassed waterways help to control water erosion. The use of equipment is limited on the steeper slopes. These slopes should be farmed on the contour if possible.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

This soil is well suited to woodland. Seedling mortality is the main management concern. It can be controlled by planting seedlings in a furrow along the contour, by applying herbicide, and by applying special harvest methods that leave some mature trees to provide shade and protection from the wind. Containerized planting stock may be needed to achieve a better survival rate.

Because of the slope, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the slope and the moderately slow permeability in the loamy subsoil and underlying material. Buildings should be designed so that they conform to the natural slope of the land. In many areas land shaping is necessary. All sanitary facilities should be connected to municipal sewerage facilities.

The land capability classification is IVe. The Michigan soil management group is 4/2a.

49B—Selfridge loamy sand, 0 to 4 percent slopes. This nearly level and undulating, somewhat poorly drained soil is on flats characterized by slight rises, on the convex foot slopes of knolls, and in drainageways. Individual areas are irregularly shaped or elongated and range from 2 to 50 acres in size.

Typically, the surface layer is dark brown, very friable loamy sand about 12 inches thick. The subsoil is about 28 inches thick. It is mottled. The upper part is yellowish brown, very friable loamy sand; the next part is dark yellowish brown, friable sandy loam; and the lower part is brown, firm clay loam. The underlying material to a depth of about 60 inches is calcareous, pinkish gray, mottled, firm loam. In places the upper part of the soil is sandy loam.

Included with this soil in mapping are small areas of Belleville, Capac, and Metea soils. Belleville soils are poorly drained and are in drainageways and depressions. Capac soils are in landscape positions similar to those of the Selfridge soil. They have a loamy surface layer. Metea soils are well drained and are higher on the landscape than the Selfridge soil. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the upper part of the Selfridge soil and moderately slow in the lower part. Available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet in winter, in spring, and during other excessively wet periods.

Most of the acreage of this soil is cropland or idle land. Some areas are used as pasture or woodland.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion, soil blowing, and wetness. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and increase the available water capacity. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing. If drainage outlets are available, a subsurface drainage system is effective in reducing the wetness. Suitable filtering material may be needed around the tile to keep fine sand and silt from flowing into the tile lines.

This soil is fairly well suited to pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet or prolonged dry periods help to keep the pasture in good condition. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is well suited to woodland. The equipment limitation is the main management concern. Heavy equipment tends to form ruts when the soil is dry or excessively wet. The equipment should be used only when the soil is moist and friable or is frozen.

Because of the wetness, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness and the moderately slow permeability in the loamy subsoil and underlying material. A surface or subsurface drainage system lowers the water table on building sites. The buildings can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIIe. The Michigan soil management group is 4/2b.

50B—Woodbeck silt loam, 2 to 6 percent slopes. This undulating, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 45 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 8 inches thick. The subsurface layer is yellowish brown, friable silt loam about 4 inches thick. Below this, in sequence downward, are about 6 inches of mixed dark brown, friable silty clay loam and brown silt loam; 9 inches of dark brown, friable silty clay loam; 9 inches of strong brown and dark brown, firm silty clay; 17 inches of yellowish brown, loose sand; and 4 inches of dark yellowish brown, friable sandy loam. The underlying material to a depth of about 60 inches is light yellowish brown, loose, calcareous sand. In some places the depth to sandy material is less than 20 inches, and in other places it is more than 40 inches. In some areas the soil has a sandy surface layer less than 20 inches thick.

Included with this soil in mapping are small areas of Blount, Ithaca, and Spinks soils. Blount and Ithaca soils are somewhat poorly drained and are in the lower landscape positions and in drainageways. Spinks soils are in landscape positions similar to those of the Woodbeck soil. They have a sandy surface layer and are more droughty and more permeable than the Woodbeck soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the upper part of the Woodbeck soil and rapid in the lower part. Available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are for cultivated crops or orchards. Some are used for pasture or building site development.

This soil is well suited to such crops as corn, oats, winter wheat, and hay. Water erosion and tilth are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control erosion, conserve moisture, and improve tilth. The soil tends to puddle and crust after heavy rains. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Restricted grazing during extremely wet periods helps to prevent compaction and helps to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the shrink-swell potential, this soil is only fairly well suited to building site development. Widening the foundation trenches, excavating down to the sandy underlying material, and backfilling with suitable coarse material help to control shrinking and swelling.

Because of the moderately slow permeability in the upper layers and a poor filtering capacity in the sandy lower layers, this soil is poorly suited to septic tank absorption fields. The sandy lower layers readily absorb but do not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies. Excavating the upper loamy layers and part of the underlying sandy layers and installing the distribution lines in suitable backfilled coarse material help to overcome the moderately slow permeability and the poor filtering capacity.

The land capability classification is IIe. The Michigan soil management group is 1/5a.

50C—Woodbeck silt loam, 6 to 12 percent slopes. This gently rolling or moderately sloping, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 25 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 8 inches thick. The subsurface layer is yellowish brown, friable silt loam about 4 inches thick. Below this, in sequence downward, are about 6 inches of mixed dark brown, friable silty clay loam and brown silt loam; 9 inches of dark brown, friable silty clay loam; 9 inches of strong brown and dark brown, firm silty clay; 14 inches of yellowish brown, loose sand; and 3 inches of dark yellowish brown, friable sandy loam. The underlying material to a depth of about 60 inches is light yellowish brown, loose, calcareous sand. In some places the depth to sandy material is less than 20 inches, and in other places it is more than 40 inches. In some areas the soil has a sandy surface layer less than 20 inches thick.

Included with this soil in mapping are small areas of Blount, Ithaca, and Spinks soils. Blount and Ithaca soils are somewhat poorly drained and are in the lower landscape positions and in drainageways. Spinks soils are in landscape positions that are similar to those of the Woodbeck soil. They have a sandy surface layer and are more droughty and more permeable than the Woodbeck soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the upper part of the Woodbeck soil and rapid in the lower part. Available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are used for cultivated crops or orchards. Some are used for pasture or building site development.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Water erosion and tilth are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops slow runoff, help to control erosion, conserve soil moisture, and improve tilth. The soil should be farmed on the contour if possible. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Restricted grazing during extremely wet periods helps to prevent compaction and helps to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope and the shrink-swell potential, this soil is only fairly well suited to building site development. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Widening the foundation trenches, excavating down to the sandy underlying material, and backfilling with suitable coarse material help to control shrinking and swelling.

Because of the slope, the moderately slow permeability in the upper layers, and a poor filtering capacity in the sandy lower layers, this soil is poorly suited to septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly. The underlying sandy layers readily absorb but do not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies. Excavating the upper loamy layers and part of the underlying sandy layers and installing the distribution lines in suitable backfilled coarse material help to overcome the moderately slow permeability and the poor filtering capacity.

The land capability classification is IIIe. The Michigan soil management group is 1/5a.

50D—Woodbeck silt loam, 12 to 18 percent slopes. This rolling, well drained soil is on the convex side slopes of ridges and knolls. Individual areas are irregular in shape and range from 2 to 15 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 6 inches thick. The subsurface layer is yellowish brown, friable silt loam about 3 inches thick. The next 4 inches is mixed dark brown, friable silty clay loam and brown silt loam. The subsoil is about 36 inches thick. The upper part is dark brown, friable silty clay loam, and the lower part is strong brown, firm silty clay. The underlying material to a depth of about 60 inches is light yellowish brown, loose, calcareous sand. In some places the depth to sandy material is less than 20 inches, and in other places it is more than 40 inches. In some areas the soil has a sandy surface layer less than 20 inches thick.

Included with this soil in mapping are small areas of Spinks soils. These soils are in landscape positions similar to those of the Woodbeck soil or are in lower positions. They have less clay in the surface soil and subsoil than the Woodbeck soil. They make up 5 to 15 percent of the unit.

Permeability is moderately slow in the upper part of the Woodbeck soil and rapid in the lower part. Available water capacity is moderate. Surface runoff is rapid.

Most areas of this soil are used as woodland. Some are used for orchards, pasture, or cultivated crops.

This soil is poorly suited to most crops, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are water erosion, the equipment limitation caused by slope, and tilth. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops slow runoff, help to control erosion, conserve moisture, and improve tilth. The soil should be farmed on the contour if possible. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods. A permanent cover of vegetation, such as perennial grasses, helps to control runoff and erosion in orchards.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling water erosion.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope, this soil is generally unsuited to septic tank absorption fields and building site development.

The land capability classification is IVe. The Michigan soil management group is 1/5a.

51B—Oakville fine sand, loamy substratum, 0 to 6 percent slopes. This nearly level to undulating, well drained soil is on the tops and convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is very dark gray, very friable fine sand about 10 inches thick. The subsoil is fine sand about 40 inches thick. The upper part is dark brown and very friable, and the lower part is yellowish brown and loose. The underlying material to a depth of about 60 inches is brown, firm clay loam. In some areas thin bands of loamy sand are in the subsoil. In other areas bright mottles are within a depth of 40 inches. In places the depth to the underlying loamy material is less than 40 inches.

Included with this soil in mapping are small areas of Marlette soils and the somewhat poorly drained Selfridge soils. Marlette soils are on the tops of some knolls and ridges. They have a loamy surface layer and are less droughty than the Oakville soil. Selfridge soils are in the lower landscape positions, in narrow drainageways, and in slight depressions. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Oakville soil, and available water capacity is low. Surface runoff is slow.

Most areas of this soil are used as woodland. Some are used for pasture, cultivated crops, or building site development.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Droughtiness and soil blowing are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops conserve moisture and help to control soil blowing. Wind stripcropping, vegetative barriers, buffer strips, and field windbreaks also help to control soil blowing. Deep-rooted crops, such as asparagus, grow well on this soil. If specialty crops are grown, additional water is needed during the growing season.

This soil is well suited to pasture. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. The equipment limitation and seedling mortality are the main management concerns. Heavy equipment tends to form ruts in the soil. Special site preparation, such as furrowing before seedlings are planted and applying herbicide, or special planting stock, such as containerized seedlings, may be necessary to achieve a better survival rate. Special harvest methods that leave some mature trees to provide shade and protection from the wind also reduce the seedling mortality rate.

This soil is well suited to building site development. It is only fairly well suited to septic tank absorption fields because of a poor filtering capacity in the upper sandy material. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity may result in the pollution of shallow ground water supplies.

The land capability classification is IIIs. The Michigan soil management group is 5/2a.

51C—Oakville fine sand, loamy substratum, 6 to 12 percent slopes. This gently rolling, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is very dark gray, very friable fine sand about 10 inches thick. The subsoil is fine sand about 40 inches thick. The upper part is dark brown and very friable, and the lower part is yellowish brown and loose. The underlying material to a depth of about 60 inches is brown, firm clay loam. In some areas thin bands of loamy sand are in the subsoil. In other areas bright mottles are within a depth of 40 inches. In places the loamy underlying material is within 40 inches of the surface.

Included with this soil in mapping are small areas of Marlette soils and the somewhat poorly drained Selfridge soils. Marlette soils are on the tops of some knolls and ridges. They have a loamy surface layer and are less droughty than the Oakville soil. Selfridge soils are in the lower landscape positions, in narrow drainageways, and in slight depressions. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Oakville soil, and available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. Some are used for pasture or building site development. Crop production is usually not practical on this soil because of droughtiness. Soil blowing and water erosion also are major concerns.

This soil is poorly suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting can help to overcome the droughtiness.

This soil is well suited to woodland. The equipment limitation and seedling mortality are the main management concerns. Heavy equipment tends to form ruts in the soil. Special site preparation, such as furrowing on the contour before seedlings are planted and applying herbicide, or special planting stock, such as containerized seedlings, may be necessary to achieve a better survival rate. Special harvest methods that leave some mature trees to provide shade and protection from the wind also reduce the seedling mortality rate.

Because of the slope, this soil is only fairly well suited to building site development. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Because of the slope and a poor filtering capacity in the upper sandy material, the soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity may result in the pollution of shallow ground water supplies. Special construction methods, such as enlarging the absorption fields, installing the distribution lines across the slope, and filling or mounding with suitable material, help to overcome the poor filtering capacity and the slope.

The land capability classification is VIs. The Michigan soil management group is 5/2a.

52—Belleville loamy sand. This nearly level, poorly drained soil is on low flats and in drainageways. It is subject to ponding. Individual areas are irregular in shape and range from 2 to 50 acres in size.

Typically, the surface layer is black, friable loamy sand about 12 inches thick. The subsoil is grayish brown, very friable loamy fine sand about 13 inches thick. The upper part of the underlying material is grayish brown, mottled, firm loam. The lower part to a depth of about 60 inches is light olive gray, mottled, firm clay loam. In some areas the surface layer is sandy loam. In other areas it is mucky and is less than 16 inches thick. In places the soil is loamy throughout.

Included with this soil in mapping are small areas of the somewhat poorly drained Rimer and Selfridge soils on the tops and sides of low knolls and small ridges. These soils make up 5 to 15 percent of the unit.

Permeability is rapid in the upper part of the Belleville soil and moderately slow in the lower part. Available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface in winter, in spring, and during other excessively wet periods.

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

If drained, this soil is fairly well suited to cultivated crops. The major management concerns are wetness, droughtiness, and soil blowing. A subsurface drainage system is effective in reducing the wetness. Suitable filtering material may be needed around the tile to keep fine sand from flowing into the tile lines. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops increase the available water capacity during dry periods and help to control soil blowing.

This soil is fairly well suited to pasture. If possible, a surface drainage system should be installed to reduce the wetness. The pasture plants that can tolerate the wetness should be selected for planting. Proper stocking rates, pasture rotation, and restricted grazing during wet and excessively dry periods help to maintain the pasture.

This soil is poorly suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. Equipment should be used only when the soil is frozen or relatively dry. Special harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness, this soil is unsuited to septic tank absorption fields and building site development.

The land capability classification is IIIw. The Michigan soil management group is 4/2c.

54B—Tuscola silt loam, 2 to 6 percent slopes. This undulating, moderately well drained soil is on the tops and side slopes of low knolls and ridges. Individual areas are irregular in shape and range from 2 to 80 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 31 inches thick. It is, in sequence downward, strong brown, friable silty clay loam; strong brown, mottled, friable silty clay loam; strong brown, mottled, friable silt loam; and light yellowish brown, mottled friable silt loam. The underlying material to a depth of about 60 inches is brown and yellowish brown, mottled, calcareous, friable, stratified silt loam and silt. In some places the depth to the underlying material is more than 50 inches. In other places the subsoil has no gray mottles. In a few areas the soil is not stratified and has a subsoil that is dominantly clay loam.

Included with this soil in mapping are small areas of Arkport and Spinks soils on the higher, more sloping parts of the landscape. These soils have a sandy surface layer and are more droughty than the Tuscola soil. Also included are small areas of the somewhat poorly drained Dixboro and Kibbie soils in drainageways and the lower landscape positions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Tuscola soil, and available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 2.0 to 3.5 feet in winter, early in spring, and during other excessively wet periods.

Most areas of this soil are used as cropland or pasture. Some of the acreage is woodland or idle land.

This soil is well suited to such crops as corn, oats, winter wheat, and hay. Water erosion and tilth are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to prevent excessive soil loss and maintain good tilth and the organic matter content. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods. Limiting the use of equipment during wet periods helps to prevent compaction.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Grazing during wet periods can result in compaction. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the wetness, this soil is only fairly well suited to building site development and is generally unsuited to septic tank absorption fields. A subsurface drainage system lowers the water table on building sites. Buildings with basements can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIe. The Michigan soil management group is 2.5a-s.

54C—Tuscola silt loam, 6 to 12 percent slopes. This gently rolling, moderately well drained soil is on the side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 40 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 31 inches thick. It is, in sequence downward, strong brown, friable silty clay loam; strong brown, mottled, friable silty clay loam; strong brown, mottled, friable silt loam; and light yellowish brown, mottled silt loam. The underlying material to a depth of about 60 inches is brown and yellowish brown, mottled, calcareous, friable, stratified silt loam and silt. In some areas the depth to the underlying material is more than 50 inches. In other areas the subsoil has no gray mottles. In a few areas the soil is not stratified and has a subsoil that is dominantly clay loam.

Included with this soil in mapping are small areas of the well drained Arkport and Spinks soils on the higher, more sloping parts of the landscape. These soils have a sandy surface layer and are more droughty than the Tuscola soil. Also included are small areas of the somewhat poorly drained Dixboro and Kibbie soils in drainageways and the lower landscape positions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Tuscola soil, and available water capacity is high. Surface runoff is medium. The seasonal high water table is at a depth of 2.0 to 3.5 feet in winter, early in spring, and during other excessively wet periods.

Most areas of this soil are used as cropland or pasture. Some of the acreage is woodland or idle land.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Water erosion and tilth are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops slow surface runoff, help to prevent excessive soil loss, and maintain good tilth and the organic matter content. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods. Limiting the use of equipment during wet periods helps to prevent compaction.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Grazing during wet periods may result in compaction. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the wetness and the slope, this soil is only fairly well suited to building site development. It is generally unsuited to septic tank absorption fields because of the wetness. A subsurface drainage system lowers the water table on building sites. Buildings with basements can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIIe. The Michigan soil management group is 2.5a-s.

56B—Scalley sandy loam, 2 to 6 percent slopes. This undulating, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 45 acres in size.

Typically, the surface layer is dark grayish brown, friable sandy loam about 8 inches thick. The subsurface layer is yellowish brown and brown, friable sandy loam about 10 inches thick. The next 7 inches is mixed dark brown, friable loam and yellowish brown sandy loam. The subsoil is strong brown, firm clay loam about 13 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown, loose fine sand that has thin bands of strong brown, very friable loamy fine sand. In some areas the depth to sandy material is less than 20 inches, and in other areas it is more than 40 inches. In some places sandy material is in the upper part of the profile. In other places the soil has thin strata of silt.

Included with this soil in mapping are small areas of the somewhat poorly drained Matherton soils and small areas of Spinks soils. Matherton soils are in drainageways and low spots. Spinks soils have a sandy surface layer and are more droughty than the Scalley soil. They are in positions on the landscape similar to those of the Scalley soil or are in lower positions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Scalley soil and rapid in the lower part. Available water capacity is moderate. Surface runoff is slow.

Most areas of this soil are used for cultivated crops or orchards. Some are used for pasture or building site development.

This soil is well suited to such crops as corn, oats, winter wheat, and hay. Water erosion is the major management concern. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control erosion and conserve moisture.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

This soil is well suited to building site development. It is only fairly well suited to septic tank absorption fields because of a poor filtering capacity in the sandy underlying material. The sandy material readily absorbs but does not adequately filter the effluent. The poor filtering capacity may result in the pollution of the ground water supplies.

The land capability classification is IIe. The Michigan soil management group is 3/5a.

56C—Scalley sandy loam, 6 to 12 percent slopes. This gently rolling or moderately sloping, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable sandy loam about 7 inches thick. The subsurface layer is yellowish brown and brown, friable sandy loam about 10 inches thick. The next 7 inches is mixed dark brown, friable loam and yellowish brown sandy loam. The subsoil is strong brown, firm clay loam about 13 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown, loose fine sand that has thin bands of strong brown, very friable loamy fine sand. In some areas the depth to sandy material is less than 20 inches, and in other areas it is more than 40 inches. In some places sandy material is in the upper part of the profile. In other places the soil has thin strata of silt.

Included with this soil in mapping are small areas of Matherton and Spinks soils. Matherton soils are somewhat poorly drained and are in drainageways and low spots. Spinks soils have a sandy surface layer and are more droughty than the Scalley soil. They are in positions on the landscape similar to those of the Scalley soil or are in lower positions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Scalley soil and rapid in the lower part. Available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are used for cultivated crops or orchards. Some are used for pasture or building site development.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Water erosion is the major management concern. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops slow surface runoff and help to control erosion.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope, this soil is only fairly well suited to building site development. It is poorly suited to septic tank absorption fields because of the slope and a poor filtering capacity. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The sandy underlying material readily absorbs but does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IIIe. The Michigan soil management group is 3/5a.

56D—Scalley sandy loam, 12 to 18 percent slopes. This strongly sloping or rolling, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 25 acres in size.

Typically, the surface layer is very dark grayish brown, friable sandy loam about 6 inches thick. The subsurface layer is yellowish brown and brown, friable sandy loam about 10 inches thick. The next 7 inches is mixed dark brown, friable loam and yellowish brown sandy loam. The subsoil is strong brown, firm clay loam about 13 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown, loose fine sand that has thin bands of strong brown, very friable loamy fine sand. In some areas the depths to sandy material is less than 20 inches, and in other areas it is more than 40 inches. In some places sandy material is in the upper part of the profile. In other places the soil has thin strata of silt.

Included with this soil in mapping are small areas of Spinks soils. These soils are in positions on the landscape similar to those of the Scalley soil or are in lower positions. They have a sandy surface layer and are more droughty than the Scalley soil. They make up about 5 percent of the unit.

Permeability is moderate in the upper part of the Scalley soil and rapid in the lower part. Available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are used as pasture or woodland. Some are used for cultivated crops or orchards.

This soil is poorly suited to most crops, but such crops as winter wheat, oats, and hay can be grown. Water erosion and equipment limitation caused by slope are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, slows surface runoff, helps to control erosion, and conserves moisture. Cover crops and green manure crops also slow runoff. In areas where it is feasible, farming on the contour minimizes the equipment limitation.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in slowing runoff and controlling water erosion. Proper stocking rates and pasture rotation help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope, this soil is generally unsuited to septic tank absorption fields and building site development.

The land capability classification is IVe. The Michigan soil management group is 3/5a.

58—Napoleon muck. This nearly level, very poorly drained soil is in bogs in upland depressions (fig. 11). It is subject to ponding. Individual areas are round, elongated, or irregularly shaped and range from 5 to 120 acres in size.

Typically, the surface tier is dark yellowish brown, friable peat about 4 inches thick. The subsurface tier is dark reddish brown and dark reddish gray muck about 8

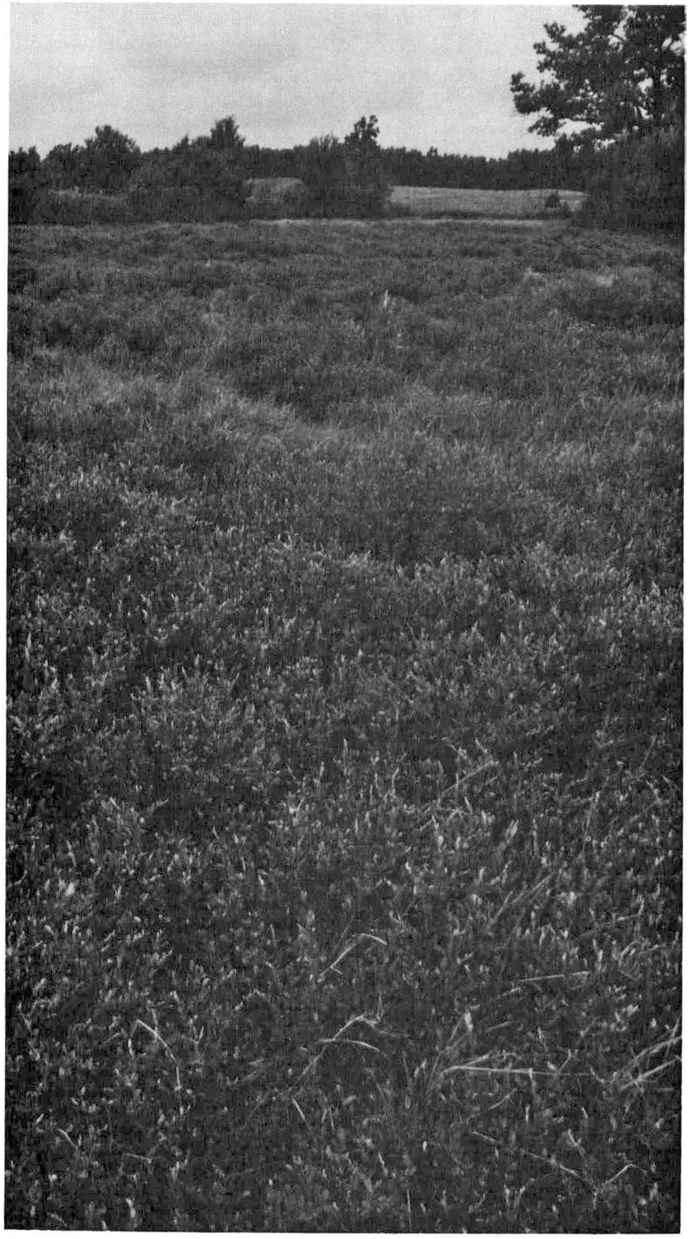

Figure 11.—An area of Napoleon muck covered with leatherleaf and wild blueberries.

inches thick. The underlying tiers to a depth of about 60 inches are dusky red and dark reddish brown muck. In some areas sand is within a depth of 51 inches. In some areas the material in the surface tier is more decayed.

Permeability is moderately slow to moderately rapid. Available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near to above the surface during excessively wet periods.

Most areas support native vegetation of sphagnum moss and blueberries. This soil is generally unsuited to cultivated crops and pasture, mainly because of the wetness.

This soil is poorly suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. The use of heavy planting and harvesting equipment is limited by wetness and by low strength. The windthrow hazard can be reduced by special harvest methods that do isolate the remaining trees or leave them widely spaced.

Because of the wetness, this soil is unsuited to septic tank absorption fields and building site development.

The land capability classification is VIw. The Michigan soil management group is Mc-a.

59B—Okee loamy fine sand, 1 to 6 percent slopes. This nearly level and undulating, well drained soil is on the tops and uneven side slopes of low knolls and ridges and on broad plains. Individual areas are irregular in shape and range from 2 to 80 acres in size.

Typically, the surface layer is black, very friable loamy fine sand about 2 inches thick. The subsurface layer is dark grayish brown loamy fine sand about 1 inch thick. Below this is dark yellowish brown, yellowish brown, and light yellowish brown, very friable loamy sand about 24 inches thick. The next 9 inches is mixed dark yellowish brown, friable loam and pale brown, friable sandy loam. The underlying material to a depth of about 60 inches is brown, friable, calcareous fine sandy loam. In some places the surface layer is eroded and the subsoil exposed. In other places mottles are below a depth of 30 inches. In some areas the depth to the underlying material is more than 60 inches. In other areas the subsoil contains more clay.

Included with this soil in mapping are small areas of the excessively drained Plainfield soils and small areas of Spinks soils. Both of these soils are in positions on the landscape similar to those of the Okee soil. They are more droughty than the Okee soil. Also included are small areas of the somewhat poorly drained Teasdale soils in narrow drainageways and in nearly level areas on the lower parts of the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Okee soil and moderate or moderately rapid in the lower part. Available water capacity is moderate. Surface runoff is slow.

Most areas of this soil are used as woodland or pasture. Some are used for cultivated crops or building site development.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Soil blowing is the major management concern. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops conserve moisture, reduce the susceptibility to soil blowing, and maintain the organic matter content. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing. Irrigating when soil moisture levels are low can increase productivity.

This soil is well suited to pasture. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition.

This soil is fairly well suited to woodland. Seedling mortality is the main management concern. It can be controlled by furrowing before planting, applying herbicide, or selecting special planting stock, such as containerized seedlings. Special harvest methods that leave some mature trees to provide shade and protection from the wind also reduce the seedling mortality rate.

This soil is well suited to building site development and septic tank absorption fields. No major management concerns affect these uses.

The land capability classification is IIIs. The Michigan soil management group is 4/2a.

59C—Okee loamy fine sand, 6 to 12 percent slopes. This gently rolling, well drained soil is on the uneven side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 60 acres in size.

Typically, the surface layer is black, very friable loamy fine sand about 2 inches thick. The subsurface layer is dark grayish brown, loose loamy fine sand about 1 inch thick. Below this is dark yellowish brown and yellowish brown, very friable loamy fine sand about 24 inches thick. The next 9 inches is mixed dark yellowish brown, friable loam and pale brown, friable sandy loam. The underlying material to a depth of about 60 inches is brown, friable, calcareous fine sandy loam. In some areas the depth to the underlying material is more than 40 inches. In other areas the loamy subsoil and underlying material contain more clay.

Included with this soil in mapping are small areas of the excessively drained Plainfield soils and small areas of Spinks soils. Both of these soils are in positions on the landscape similar to those of the Okee soil. They are more droughty than the Okee soil. Also included are small areas of the somewhat poorly drained Teasdale soils in narrow drainageways and in or around small depressions. Included soils make up 7 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Okee soil and moderate or moderately rapid in the lower part. Available water capacity is moderate. Surface runoff is slow.

Most areas of this soil are used as woodland or pasture. Some are used for cultivated crops or building site development.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Water erosion and soil blowing are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and conserve moisture. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing. Irrigating when soil moisture levels are low can increase productivity.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition.

This soil is fairly well suited to woodland. Seedling mortality is the main management concern. It can be controlled by furrowing on the contour before seedlings are planted, applying herbicide, or selecting special planting stock, such as containerized seedlings. Special harvest methods that leave some mature trees to provide shade and protection from the wind also reduce the seedling mortality rate.

Because of the slope, this soil is only fairly well suited to building site development and septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly.

The land capability classification is IIIe. The Michigan soil management group is 4/2a.

59D—Okee loamy fine sand, 12 to 18 percent slopes. This rolling, well drained soil is on the uneven side slopes of ridges. Individual areas are long and narrow and range from 2 to 40 acres in size.

Typically, the surface layer is black, very friable loamy fine sand about 2 inches thick. The subsurface layer is dark grayish brown, loose loamy sand about 1 inch thick. Below this is dark yellowish brown and yellowish brown, very friable loamy fine sand about 24 inches thick. The next 9 inches is mixed dark yellowish brown, friable loam and pale brown fine sandy loam. The underlying material to a depth of about 60 inches is brown, friable, calcareous fine sandy loam. In places the depth to the underlying material is more than 40 inches. In some areas the surface layer is eroded and the subsoil exposed. In other areas the subsoil and underlying material contain more clay.

Included with this soil in mapping are small areas of the excessively drained Plainfield soils and small areas of Spinks soils. Both of these soils are in positions on the landscape similar to those of the Okee soil. They are more droughty than the Okee soil. Also included are small areas of the somewhat poorly drained Teasdale soils in narrow drainageways and in or around small depressions. Included soils make up 7 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Okee soil and moderate or moderately rapid in the lower part. Available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are used as woodland or pasture. Some are used for cultivated crops or building site development.

This soil is poorly suited to most crops, but such crops as winter wheat, oats, and hay can be grown. Water erosion and soil blowing are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to prevent excessive soil loss and conserve moisture. Wind stripcropping, vegetative barriers, buffer strips, and field windbreaks help to control soil blowing. Grassed waterways are effective in controlling water erosion. The use of equipment is limited on the steeper slopes.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition.

This soil is fairly well suited to woodland. Seedling mortality is the main management concern. It can be controlled by furrowing on the contour, applying herbicide, or selecting special planting stock, such as containerized seedlings. Special harvest methods that leave some mature trees to provide shade and protection from the wind also reduce the seedling mortality rate.

Because of the slope, this soil is poorly suited to building site development and septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In many areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly.

The land capability classification is IVe. The Michigan soil management group is 4/2a.

62A—Tekenink fine sandy loam, 0 to 2 percent slopes. This nearly level, well drained soil is on broad plains and low knolls. Individual areas are irregular in shape and range from 10 to 270 acres in size.

Typically, the surface layer is dark grayish brown, friable fine sandy loam about 9 inches thick. The subsurface layer is yellowish brown, friable fine sandy loam about 3 inches thick. The next 4 inches is mixed strong brown and pale brown, friable fine sandy loam. Below this is strong brown, firm fine sandy loam about 14 inches thick. The subsoil is brown, friable fine sandy loam about 29 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, calcareous, friable fine sandy loam. In some areas the subsoil is brittle when moist and very hard when dry. In other areas pockets or layers of sand or gravelly sand are below a depth of 40 inches. In places the lower part of the subsoil has gray mottles.

Included with this soil in mapping are small areas of Plainfield, Spinks, and Teasdale soils. Plainfield soils are excessively drained. Plainfield and Spinks soils are on the tops of knolls and on breaks to drainageways. They are sandy and are more droughty than the Tekenink soil. Teasdale soils are somewhat poorly drained and are in drainageways. Included soils make up 8 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Tekenink soil. Surface runoff is very slow.

Most areas of this soil are used as cropland or pasture. Some are used as woodland or as building sites.

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concern is soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops increase the available water capacity and help to control soil blowing. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing. Irrigating when soil moisture levels are low can increase productivity.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Restricted grazing during extremely dry periods helps to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

This soil is well suited to building site development and septic tank absorption fields. No major management concerns affect these uses.

The land capability classification is IIs. The Michigan soil management group is 3a.

62B—Tekenink fine sandy loam, 2 to 6 percent slopes. This undulating, well drained soil is on the uneven side slopes of low knolls and ridges. Individual areas are irregular in shape and range from 5 to 640 acres in size.

Typically, the surface layer is very dark grayish brown, friable fine sandy loam about 9 inches thick. The subsurface layer is yellowish brown, very friable fine sandy loam about 3 inches thick. The next 18 inches is mixed pale brown and strong brown, friable fine sandy loam. The subsoil is brown, friable fine sandy loam about 29 inches thick. The underlying material to a depth of more than 60 inches is yellowish brown, calcareous, friable fine sandy loam. In some places the surface soil is sand and is more than 20 inches thick. In other places pockets or layers of sand or gravelly sand are below a depth of 40 inches. In some areas gray mottles are in the lower part of the subsoil. In other areas the subsoil is brittle when moist and very hard when dry.

Included with this soil in mapping are small areas of Marlette, Plainfield, and Spinks soils. These soils are on the tops of knolls and on breaks to drainageways. Marlette soils are less droughty than the Tekenink soil. Plainfield soils are excessively drained. Plainfield and Spinks soils have a sandy surface layer and are more droughty than the Tekenink soil. Also included are areas of the somewhat poorly drained Teasdale soils in drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Tekenink soil. Surface runoff is slow.

Most areas of this soil are used as cropland or pasture. Some are used as woodland or as building sites.

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion and soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material help to control water erosion and soil blowing and increase the available water capacity (fig. 12). Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing. Irrigating when soil moisture levels are low can increase productivity.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted use during extremely dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect these uses.

This soil is well suited to building site development and septic tank absorption fields. No major management concerns affect these uses.

The land capability classification is IIe. The Michigan soil management group is 3a.

62C—Tekenink fine sandy loam, 6 to 12 percent slopes. This gently rolling, well drained soil is on the

Figure 12.—No-till corn in an area of Tekenink fine sandy loam, 2 to 6 percent slopes.

convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 285 acres in size.

Typically, the surface layer is very dark grayish brown, friable fine sandy loam about 7 inches thick. The subsurface layer is yellowish brown, friable fine sandy loam about 3 inches thick. Below this is mixed strong brown and pale brown, friable fine sandy loam about 3 inches thick. The next 12 inches is mixed pale brown, friable fine sandy loam and strong brown loamy fine sand. The subsoil is brown, friable fine sandy loam about 35 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, calcareous, friable fine sandy loam. In some areas the surface soil is sand and is more than 20 inches thick. In other areas pockets or layers of sand or gravelly sand are below a depth of 40 inches. In places the subsoil is brittle when moist and very hard when dry.

Included with this soil in mapping are small areas of Marlette, Plainfield, and Spinks soils. These soils are on the sides and tops of knolls and on breaks to drainageways. Marlette soils are less droughty than the Tekenink soil. Plainfield soils are excessively drained. Plainfield and Spinks soils have a sandy surface layer and are more droughty than the Tekenink soil. Also included are areas of the somewhat poorly drained Teasdale soils in drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Tekenink soil. Surface runoff is slow.

Most areas of this soil are pastured. Some are used as cropland, woodland, or building sites.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion and soil blowing. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to prevent excessive soil loss and increase the available water capacity. Grassed waterways are effective in controlling water erosion. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks help to control soil blowing.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope, this soil is only fairly well suited to building site development and septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly.

The land capability classification is IIIe. The Michigan soil management group is 3a.

62D—Tekenink fine sandy loam, 12 to 18 percent slopes. This rolling, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are elongated or irregularly shaped and range from 2 to 65 acres in size.

Typically, the surface layer is very dark grayish brown, friable fine sandy loam about 6 inches thick. The subsurface layer is yellowish brown, friable fine sandy loam about 3 inches thick. The next 3 inches is mixed strong brown, friable fine sandy loam and pale brown, very friable fine sandy loam. Below this is about 12 inches of brown, firm and friable fine sandy loam and pale brown, friable fine sandy loam. The subsoil is brown, friable fine sandy loam about 25 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, calcareous, friable fine sandy loam. In some areas the surface soil is sand and is more than 20 inches thick. In other areas pockets or layers of sand or gravelly sand are below a depth of 40 inches. In places the subsoil is brittle when moist and very hard when dry.

Included with this soil in mapping are small areas of Marlette, Plainfield, and Spinks soils. These soils are on the tops and sides of knolls and on breaks to drainageways. Marlette soils are less droughty than the Tekenink soil. Plainfield soils are excessively drained. Plainfield and Spinks soils have a sandy surface layer and are more droughty than the Tekenink soil. Also included are areas of the somewhat poorly drained Teasdale soils in drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Tekenink soil. Surface runoff is medium.

Most areas of this soil are pastured. Some are used as cropland or woodland. A few are used for building site development.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are water erosion, soil blowing, and the equipment limitation caused by slope. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and increase the available water capacity. Wind stripcropping, buffer strips, and field windbreaks also help to control soil blowing. In areas where it is feasible, farming on the contour helps to overcome the equipment limitation.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted grazing during extremely dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope, this soil is poorly suited to building site development and septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. In most areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly.

The land capability classification is IVe. The Michigan soil management group is 3a.

62E—Tekenink fine sandy loam, 18 to 40 percent slopes. This steep and very steep, well drained soil is on the convex side slopes of ridges and hills and on breaks to streams. Individual areas are long and narrow and range from 2 to 45 acres in size.

Typically, the surface layer is very dark grayish brown, friable fine sandy loam about 5 inches thick. The subsurface layer is yellowish brown, fine sandy loam about 2 inches thick. The next 2 inches is mixed strong brown and pale brown, friable fine sandy loam. Below this is mixed strong brown and pale brown, friable fine sandy loam about 10 inches thick. The subsoil is brown, friable fine sandy loam about 25 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, calcareous, friable fine sandy loam. In some areas the surface soil is sand and is more than 20 inches thick. In other areas pockets or layers of sand are below a depth of 40 inches. In places the subsoil is brittle when moist and very hard when dry.

Included with this soil in mapping are small areas of Marlette, Plainfield, and Spinks soils. These soils are on the tops and sides of knolls and on breaks to drainageways. Marlette soils are less droughty than the Tekenink soil. Plainfield soils are excessively drained. Plainfield and Spinks soils have a sandy surface layer and are more droughty than the Tekenink soil. Also included are areas of the somewhat poorly drained Teasdale soils in drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Tekenink soil. Surface runoff is rapid.

Most areas are wooded. This soil is well suited to woodland. Erosion and the equipment limitation are the major management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, and culverts. Caution is needed if ordinary crawler tractors and rubber-tired skidders are operated on these slopes.

Because of the slope, this soil is generally unsuited to building site development and septic tank absorption fields.

The land capability classification is VIIe. The Michigan soil management group is 3a.

63—Urban land-Cohoctah complex. This map unit occurs as areas of Urban land intricately mixed with areas of a nearly level, poorly drained Cohoctah soil. The unit is on large, broad flood plains along the Flat, Rogue, and Grand Rivers. Areas that have not been raised and protected are subject to flooding. Individual areas are long and narrow and range from 2 to 185 acres. They are 50 to 80 percent Urban land and 10 to 40 percent Cohoctah soil. The Urban land and Cohoctah soil occur as areas so intricately mixed that mapping them separately is not practical at the scale used.

Urban land is covered by asphalt, concrete, and other impervious material. Structures include parking lots, streets, and industrial parks. Commonly, some of the higher areas have been leveled and the lower areas filled and smoothed.

Typically, the surface layer of the Cohoctah soil is very dark grayish brown loam about 10 inches thick. The underlying material to a depth of about 60 inches is mottled. It is dark gray sandy loam in the upper part, dark gray loam in the next part, and grayish brown fine sandy loam in the lower part. In some areas the surface layer is calcareous. In other areas the underlying material is high in content of clay. In places the surface layer is muck less than 16 inches thick.

Permeability is moderately rapid in the Cohoctah soil, available water capacity is high, and surface runoff is slow to ponded. The soil has a seasonal high water table near or above the surface from fall to spring.

Most of the acreage of the Cohoctah soil is idle land. This soil is poorly suited to trees, shrubs, and gardens and is unsuited to residential and commercial buildings. Flooding is the major hazard. In all areas of this unit, onsite investigation is needed to determine the hazards, limitations, and suitability for building site development, plantings, and other uses.

This unit has not been assigned to a land capability classification or a Michigan soil management group.

64B—Grattan sand, 0 to 6 percent slopes. This nearly level and undulating, excessively drained soil is on the tops and uneven side slopes of knolls and ridges. Individual areas are irregular in shape and range from 3 to 225 acres in size.

Typically, the surface layer is very dark gray, very friable sand about 5 inches thick. The subsurface layer is pinkish gray, loose sand about 7 inches thick. The subsoil is about 20 inches thick. It is, in sequence downward, dark reddish brown, very friable sand; yellowish red, loose sand that has chunks of brittle soil material; strong brown, slightly brittle sand; and reddish yellow, loose sand. The underlying material to a depth of about 60 inches is light brown, loose sand. In some areas the subsoil is not so red and does not have chunks of brittle soil material. In other areas it has bright mottles in the lower part.

Included with this soil in mapping are small areas of Granby, Metea, and Pipestone soils. Granby soils are poorly drained and are in drainageways and low areas.

Metea soils are well drained and are on low knolls and slight rises. They are less permeable in the subsoil than the Grattan soil. Pipestone soils are somewhat poorly drained and are in small depressions and on the sides of drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Grattan soil, and available water capacity is low. Surface runoff is slow.

Most areas of this soil are used as woodland. Some of the acreage is cropland or idle land.

Crop production generally is not practical on this soil because of droughtiness. The soil is poorly suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Selection of deep-rooted forage species for planting can help to overcome the droughtiness. Limiting the stocking rates and grazing mainly during wet periods help to maintain the pasture. Pasture rotation also is beneficial.

This soil is fairly well suited to woodland. The equipment limitation and seedling mortality are the main management concerns. The sandy surface layer can affect equipment trafficability during dry periods. Heavy equipment tends to form ruts in the soil. The mortality rate of planted seedlings is in excess of 50 percent in years when summers are dry. It can be reduced by special harvest methods that leave some mature trees to provide shade and protection from the wind. Special site preparation, such as furrowing or applying herbicide, may be needed to control plant competition if the vegetation is dense.

This soil is well suited to building site development. It is only fairly well suited to septic tank absorption fields because of a poor filtering capacity. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is VIs. The Michigan soil management group is 5.3a.

64C—Grattan sand, 6 to 12 percent slopes. This gently rolling, excessively drained soil is on the uneven side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 70 acres in size.

Typically, the surface layer is very dark gray, very friable sand about 5 inches thick. The subsurface layer is pinkish gray, loose sand about 7 inches thick. The subsoil is about 20 inches thick. It is, in sequence downward, dark reddish brown, very friable sand; yellowish red, loose sand that has chunks of brittle soil material; strong brown, slightly brittle sand; and reddish yellow, loose sand. The underlying material to a depth of about 60 inches is light brown, loose sand. In some areas the subsoil is not so red and does not have chunks of brittle soil material. In other areas it has bright mottles in the lower part.

Included with this soil in mapping are small areas of the well drained Metea, Spinks, and Tekenink soils. Metea soils are on low knolls and slight rises. Tekenink soils have a loamy surface layer. Metea and Tekenink soils are less permeable in the subsoil than the Grattan soil. Spinks and Tekenink soils are in landscape positions similar to those of the Grattan soil. Spinks soils are moderately rapidly permeable. Also included are small areas of the somewhat poorly drained Pipestone soils in drainageways and small depressions. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Grattan soil, and available water capacity is low. Surface runoff is slow.

Most areas of this soil are used as woodland. Some of the acreage is pasture or idle land.

Crop production generally is not practical on this soil because of droughtiness. The soil is poorly suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Selection of deep-rooted forage species for planting can help to overcome the droughtiness. Limiting the stocking rates and grazing mainly during wet periods help to maintain the pasture. Pasture rotation also is beneficial.

This soil is fairly well suited to woodland. The equipment limitation and seedling mortality are the main management concerns. The sandy surface layer can affect equipment trafficability during dry periods. Heavy equipment tends to form ruts in the soil. The mortality rate of planted seedlings may be in excess of 50 percent in years when summers are dry. It can be reduced by special harvest methods that leave some mature trees to provide shade and protection from the wind. Special site preparations, such as furrowing or applying herbicide, can control plant competition if the vegetation is dense.

Because of the slope, this soil is only fairly well suited to building site development. It is poorly suited to septic tank absorption fields because of the slope and a poor filtering capacity. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is VIs. The Michigan soil management group is 5.3a.

66B—Boyer loamy sand, 0 to 6 percent slopes. This nearly level and undulating, well drained soil is on broad plains characterized by slight rises and on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 400 acres in size.

Typically, the surface layer is very dark grayish brown, friable loamy sand about 9 inches thick. The friable subsoil is about 16 inches thick. It is strong brown and friable. The upper part is gravelly loamy sand, the next part is gravelly sandy loam, and the lower part is gravelly sandy clay loam. The upper part of the underlying material is yellowish brown, loose gravelly sand. The lower part to a depth of about 60 inches is light yellowish brown gravelly coarse sand. In some areas the upper part of the soil is sand more than 20 inches thick. In other areas the depth to calcareous sand and gravelly sand is more than 40 inches. In some places the loamy subsoil is less than 10 inches thick, and in other places the soil does not have a subsoil. In places gray mottles are in the lower part of the subsoil. In some areas calcareous, loamy material is below a depth of 40 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Wasepi soils. These soils are in drainageways and the lower landscape positions. Also included are small areas of the excessively drained Plainfield soils on the tops of low knolls and ridges and on side slopes along drainageways. These soils are sand throughout and are rapidly permeable. Included soils make up 2 to 7 percent of the unit.

Permeability is moderately rapid in the upper part of the Boyer soil and very rapid in the lower part. Available water capacity is low. Surface runoff is very slow.

Most areas of this soil are used as cropland or pasture. Some are used as woodland or building sites. Gravel pits are in many areas (fig. 13).

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay (fig. 14). Droughtiness and soil blowing are the major management concerns. Returning crop residue to the soil and growing cover crops or green manure crops improve the available water capacity and help to control soil blowing. Wind stripcropping and windbreaks also are effective in controlling soil blowing. Irrigating when soil moisture levels are low can increase productivity.

This soil is well suited to pasture. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. Seedling mortality is the main management concern. It can be controlled by furrowing before seedlings are planted, by applying herbicide, or by selecting containerized planting stock. Special harvest methods that leave some mature trees to provide shade and protection from the wind also reduce the seedling mortality rate. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem.

This soil is well suited to building site development. It is only fairly well suited to septic tank absorption fields because of a poor filtering capacity. The soil readily absorbs but does not adequately filter the effluent. The

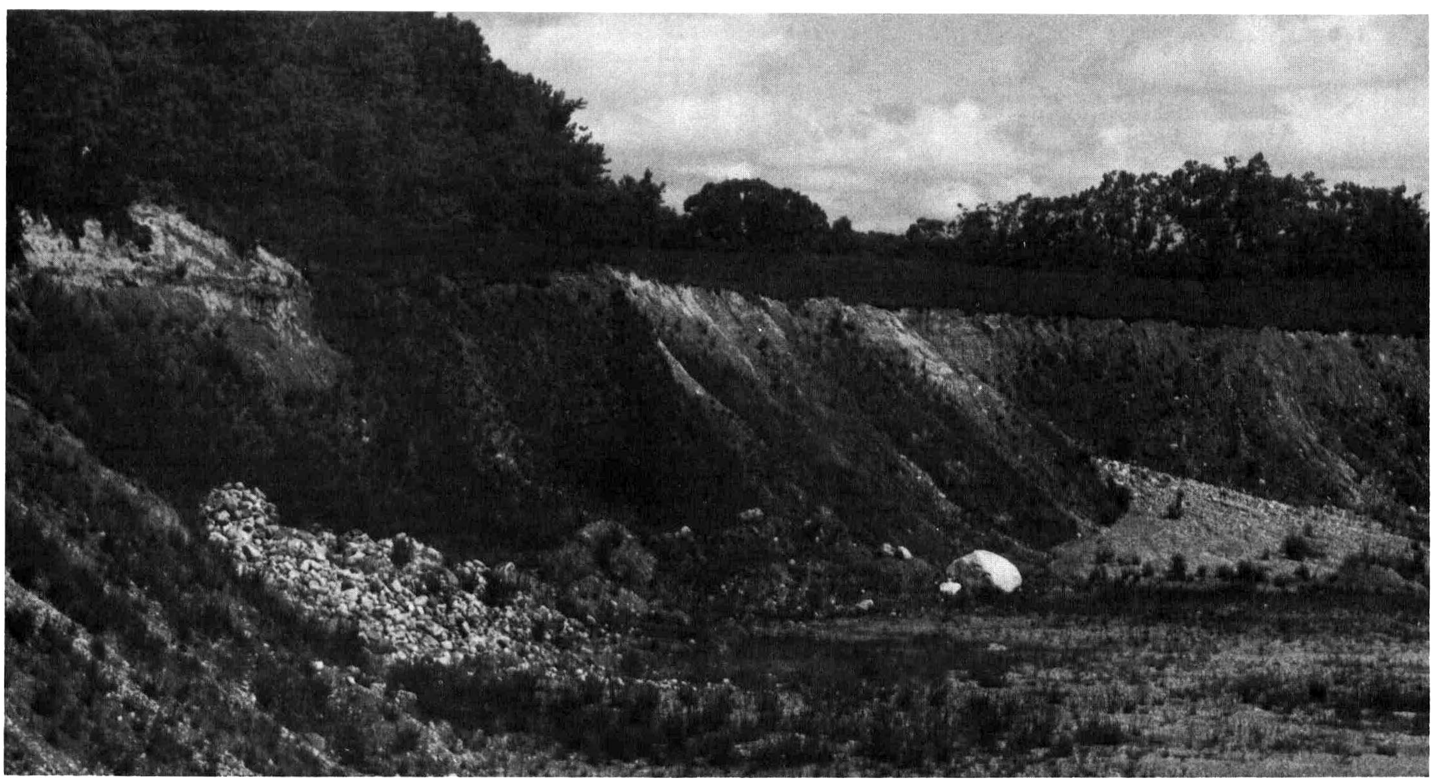

Figure 13.—A gravel pit in an area of Boyer loamy sand, 0 to 6 percent slopes.

Figure 14.—Corn on Boyer loamy sand, 0 to 6 percent slopes. The pine windbreak in the background helps to control soil blowing.

poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IIIs. The Michigan soil management group is 4a.

66C—Boyer loamy sand, 6 to 12 percent slopes. This gently rolling, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 60 acres in size.

Typically, the surface layer is very dark grayish brown, friable loamy sand about 8 inches thick. The subsoil is about 16 inches thick. It is strong brown and friable. The upper part is gravelly loamy sand, the next part is gravelly sandy loam, and the lower part is gravelly sandy clay loam. The upper part of the underlying material is yellowish brown, loose gravelly sand. The lower part to a depth of about 60 inches is light yellowish brown gravelly coarse sand. In some areas the upper part of the soil is sand more than 20 inches thick. In other areas the depth to calcareous sand and gravelly sand is more than 40 inches. In some places the loamy subsoil is less than 10 inches thick, and in other places the soil does not have a subsoil. In places gray mottles are in the lower part of the subsoil. In some areas calcareous, loamy material is below a depth of 40 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Wasepi soils. These soils are in drainageways and the lower landscape positions. Also included are small areas of the excessively drained Plainfield soils and small areas of Marlette soils. Both of these soils are on the tops of low knolls and ridges and on side slopes along drainageways. Plainfield soils are sand throughout and are rapidly permeable. Marlette soils are loamy throughout and are not so droughty as the Boyer soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Boyer soil and very rapid in the lower part. Available water capacity is low. Surface runoff is very slow.

Most areas of this soil are used as cropland or pasture. Some are used as woodland or building sites. Gravel pits are in many areas.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Water erosion, soil blowing, and droughtiness are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and conserve moisture. Irrigating when soil moisture levels are low can increase productivity.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. Seedling mortality is the main management concern. It can be controlled by furrowing before seedlings are planted, by applying herbicide, or by selecting containerized planting stock. Special harvest methods that leave some mature trees to provide shade and protection from the wind also reduce the seedling mortality rate. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem.

Because of the slope, this soil is only fairly well suited to building site development. It is only fairly well suited to septic tank absorption fields because of the slope and a poor filtering capacity. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IIIe. The Michigan soil management group is 4a.

66D—Boyer loamy sand, 12 to 18 percent slopes. This rolling, well drained soil is on the convex side slopes of breaks to streams and drainageways and on the side slopes of knolls and ridges. Individual areas are elongated or irregularly shaped and range from 2 to 120 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loamy sand about 5 inches thick. The subsoil is about 16 inches thick. It is strong brown and friable. The upper part is gravelly loamy sand, the next part is gravelly sandy loam, and the lower part is gravelly sandy clay loam. The upper part of the underlying material is yellowish brown, loose gravelly sand. The lower part to a depth of about 60 inches is light yellowish brown gravelly coarse sand. In some areas the upper part of the soil is sand more than 20 inches thick. In other areas the depth to calcareous sand and gravelly sand is more than 40 inches. In some places the loamy subsoil is less than 10 inches thick, and in other places the soil does not have a subsoil. In some areas calcareous, loamy material is below a depth of 40 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Wasepi soils in narrow drainageways. Also included are small areas of Marlette, Plainfield, and Tekenink soils. Marlette and Tekenink soils are in landscape positions similar to those of the Boyer soil. They are less droughty than the Boyer soil. The excessively drained Plainfield soils are on the tops of knolls and ridges and along drainageways. They are sand throughout and are more droughty than the Boyer soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Boyer soil and very rapid in the lower part. Available water capacity is low. Surface runoff is medium.

Most of the acreage of this soil is woodland, pasture, or idle land. A few areas are used as cropland or building sites. Gravel pits are in many areas.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are water erosion, soil blowing, the equipment limitations caused by slope and droughtiness. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control erosion and soil blowing and increase the available water capacity. Wind stripcropping, buffer strips, and field windbreaks also help to control soil blowing. In areas where it is feasible, farming on the contour can help to overcome the equipment limitation.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to woodland. Seedling mortality is the main management concern. It can be controlled by furrowing on the contour before seedlings are planted, by applying herbicide, or by selecting containerized planting stock. Special harvest methods that leave some mature trees to provide shade and protection from the wind also reduce the seedling mortality rate. If the soil is exposed prior to the production of a seed crop, desirable seedlings can be established before competing vegetation becomes a problem.

Because of the slope, this soil is poorly suited to building site development. It is poorly suited to septic tank absorption fields because of the slope and a poor filtering capacity. Buildings should be designed so that they conform to the natural slope of the land. In many areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IVe. The Michigan soil management group is 4a.

66E—Boyer loamy sand, 18 to 40 percent slopes. This steep and very steep, well drained soil is on the convex slopes of breaks to streams and drainageways and on the side slopes of ridges and knolls. Individual areas are long and narrow and range from 2 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable loamy sand about 4 inches thick. The subsoil is about 16 inches thick. It is strong brown and friable. The upper part is gravelly loamy sand, the next part is gravelly sand loam, and the lower part is gravelly sandy clay loam. The underlying material to a depth of about 60 inches is yellowish brown, loose sand and gravelly sand. In places the upper part of the soil is sand more than 20 inches thick. In some areas the loamy subsoil is less than 10 inches thick, and in other areas the soil does not have a subsoil. In some places the depth to calcareous sand and gravelly sand is more than 40 inches. In other places calcareous, loamy material is below a depth of 40 inches.

Included with this soil in mapping are small areas of Marlette and Tekenink soils. These soils are in landscape positions similar to those of the Boyer soil. They are less droughty than the Boyer soil. Also included are areas of the excessively drained Plainfield soils on the tops of knolls and ridges and along drainageways. These soils are sand throughout and are more droughty than the Boyer soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Boyer soil and very rapid in the lower part. Available water capacity is low. Surface runoff is rapid.

Most of the acreage is woodland or idle land. A few areas are pastured. This soil is unsuited to cultivated crops and pasture because of the slope.

This soil is well suited to woodland. Erosion, the equipment limitation, and seedling mortality are the main management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, and culverts. Caution is needed if ordinary crawler tractors and rubber-tired skidders are operated on these slopes. Furrowing on the contour before seedlings are planted, applying herbicide, or selecting containerized planting stock reduces the seedling mortality rate. Special harvest methods that leave some mature trees to provide shade and protection from the wind also help to control seedling mortality.

Because of the slope, this soil is generally unsuited to building site development and septic tank absorption fields.

The land capability classification is VIIe. The Michigan soil management group is 4a.

67B—Kalamazoo loam, 1 to 6 percent slopes. This nearly level and undulating, well drained soil is on broad plains characterized by slight rises, on low knolls, and on ridgetops. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 10 inches thick. The subsoil is about 33 inches thick. It is dark yellowish brown. In sequence downward, it is firm clay loam, firm gravelly sandy clay loam, friable gravelly sandy loam, and friable gravelly loamy sand. The upper part of the underlying material is dark yellowish brown, calcareous, loose very gravelly sand. The lower part to a depth of about 60 inches is yellowish brown, calcareous, loose gravelly sand. In some places gray mottles are in the lower part of the subsoil. In other places calcareous sand and gravelly sand are within a depth of 40 inches. In a few areas the subsoil contains less clay. In some areas the soil is stony or cobbly.

Included with this soil in mapping are small areas of Marlette and Spinks soils. Marlette soils are on the tops of some knolls and ridges. They are less droughty than the Kalamazoo soil. Spinks soils are in landscape positions similar to those of the Kalamazoo soil. They have a sandy surface layer and are more droughty than the Kalamazoo soil. Also included are small areas of the somewhat poorly drained Matherton and poorly drained Sebewa soils in drainageways and low spots. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Kalamazoo soil and rapid in the lower part. Available water capacity is moderate. Surface runoff is slow.

Most areas of this soil are used as cropland. Some are used as pasture, woodland, or building sites. Gravel pits are in many areas.

This soil is well suited to such crops as corn, oats, winter wheat, and hay. Water erosion and tilth are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops slow runoff, help to control water erosion, improve tilth, conserve moisture, and increase the rate of water infiltration.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

This soil is well suited to building site development. It is only fairly well suited to septic tank absorption fields because of a poor filtering capacity in the sandy and gravelly underlying material. The underlying layers readily absorb but do not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IIe. The Michigan soil management group is 3/5a.

67C—Kalamazoo loam, 6 to 12 percent slopes. This gently rolling, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 9 inches thick. The subsoil is about 33 inches thick. It is dark yellowish brown. In sequence downward, it is firm clay loam, firm gravelly sandy clay loam, friable gravelly sandy loam, and friable gravelly loamy sand. The underlying material to a depth of about 60 inches is dark yellowish brown, calcareous, loose gravelly sand. In some areas calcareous sand and gravelly sand are within a depth of 40 inches. In a few areas the subsoil contains less clay. In places the soil is stony or cobbly.

Included with this soil in mapping are small areas of Marlette and Spinks soils. Marlette soils are on the tops of some knolls and ridges. They are loamy throughout. Spinks soils are in landscape positions similar to those of the Kalamazoo soil or are on the lower back slopes of knolls and ridges. They have a sandy surface layer and are more droughty than the Kalamazoo soil. Also included are small areas of the somewhat poorly drained Matherton and poorly drained Sebewa soils in drainageways and low spots. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Kalamazoo soil and rapid in the lower part. Available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are used as cropland or pasture. Some of the acreage is woodland, is used for building site development, or is idle land. Gravel pits are in many areas.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Water erosion and tilth are the major management concerns. Contour farming slows runoff. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control runoff and water erosion, improve tilth, conserve moisture, and increase the rate of water infiltration.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope, this soil is only fairly well suited to building site development. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. The soil is only fairly well suited to septic tank absorption fields because of the slope and a poor filtering capacity in the sandy and gravelly underlying material. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly. The underlying layers readily absorb but do not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IIIe. The Michigan soil management group is 3/5a.

67D—Kalamazoo loam, 12 to 18 percent slopes. This rolling, well drained soil is on the convex side slopes of knolls and ridges. Individual areas are irregularly shaped or elongated and range from 5 to 75 acres.

Typically, the surface layer is very dark grayish brown, friable loam about 8 inches thick. The subsoil is about 33 inches thick. It is dark yellowish brown. In sequence downward, it is firm clay loam, firm gravelly sandy clay loam, friable gravelly sandy loam, and friable gravelly loamy sand. The underlying material to a depth of about 60 inches is dark yellowish brown, calcareous, loose gravelly sand. In places calcareous sand and gravelly sand are within a depth of 40 inches. In a few areas the subsoil contains less clay. In some areas the soil is stony or cobbly. In other areas the slope is more than 18 percent.

Included with this soil in mapping are small areas of Marlette and Spinks soils. Marlette soils are on the tops and upper sides slopes of some knolls and ridges. They are less droughty than the Kalamazoo soil. Spinks soils are in landscape positions similar to those of the Kalamazoo soil or are on the tops and lower back slopes of knolls and ridges. They have a sandy surface layer and are more droughty than the Kalamazoo soil. Also included are small areas of the somewhat poorly drained Matherton and poorly drained Sebewa soils in drainageways and low spots. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Kalamazoo soil and rapid in the lower part. Available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are pastured. Some are used as woodland, cropland, or building sites. Gravel pits are in many areas.

This soil is poorly suited to most crops, but such crops as winter wheat and hay can be grown. Water erosion and tilth are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and conserve moisture. The use of equipment is limited because of the slope.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling water erosion.

Proper stocking rates and pasture rotation help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope, this soil is poorly suited to building site development. Buildings should be designed so that they conform to the natural slope of the land. In many areas land shaping is necessary. The soil is poorly suited to septic tank absorption fields because of the slope and a poor filtering capacity in the sandy and gravelly underlying material. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

The land capability classification is IVe. The Michigan soil management group is 3/5a.

68B—Saylesville silt loam, 2 to 6 percent slopes. This undulating, well drained soil is on the tops of low knolls and ridges. Individual areas are irregular in shape and range from 2 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 21 inches thick. It dark brown and firm. The upper part is silty clay loam, the next part is silty clay, and the lower part is silty clay loam. The underlying material to a depth of about 60 inches is dark yellowish brown, firm, calcareous, stratified silty clay loam and silt loam. In some places the surface layer is clay loam. In other places gray mottles are in the lower part of the subsoil. In some areas the soil contains pebbles and cobbles and is not stratified. In other areas it has a layer of sandy material less than 20 inches thick.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount and Rimer soils. These soils are in nearly level areas on the lower parts of the landscape positions or are in narrow drainageways. Also included are some areas of Tustin soils. These soils have a sandy surface layer and are more droughty than the Saylesville soil. They are on foot slopes and the tops of low ridges and knolls. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Saylesville soil, and available water capacity is high. Surface runoff is medium.

Most areas of this soil are used as cropland or pasture. Some of the acreage is woodland or idle land.

This soil is well suited to such crops as corn, soybeans, winter wheat, and hay. Water erosion and tilth are the major management concerns. Contour farming and contour stripcropping slow runoff. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to prevent crusting, control water erosion, and increase the rate of water infiltration. Tilling when the soil is too wet can alter soil structure and can result in the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Overgrazing when the soil is excessively wet can cause compaction and poor tilth. Proper stocking rates and pasture rotation help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the shrink-swell potential in the subsoil and underlying material, this soil is only fairly well suited to building site development. It is generally unsuited to septic tank absorption fields because of the moderately slow permeability. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIe. The Michigan soil management group is 1.5a.

68C—Saylesville silt loam, 6 to 12 percent slopes. This gently rolling, well drained soil is on the short, uneven side slopes of knolls and ridges. Individual areas are irregular in shape and range from 2 to 40 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 9 inches thick. The subsoil is about 21 inches thick. It is dark brown and firm. The upper part is silty clay loam, the next part is silty clay, and the lower part is silty clay loam. The underlying material to a depth of about 60 inches is dark yellowish brown, firm calcareous, stratified silty clay loam and silt loam. In some areas the surface layer is clay loam. In other areas the soil contains pebbles and cobbles and does not have thin strata. In places gray mottles are in the lower part of the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount and Rimer soils. These soils are in nearly level areas on the lower parts of the landscape or are in drainageways. Also included are some areas of Tustin soils. These soils are along the borders of drainageways and on the tops of knolls and ridges. They have a sandy surface layer and are more droughty than the Saylesville soil. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Saylesville soil, and available water capacity is high. Surface runoff is medium.

Most areas of this soil are used as cropland or pasture. Some of the acreage is woodland or idle land.

This soil is fairly well suited to such crops as corn, oats, winter wheat, and hay. Water erosion and tilth are the major management concerns. Contour farming and contour stripcropping slow runoff. Grassed waterways are effective in controlling water erosion. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control erosion, prevent crusting, and increase the rate of water infiltration. Tilling when the soil is too wet can alter soil structure and can result in the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion. Overgrazing when the soil is excessively wet can cause compaction and poor tilth. Proper stocking rates and pasture rotation help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because of the slope and a moderate shrink-swell potential in the subsoil and underlying material, this soil is only fairly well suited to building site development. It is generally unsuited to septic tank absorption fields because of the moderately slow permeability. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification system is IIIe. The Michigan soil management group is 1.5a.

69—Colwood silt loam. This nearly level, poorly drained soil is on low flats and in drainageways. It is subject to ponding. Individual areas are irregular in shape and range from 2 to 40 acres in size.

Typically, the surface layer is very dark gray, friable silt loam about 9 inches thick. The subsurface layer also is very dark gray, friable silt loam. It is about 7 inches thick. The subsoil is about 20 inches thick. It is mottled. The upper part is dark gray, firm silty clay loam, and the lower part is greenish gray, very firm silty clay loam stratified with thin layers of loam and silt loam. The underlying material to a depth of about 60 inches is dark gray, mottled, calcareous, firm silty clay loam stratified with thin layers of silt loam, silty clay, and fine sand. In some areas the soil contains more pebbles and cobbles and is not stratified. In other areas the surface layer is muck less than 16 inches thick.

Included with this soil in mapping are small areas of the somewhat poorly drained Capac and Kibbie soils on slight rises and low knolls. These soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Colwood soil, and available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during excessively wet periods.

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

If drained, this soil is well suited to such crops as corn, winter wheat, oats, and hay. Wetness and tilth are the major management concerns. A subsurface drainage system is effective in removing excess water. Draining many areas is difficult, however, because drainage outlets are not readily available. Suitable filtering material may be needed around the tile to keep fine sand and silt from flowing into the tile lines. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to maintain good tilth.

This soil is poorly suited to pasture. If drainage outlets are available, a surface drainage system can help to remove excess water. Restricted grazing during wet periods helps to keep the pasture in good condition. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. Logging roads tend to be slippery when the soil is wet. Also, ruts form quickly along the roads. Equipment should be used only when the soil is frozen or relatively dry. Special planting methods, such as bedding, may be needed to reduce the seedling mortality rate. Special harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is IIw. The Michigan soil management group is 2.5c-s.

73—Sebewa loam. This nearly level, poorly drained soil is on low flats. It is subject to ponding. Individual areas are irregular in shape and range from 2 to 65 acres in size.

Typically, the surface layer is very dark gray, friable loam about 10 inches thick. The subsoil is about 28 inches thick. It is mottled and firm. The upper part is gray clay loam, the next part is dark gray clay loam, and the lower part is dark gray sandy clay loam. The underlying material to a depth of about 60 inches is grayish brown, mottled, loose, calcareous gravelly sand. In some places the surface layer is muck. In other places the depth to sand and gravelly sand is more than 40 inches. In some areas the underlying material is fine sand or very fine sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Matherton soils on low knolls and ridges. These soils make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Sebewa soil and rapid in the lower part. Available water capacity is moderate. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during excessively wet periods.

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

If drained, this soil is well suited to such crops as corn, winter wheat, oats, and hay. Wetness and tilth are the major management concerns. A subsurface drainage system is effective in removing excess water. Suitable filtering material may be needed around the tile to keep sand and silt from flowing into the tile lines. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops improve tilth. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods.

This soil is poorly suited to pasture. If adequate drainage outlets are available, a surface drainage system can help to remove excess water. Restricted grazing during wet periods helps to maintain the pasture. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. Because the soil is wet and sticky, equipment should be used only when the soil is frozen or relatively dry. Special harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is IIw. The Michigan soil management group is 3/5c.

74—Dumps. This map unit consists of nearly level to steep areas of fill material. Individual areas are irregularly shaped or rectangular and range from 2 to 100 acres in size.

The composition of these nonsoil areas varies, generally consisting of discarded manmade material as well as earthy material. The areas have no soil cover, or the cover is too thin for revegetation.

The suitability for building site development and recreational uses varies greatly. Onsite investigation is needed to determine the hazards and limitations affecting specific uses.

This unit is not assigned to a land capability classification or a Michigan soil management group.

75—Udorthents, loamy. These nearly level to steep, moderately well drained or well drained soils are on outwash plains, till plains, and moraines. Some areas have been excavated, and others have been filled. The soil material has been so altered that identification of the soil series is not feasible. Individual areas are irregularly shaped or rectangular and range from 2 to 130 acres in size.

Included with these soils in mapping are small areas of very steep soils. These included soils are at the edge of some mapped areas. They are more susceptible to water erosion than the Udorthents. Also included are a few areas where the soils are sandy or clayey or are underlain by organic material below a depth of 5 feet. Included soils make up 5 to 10 percent of the unit.

The Udorthents vary greatly in some important soil properties, especially texture, permeability, and drainage. The texture ranges from sandy loam to clay loam.

Most of the acreage is idle land. A few areas are used for recreation or pasture. These soils generally are poorly suited to cultivated crops. Onsite investigation is needed to determine the suitability for woodland, pasture, building site development, and onsite waste disposal. In some areas measures that control soil blowing and water erosion are needed. If these areas are vegetated, special management generally is needed because of the altered nature of the soils.

These soils are not assigned to a land capability classification or a Michigan soil management group.

76—Udipsamments, nearly level to steep. These moderately well drained or well drained soils are on outwash plains and moraines. Most areas are sand excavation sites and borrow pits. Some of the acreage includes blown-out land, fill areas, and piles of overburden or spoil material from the mining of gravel. The soil material has been so altered that identification of the soil series is not feasible. Individual areas are irregularly shaped or rectangular and range from 3 to 200 acres in size.

Included with these soils in mapping are small areas of very steep soils. These included soils are at the edge of some mapped areas. Also included are small areas of loamy soils. Included soils make up 5 to 10 percent of the unit.

The Udipsamments vary greatly in some important soil properties, especially texture, permeability, and drainage. The texture ranges from loamy sand to gravelly sand.

Most of the acreage is idle land. Some areas are used for building site development or recreation. These soils are unsuited to cultivated crops. Onsite investigation is needed to determine the suitability for woodland, pasture, building site development, and onsite waste disposal. In some areas measures that control soil blowing and water erosion are needed. If these areas are vegetated, special management generally is needed because of the altered nature of the soils.

These soils are not assigned to a land capability classification or a Michigan soil management group.

77—Pits, gravel. This map unit consists of open excavations from which sand and gravel have been removed for use as fill or aggregates. The remaining exposed material supports few plants. In areas where the excavation extends below the water table, the bottom of the pit may be ponded seasonally or during the entire year. Individual areas are rectangular and range from 2 to 140 acres in size.

Some areas are being mined, and others are abandoned. This unit is unsuitable as cropland, pasture, or woodland. It is poorly suited to building site development.

This unit is not assigned to a land capability classification or a Michigan soil management group.

78—Urban land. This map unit consists of nearly level to very steep areas where more than 80 percent of the surface is covered by streets, parking lots, driveways, sidewalks, office buildings, housing units, and industrial parks. Commonly, some of the higher areas have been leveled and the lower ones filled and smoothed. Individual areas vary in shape and range from 5 to 450 acres in size.

Included with the Urban land in mapping are small areas of the well drained Perrinton and Spinks soils. These soils make up 10 to 20 percent of the unit.

This unit is not assigned to a land capability classification or a Michigan soil management group.

79—Houghton muck, ponded. This nearly level, very poorly drained soil is in bogs, along drainageways, and in depressions on uplands. It is covered by shallow water most of the year. Most areas collect runoff from the adjacent uplands, store it, and filter it. This runoff recharges the ground water supplies. Individual areas are round, elongated, or irregularly shaped and range from 2 to 110 acres in size.

Typically, the surface layer is black muck about 7 inches thick. The underlying material to a depth of about 55 inches also is black muck. In some areas the muck is underlain by sand, marl, or loamy material.

Included with this soil in mapping are small areas of the poorly drained Cohoctah soils along drainageways and on flood plains. These soils make up 5 to 15 percent of the unit.

Permeability is moderately slow to moderately rapid in the Houghton soil. Available water capacity is high. Surface runoff is ponded. The seasonal high water table is near or above the surface most of the year.

Most areas support native vegetation, primarily cattails and reeds. This soil is well suited to wetland wildlife habitat. It provides cover, nesting areas, and food for many aquatic animals, including ducks, geese, and other birds.

This soil is unsuited to septic tank absorption fields and building site development because of the ponding.

The land capability classification is VIIIw. The Michigan soil management group is Mc.

80—Udorthents, nearly level to steep. These well drained, loamy soils are in areas where garbage and more durable refuse are at a depth of 3 feet or more. Individual areas are generally rectangular and range from 2 to 175 acres in size.

These soils vary greatly in some important soil properties, especially texture, permeability, and drainage.

Onsite investigation is needed to determine the suitability of specific areas for plantings, buildings, and other uses and the hazards and limitations affecting those uses.

This unit is not assigned to a land capability classification or a Michigan soil management group.

81B—Urban land-Spinks complex, 0 to 8 percent slopes. This map unit occurs as areas of Urban land intricately mixed with areas of a nearly level to gently rolling, well drained Spinks soil. The unit is in broad areas and on the side slopes of knolls and ridges. Individual areas are irregularly shaped or rectangular and range from 5 to 1,950 acres in size. They are 40 to 80 percent Urban land and 20 to 50 percent Spinks and similar soils. The Urban land and Spinks soil occur as areas so intricately mixed that mapping them separately is not practical at the scale used.

Urban land is covered by buildings, concrete, asphalt, and other impervious material that so obscure or alter the soils that identification of the soil series is not feasible.

Typically, the Spinks soil has a surface layer of dark brown, very friable loamy sand about 10 inches thick. The subsurface layer is yellowish brown, very friable loamy sand about 6 inches thick. Below this to a depth of about 60 inches is yellowish brown, loose sand that has thin lamellae of dark brown, friable loamy sand. In places the underlying material is loamy.

Included with this unit in mapping are small areas of the somewhat poorly drained Wasepi and Thetford soils. These soils are in nearly level areas and in the lower landscape positions, such as depressions and drainageways. Also included are small areas of soils that have been radically altered. Some of the higher areas of these soils have been leveled, and the lower ones have been filled and smoothed. Included soils make up 10 to 25 percent of the unit.

Permeability is moderately rapid in the Spinks soil, available water capacity is low, and surface runoff is slow.

Most areas of this unit are used for residential, commercial, and industrial development. Some are used for schools and small parks. In disturbed areas the suitability for specific uses should be determined by onsite investigation.

The Spinks soil is fairly well suited to grasses, flowers, vegetables, trees, and shrubs. It is droughty. As a result, deep-rooted plants or those that are highly tolerant of dry soil conditions should be selected for planting. In areas where the surface is exposed because of construction or gardening, soil blowing is a hazard. It can be controlled by mulching and sodding. In areas where the subsoil has been exposed, vegetation should be established on a cover of suitable topsoil.

The Spinks soil is well suited to building site development. The droughtiness and the susceptibility to soil blowing are the major management concerns on building sites. All sanitary facilities should be connected to municipal sewerage systems.

This unit is not assigned to a land capability classification or a Michigan soil management group.

81C—Urban land-Spinks complex, 8 to 15 percent slopes. This map unit occurs as areas of Urban land intricately mixed with areas of a gently rolling and rolling, well drained Spinks soil. The unit is on the side slopes of knolls and ridges. Individual areas are irregularly shaped or rectangular and range from 5 to more than 100 acres in size. They are 40 to 80 percent Urban land and 20 to 50 percent Spinks and similar soils. The Urban land and Spinks soil occur as areas so intricately mixed that mapping them separately is not practical at the scale used.

Urban land is covered by buildings, concrete, asphalt, and other impervious material that so obscure or alter the soils that identification of the soil series is not feasible.

Typically, the Spinks soil has a surface layer of dark brown, very friable loamy sand about 7 inches thick. The subsurface layer is yellowish brown, loose loamy sand about 6 inches thick. Below this to a depth of about 60 inches is yellowish brown, loose sand that has thin lamellae of dark brown, friable loamy sand. In places the underlying material is loamy.

Included with this unit in mapping are small areas of the somewhat poorly drained Wasepi and Thetford soils in the lower landscape positions, such as depressions and drainageways. Also included are small areas of soils that have been radically altered. Some of the higher areas of these soils have been leveled, and the lower ones have been filled and smoothed. Included soils make up 10 to 20 percent of the unit.

Permeability is moderately rapid in the Spinks soil, available water capacity is low, and surface runoff is medium.

Most areas of this unit are used for residential, commercial, and industrial development. Some are used for schools and small parks. In disturbed areas the suitability for specific uses should be determined by onsite investigation.

The Spinks soil is fairly well suited to grasses, flowers, vegetables, trees, and shrubs. It is droughty. As a result, deep-rooted plants or those that are highly tolerant of dry soil conditions should be selected for planting. In areas where the surface is exposed because of construction or gardening, soil blowing is a hazard. It can be controlled by mulching and sodding. In areas where the subsoil has been exposed, vegetation should be established on a cover of suitable topsoil.

The Spinks soil is fairly well suited to building site development. The slope, the droughtiness, and the susceptibility to water erosion and soil blowing are the major management concerns on building sites. The buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is needed. All sanitary facilities should be connected to municipal sewerage systems.

This unit is not assigned to a land capability classification or a Michigan soil management group.

81D—Urban land-Spinks complex, 15 to 25 percent slopes. This map unit occurs as areas of Urban land intricately mixed with a rolling and steep, well drained Spinks soil. The unit is on the side slopes of knolls and ridges. Individual areas are irregularly shaped or rectangular and range from 3 to 90 acres in size. They are 40 to 80 percent Urban land and 20 to 50 percent Spinks and similar soils. The Urban land and Spinks soil occur as areas so intricately mixed that mapping them separately is not practical at the scale used.

Urban land is covered by buildings, concrete, asphalt, and other impervious material that so obscure or alter the soils that identification of the soil series is not feasible.

Typically, the Spinks soil has a surface layer of dark brown, very friable loamy sand about 5 inches thick. The subsurface layer is yellowish brown, loose loamy sand about 14 inches thick. Below this to a depth of about 60 inches is yellowish brown, loose sand that has thin lamellae of dark brown, friable loamy sand. In places the underlying material is loamy.

Included with this unit in mapping are small areas of the somewhat poorly drained Wasepi and Thetford soils in the lower landscape positions, such as depressions and drainageways. Also included are small areas of soils that have been radically altered and some areas, especially along breaks to streams and rivers, where the slope is more than 25 percent. Some of the higher areas of the altered soils have been leveled, and the lower ones have been filled and smoothed. Included soils make up 10 to 25 percent of the unit.

Permeability is moderately rapid in the Spinks soil, available water capacity is low, and surface runoff is rapid.

Most areas of this unit are used for residential development. Some are used as small parks.

The Spinks soil is poorly suited to grasses, flowers, and vegetables and is fairly well suited to trees and shrubs. Terraces and retaining structures are needed in areas where gardens or environmental plantings are established. The soil is droughty. As a result, deep-rooted plants or those that are highly tolerant of dry soil conditions should be selected for planting. In areas where the surface is exposed because of construction or gardening, soil blowing and water erosion are hazards. They can be controlled by mulching and sodding. In areas where the subsoil has been exposed, vegetation should be established on a cover of suitable topsoil.

The Spinks soil is poorly suited to building site development. The slope, the droughtiness, and the susceptibility to soil blowing are the major management concerns on building sites. The buildings should be designed so that they conform to the natural slope of the land. In many areas land shaping is necessary. Sodding may be necessary to establish lawns. All sanitary facilities should be connected to municipal sewerage systems.

This unit is not assigned to a land capability classification or a Michigan soil management group.

82B—Urban land-Perrinton complex, 0 to 8 percent slopes. This map unit occurs as areas of Urban land intricately mixed with a nearly level to gently rolling, well drained Perrinton soil. The unit is in broad areas and on the side slopes of knolls and ridges. Individual areas are irregularly shaped or rectangular and range from 5 to 1,100 acres in size. They are 40 to 80 percent Urban land and 20 to 50 percent Perrinton and similar soils. The Urban land and Perrinton soil occur as areas so intricately mixed that mapping them separately is not practical at the scale used.

Urban land is covered by buildings, concrete, asphalt, and other impervious material that so obscure or alter the soils that identification of the soil series is not feasible.

Typically, the Perrinton soil has a surface layer of very dark grayish brown, friable loam about 5 inches thick. The subsurface layer is pale brown, friable loam about 3 inches thick. The next 12 inches is pale brown and brown, firm loam and reddish brown, firm clay loam. Below this is about 19 inches of reddish brown, firm clay loam and silty clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, firm silty clay loam. In some areas gray mottles are in the lower part of the subsoil and in the underlying material.

Included with this unit in mapping are small areas of the somewhat poorly drained Capac and Ithaca soils. These soils are in nearly level areas and in the lower landscape positions, such as depressions and drainageways. Also included are small areas where the soils have been radically altered. Some of the higher areas of these soils have been leveled, and the lower ones have been filled and smoothed. Included soils make up 10 to 25 percent of the unit.

Permeability is moderately slow in the Perrinton soil, available water capacity is high, and surface runoff is medium or rapid.

Most areas of this unit are used for residential, commercial, and industrial development. Some are used for schools and small parks. In disturbed areas the suitability for specific uses should be determined by onsite investigation.

Erosion is the main concern in using the Perrinton soil for grasses, flowers, vegetables, trees, and shrubs. If the surface is disturbed and exposed, the soil material will erode into local drainage systems. As a result, mulching, sodding, diversions, erosion-control structures, and grassed waterways are needed. In areas where the subsoil is exposed, vegetation should be established on a cover of suitable topsoil.

The Perrinton soil is only fairly well suited to building site development because of a moderate shrink-swell potential in the subsoil and underlying material. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. All sanitary facilities should be connected to municipal sewerage systems.

This unit is not assigned to a land capability classification or a Michigan soil management group.

82C—Urban land-Perrinton complex, 8 to 15 percent slopes. This map unit occurs as areas of Urban land intricately mixed with areas of a gently rolling and rolling, well drained Perrinton soil. The unit is on the side slopes of knolls and ridges. Individual areas are irregularly shaped or rectangular and range from 5 to 70 acres in size. They are 40 to 80 percent Urban land and 20 to 50 percent Perrinton and similar soils. The Urban land and Perrinton soil occur as areas so intricately mixed that mapping them separately is not practical at the scale used.

Urban land is covered by buildings, concrete, asphalt, and other impervious material that so obscure or alter the soils that identification of the soil series is not feasible.

Typically, the Perrinton soil has a surface layer of very dark grayish brown, friable loam about 4 inches thick. The subsurface layer is pale brown, friable loam about 3 inches thick. The next 12 inches is mixed brown and pale brown, firm loam and reddish brown, firm clay loam. Below this is about 10 inches of reddish brown, firm clay loam and silty clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, firm silty clay loam. In some areas gray mottles are in the lower part of the subsoil and in the underlying material.

Included with this unit in mapping are small areas of the somewhat poorly drained Capac and Ithaca soils in the lower landscape positions, such as depressions and drainageways. Also included are small areas where the soils have been radically altered. Some of the higher areas of these soils have been leveled, and the lower ones have been filled and smoothed. Included soils make up 10 to 20 percent of the unit.

Permeability is moderately slow in the Perrinton soil, available water capacity is high, and surface runoff is medium or rapid.

Most areas of this unit are used for residential, commercial, and industrial development. Some are used for schools and small parks. In disturbed areas the suitability for specific uses should be determined by onsite investigation.

The Perrinton soil is fairly well suited to lawns, gardens, environmental plantings, and parks and is poorly suited to playgrounds. Erosion is the main concern in using this soil for grasses, flowers, vegetables, trees, and shrubs. If the surface is disturbed and exposed, the soil material will erode into local drainage systems. As a result, mulching, sodding, diversions, erosion-control structures, and grassed waterways are needed. In areas where the subsoil is exposed, vegetation should be established on a cover of suitable topsoil.

The Perrinton soil is only fairly well suited to building site development because of the slope and a moderate shrink-swell potential in the subsoil and underlying material. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. All sanitary facilities should be connected to municipal sewerage systems.

This unit is not assigned to a land capability classification or a Michigan soil management group.

82D—Urban land-Perrinton complex, 15 to 25 percent slopes. This map unit occurs as areas of Urban land intricately mixed with areas of a rolling and steep, well drained Perrinton soil. The unit is on the side slopes of knolls and ridges. Individual areas are irregularly shaped or rectangular and range from 5 to 40 acres in size. They are 40 to 80 percent Urban land and 20 to 50 percent Perrinton and similar soils. The Urban land and Perrinton soil occur as areas so intricately mixed that mapping them separately is not practical at the scale used.

Urban land is covered by buildings, concrete, asphalt, and other impervious material that so obscure or alter the soils that identification of the soil series is not feasible.

Typically, the Perrinton soil has a surface layer of very dark grayish brown, friable loam about 3 inches thick. The subsurface layer is pale brown, friable loam about 3 inches thick. The next 7 inches is mixed brown and pale brown, firm loam and reddish brown, firm clay loam. Below this is about 13 inches of reddish brown, firm clay loam and silty clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, firm silty clay loam.

Included with this unit in mapping are small areas of the somewhat poorly drained Capac and Ithaca soils in the lower landscape positions, such as depressions and drainageways. Also included are small areas where the soils have been radically altered and small areas where the slope is more than 25 percent. Some of the higher areas of the altered soils have been leveled, and the lower ones have been filled and smoothed. Included soils make up 10 to 25 percent of the unit.

Permeability is moderately slow in the Perrinton soil, available water capacity is high, and surface runoff is rapid.

Most areas of this unit are used for residential development. Some are used as small parks and open areas. In disturbed areas the suitability for specific uses should be determined by onsite investigation.

The Perrinton soil is poorly suited to lawns, environmental plantings, and parks because of the hazard of water erosion. If the surface is disturbed, the soil material will erode into local drainage systems. As a result, mulching, sodding, diversions, and erosion-control structures are needed. In areas where the subsoil is exposed, perennial vegetation should be established on a cover of suitable topsoil.

The Perrinton soil is poorly suited to houses and small commercial buildings and generally is unsuited to gardens and playgrounds. The slope is the main limitation. Also, the shrink-swell potential is a limitation on sites for buildings. The buildings should be designed so that they conform to the natural slope of the land. In many areas land shaping is necessary. Widening the foundation trenches and then backfilling with suitable coarse material help to control shrinking and swelling. Subsurface drains also help to control shrinking and swelling. All sanitary facilities should be connected to municipal sewerage systems.

This unit is not assigned to a land capability classification or a Michigan soil management group.

83B—Marlette loam, moderately wet, 1 to 5 percent slopes. This nearly level and undulating, moderately well drained soil is on the tops and convex side slopes of low knolls and ridges and in broad areas characterized by slight rises. Individual areas are irregular in shape and range from 2 to 140 acres in size.

Typically, the surface layer is dark brown, friable loam about 9 inches thick. The next 7 inches is mixed light brown, firm clay loam and pinkish gray loam. Below this is dark brown, firm clay loam about 4 inches thick. The next part is dark brown, mottled, firm clay loam about 14 inches thick. The underlying material to a depth of about 60 inches is brown, mottled, firm, calcareous clay loam. In some areas the subsoil does not have gray mottles. In some small areas sand is below a depth of 40 inches.

Included with this soil in mapping are small areas of Capac, Metea, Oakville, and Selfridge soils. Capac and Selfridge soils are somewhat poorly drained and are in the lower swales and drainageways. Selfridge, Metea, and Oakville soils have a sandy surface layer. Metea and Oakville soils are on the tops of knolls and ridges. Oakville soils are well drained or moderately drained. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Marlette soil, and available water capacity is high. Surface runoff is medium. The seasonal high water table is at a depth of 2.5 to 6.0 feet in winter, in spring, and during other excessively wet periods.

Most areas of this soil are used for cultivated crops or orchards. Some are used as woodland. A few are used for building site development.

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion and tilth. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and improve tilth. The soil tends to puddle and crust after heavy rains. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling water erosion and soil blowing. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is well suited to woodland. No major management concerns affect planting or harvesting.

Because the wetness is a limitation on sites for buildings with basements, this soil is only fairly well suited to building site development. Buildings with basements can be constructed on well compacted fill material, which raises the site. Artificial drainage lowers the water table. The soil is poorly suited to septic tank absorption fields because of the moderately slow permeability and the wetness. Special construction methods, such as enlarging the absorption fields or installing alternating drain fields, can overcome these limitations.

The land capability classification is IIe. The Michigan soil management group is 2.5a.

84B—Dixboro loamy fine sand, 0 to 4 percent slopes. This nearly level and undulating, somewhat poorly drained soil is in drainageways, on broad flats, and on the convex foot slopes of low knolls. Individual areas are irregular in shape and range from 2 to 120 acres in size.

Typically, the surface layer is dark brown, very friable loamy fine sand about 9 inches thick. The subsurface layer is brown, mottled, very friable loamy fine sand about 7 inches thick. The subsoil is about 15 inches thick. It is mottled. The upper part is yellowish brown, very friable loamy fine sand, and the lower part is yellowish brown and dark yellowish brown, friable fine sandy loam. The underlying material to a depth of about 60 inches is brown, mottled, calcareous, firm, stratified loamy fine sand to sandy clay. In some places the subsoil has thicker layers of loamy material and is not stratified. In other places the underlying material is sandier.

Included with this soil in mapping are small areas of Arkport, Kibbie, and Lamson soils. Arkport soils are well drained and are on the tops of knolls and ridges. Kibbie soils are in landscape positions similar to those of the Dixboro soil. They have a loamy surface layer. Lamson soils are poorly drained and are in drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Dixboro soil. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet in winter, in spring, and during other excessively wet periods.

Most areas of this soil are used as cropland or pasture. Some of the acreage is woodland or idle land.

This soil is well suited to such crops as corn, oats, winter wheat, and hay. Wetness and soil blowing are the major management concerns. A subsurface drainage system is effective in removing excess water. Suitable filtering material may be needed around the tile to keep sand and silt from plugging the tile lines. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops reduce the susceptibility to soil blowing. Wind stripcropping, vegetative barriers, buffer strips, and field windbreaks also help to control soil blowing.

This soil is well suited to pasture. If drainage outlets are available, a surface drainage system can help to remove excess water. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is well suited to woodland. The equipment limitation is the major management concern. Heavy equipment tends to form ruts when the soil is wet. The equipment should be used only when the soil is relatively dry or frozen.

Because of the wetness, this soil is poorly suited to building site development and is generally unsuited to septic tank absorption fields. A surface or subsurface drainage system lowers the water table on building sites. The buildings can be constructed on well compacted fill material, which raises the site. Sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIw. The Michigan soil management group is 3b-s.

85—Lamson fine sandy loam. This nearly level, poorly drained soil is on flats and in drainageways. It is subject to ponding. Individual areas are irregular in shape and range from 2 to 285 acres in size.

Typically, the surface layer is very dark grayish brown, friable fine sandy loam about 11 inches thick. The subsurface layer is grayish brown, friable fine sandy loam about 9 inches thick. The subsoil is about 30 inches thick. It is mottled. The upper part is dark grayish brown and brown, friable fine sandy loam, and the lower part is light brownish gray, friable fine sandy loam stratified with loam, loamy sand, and fine sand. The underlying material to a depth of about 60 inches is brown, loose fine sand. In places the surface layer is muck. In some areas the soil is underlain by gravelly sand. In other areas it is dominantly sandy but has strata of finer textured material.

Included with this soil in mapping are small areas of the somewhat poorly drained Thetford soils on small ridges and knolls. These soils are sandy throughout. They make up 5 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Lamson soil. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during prolonged wet periods.

Most of the acreage of this soil is pasture or idle land. Some areas are used as cropland.

If drained, this soil is fairly well suited to such crops as corn and hay. Wetness, soil blowing, and tilth are the major management concerns. A subsurface drainage system is effective in removing excess water. Draining many areas is difficult, however, because drainage outlets are not readily available. Suitable filtering material may be needed around the tile to keep sand and silt from flowing into the tile lines. Tilling when the soil is too wet can alter soil structure and can result in compaction. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control soil blowing and improve tilth.

This soil is fairly well suited to pasture. If drainage outlets are available, a surface drainage system can help to remove excess water. Restricted grazing during wet periods helps to keep the pasture in good condition. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is fairly well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. Equipment should be used only when the soil is relatively dry or frozen. When the soil is wet, logging roads tend to become slippery and ruts form quickly. Special harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the ponding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is IIIw. The Michigan soil management group is 3c-s.

86B—Teasdale fine sandy loam, 0 to 4 percent slopes. This nearly level and undulating, somewhat poorly drained soil is on narrow or broad plains and in drainageways. Individual areas are irregular in shape and range from 2 to 80 acres in size.

Typically, the surface layer is dark brown, friable fine sandy loam about 9 inches thick. The subsurface layer is about 12 inches thick. It is mottled. The upper part is yellowish brown, friable fine sandy loam, and the lower part is light yellowish brown, very friable loamy fine sand. Below this is about 5 inches of mixed strong brown, friable loam and light yellowish brown loamy fine sand. The subsoil is about 30 inches thick. It is mottled and friable. The upper part is strong brown loam, and the lower part is yellowish brown fine sandy loam. The underlying material to a depth of about 60 inches is yellowish brown, friable, calcareous fine sandy loam. In some places banded sand and loamy sand are below a depth of 50 inches. In other places the underlying material is calcareous clay loam. In some areas a sand or loamy sand layer overlies the loamy material. In other areas the upper part of the subsoil has no gray mottles.

Included with this soil in mapping are small areas of Lamson, Oakville, and Tekenink soils. The poorly drained Lamson soils are in drainageways and in nearly level areas on the lower parts of the landscape. The moderately well drained Oakville and well drained Tekenink soils are on low ridges and knolls. Oakville soils are more permeable and more droughty than the Teasdale soil. Included soils make up 5 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Teasdale soil. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet during excessively wet periods.

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

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are wetness, soil blowing, and tilth. If drainage outlets are available, a subsurface drainage system is effective in reducing the wetness. Suitable filtering material may be needed around the tile to keep fine sand and silt from flowing into the tile lines. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control soil blowing and improve tilth. Tilling when the soil is too wet can alter soil structure and can result in compaction and the formation of clods.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Restricted grazing during wet periods helps to keep the pasture in good condition. The pasture plants that can tolerate the wetness should be selected for planting.

This soil is well suited to woodland. The major management concern is the equipment limitation. Heavy equipment tends to form ruts when the soil is wet. It should be used only when the soil is relatively dry or frozen.

Because of the wetness, this soil is poorly suited to building site development and is generally unsuited to septic tank absorption fields. A surface or subsurface drainage system lowers the water table on building sites. The buildings can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IIw. The Michigan soil management group is 3b.

87B—Pipestone sand, 0 to 4 percent slopes. This nearly level and undulating, somewhat poorly drained soil is on flats and on the concave side slopes of low knolls and ridges. Individual areas are irregular in shape and range from 2 to 30 acres in size.

Typically, the surface layer is black, very friable sand about 8 inches thick. The subsurface layer is grayish brown, mottled, loose sand about 3 inches thick. The subsoil is mottled sand about 37 inches thick. The upper part is dark reddish brown and very friable and has chunks of hard, brittle soil material; the next part is strong brown and loose; and the lower part is yellowish brown and loose. The underlying material to a depth of about 60 inches is brown, mottled, loose sand. In some places it is sand and gravelly sand. In other places the upper part of the subsoil has no gray mottles. In some areas the subsoil is not so red and does not have chunks of hard, brittle soil material.

Included with this soil in mapping are areas of Granby, Grattan, and Selfridge soils. Granby soils are poorly drained and are in drainageways and the lower areas. Grattan soils are excessively drained and are on the convex side slopes of ridges and the tops of knolls. Selfridge soils are in landscape positions similar to those of the Pipestone soil. In the lower part of the subsoil, they are loamy and less permeable than the Pipestone soil. Included soils make up 2 to 7 percent of the unit.

Permeability is rapid in the Pipestone soil, and available water capacity is low. Surface runoff is low or very slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet during excessively wet periods.

Most of the acreage of this soil is woodland or idle land. A few areas are used as cropland.

This soil is poorly suited to corn, but such crops as winter wheat, oats, hay, and blueberries can be grown. The major management concerns are wetness, droughtiness, and soil blowing. If drainage outlets are available, a subsurface drainage system is effective in reducing the wetness. Suitable filtering material may be needed around the tile to keep fine sand from flowing into the tile lines. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material increase the available water capacity and reduce the susceptibility to soil blowing. Wind stripcropping, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing. Irrigating when soil moisture levels are low can increase productivity.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

This soil is well suited to woodland. The equipment limitation is the major management concern. Heavy equipment tends to form ruts when the soil is dry or excessively wet. It should be used only when the soil is moist and friable or is frozen.

Because of the wetness, this soil is poorly suited to building site development and generally is unsuited to septic tank absorption fields. A surface or subsurface drainage system lowers the water table on building sites. The buildings can be constructed on well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewerage systems.

The land capability classification is IVw. The Michigan soil management group is 5b.

89E—Marlette-Oakville-Boyer complex, 15 to 60 percent slopes. These well drained, strongly sloping to very steep soils are in areas on uplands where successive layers of glacial deposits have been deeply dissected by glacial meltwater. Individual areas are elongated or irregularly shaped and range from 5 to 200 acres in size. They are 30 to 55 percent Marlette soil, 20 to 55 percent Oakville soil, and 10 to 30 percent Boyer soil. The three soils occur as areas so small or so intricately mixed that mapping them separately is not practical at the scale used.

Typically, the Marlette soil has a surface layer of dark brown loam about 4 inches thick. The next 5 inches is mixed dark yellowish brown, firm clay loam and light brownish gray, friable loam. The subsoil is dark yellowish brown, firm clay loam about 15 inches thick. The underlying material to a depth of about 60 inches is brown, friable, calcareous loam. In some areas the soil is underlain by sand below a depth of 40 inches. In some places, the subsoil has less clay and the underlying material is sandy loam. In other places as much as 40 inches of sand overlies the loamy material.

Typically, the Oakville soil has a surface layer of dark grayish brown fine sand about 4 inches thick. The subsoil is yellowish brown, loose fine sand about 21 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown, loose fine sand. In some areas thin bands of loamy fine sand are in the subsoil. In other areas the underlying material is loam or sandy loam below a depth of 40 inches.

Typically, the Boyer soil has a surface layer of very dark grayish brown loamy sand about 4 inches thick. The subsoil is about 16 inches thick. It is strong brown and friable. The upper part is gravelly loamy sand, the next part is gravelly sandy loam, and the lower part is gravelly sandy clay loam. The underlying material to a depth of about 60 inches is yellowish brown, loose sand and gravelly sand. In some areas the upper part of the profile is sand to a depth of more than 20 inches. In a few areas the loamy part of the subsoil is less than 10 inches thick. In some places the depth to calcareous sand and gravelly sand is more than 40 inches. In other places the slope is more than 60 percent.

Included with these soils in mapping are small areas of the somewhat poorly drained Capac and Wasepi soils on concave foot slopes, in depressions, and along drainageways. Also included are the poorly drained Parkhill and Cohoctah soils in depressions and drainageways and small seepy areas at the base of slopes. Included areas make up 2 to 15 percent of the unit.

Permeability is moderately slow in the Marlette soil and rapid in the Oakville soil. It is moderately rapid in the upper part of the Boyer soil and very rapid in the lower part. Available water capacity is high in the Marlette soil and low in the Oakville and Boyer soils. Surface runoff is rapid on all three soils.

Most of the acreage is woodland or idle land. A few areas are pastured. These soils are generally unsuited to cultivated crops and pasture because of the slope.

These soils are generally suited to woodland. The erosion hazard, the equipment limitation, and seedling mortality are the main management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, and culverts. Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on the steeper slopes. As a result, special logging methods, such as yarding logs uphill with a cable, may be needed. Special harvest methods that leave some mature trees to provide shade and protection from the wind reduce the seedling mortality rate.

Because of the slope, these soils are generally unsuited to building site development and septic tank absorption fields.

The land capability classification is VIIe. The Michigan soil management groups are 2.5a, 5.3a, and 4a.

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 economically to produce a sustained high yield of crops. 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.

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

Some soils that have a seasonal high water table qualify 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 in table 5. Onsite evaluation is needed to determine whether or not the limitation has been overcome by corrective measures.

Use and Management of the Soils

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

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

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties (*14*).

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 wetness or very firm soil layers can cause difficulty in excavation.

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

Crops and Pasture

Steve Utic, district conservationist, and Jerry Griger, 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 230,000 acres in Kent County, or nearly 42 percent of the total land area, is farmland. More than 195,000 acres was used for crops and pasture in 1978 (*18*). Of this total, about 25,000 acres was used for permanent pasture; 67,000 acres for row crops, mostly corn; 16,000 acres for close-grown crops, mainly oats and wheat; 46,800 acres for hay crops; and 21,000 acres for specialty crops. The rest was idle cropland or was planted to cover crops.

The main management needs in the areas of the county used for crops and pasture are measures that help to control water erosion and soil blowing, reduce wetness, conserve soil moisture, and improve fertility and tilth.

Water erosion and *soil blowing* are major management concerns on most of the cropland in the county. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Glynwood and Saylesville soils, and on soils that tend to be droughty, such as Spinks and Plainfield soils. Second, erosion on farmland results in the sedimentation of streams. Controlling erosion minimizes this pollution and improves the quality of water for municipal and recreation uses and for fish and other wildlife.

Water erosion is a serious hazard on all of the soils that have slopes of 2 percent or more. Preparing a good seedbed is difficult on some of the soils because the friable surface layer has been eroded away in places.

Erosion-control practices provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods reduces the susceptibility to erosion and preserves the productive capacity of the soil. On livestock farms, where pasture and hay are needed, including forage crops of grasses and legumes in the cropping sequence helps to control erosion on the more sloping land, provides nitrogen for subsequent crops, and improves tilth. Conservation tillage helps to control runoff and erosion by leaving protective amounts of crop residue on the surface. Cover crops, diversions, and grassed waterways also help to control erosion.

Soil blowing is a hazard on the sandy Oakville, Chelsea, Spinks, Boyer, Metea, Rimer, and Selfridge soils and on the mucky Houghton, Edwards, Palms, and Adrian soils. It can damage these soils in a few hours, especially the mucky soils, if the wind is strong, the soils are dry, and the surface is bare. An adequate plant cover, surface mulch, buffer strips, and tillage methods that leave the surface rough help to control soil blowing. Wind barriers and conservation tillage also help to control soil blowing. Examples of wind barriers are stands of tall wheatgrass and windbreaks of trees and shrubs.

No-tillage, which is increasingly common in the county, is effective in controlling water erosion and soil blowing because it leaves crop residue on the surface. It is suited to most of the soils in the county. It is not so successful, however, on soils that have a clayey surface layer. Because of no-tillage, erosive areas that otherwise are only marginally productive can be used for corn. No-tillage helps to maintain the productive capacity of nearly all cropland. In areas where no-till crops are grown, different methods of planting and of controlling insects and weeds are needed. The proper time for planting, the selection of herbicides that are suited to the existing vegetation, an adequate supply of plant nutrients, and the selection of tillage systems based on soil characteristics are important management requirements.

Much of the permanent pasture in the county is in areas where erosion is a hazard. Control of erosion is particularly important when the pasture is seeded. Forage production and the extent to which the plant cover protects the surface of the soil are influenced by the number of livestock that the pasture supports, the length of time that they graze, and the distribution of rainfall. Good pasture management includes stocking rates that maintain the key forage species, pasture rotation, deferred grazing, timely grazing, and strategic location of water supplies for livestock.

Information about the design and application of erosion-control practices for different soils is available in local offices of the Soil Conservation Service.

Soil drainage is a major management concern in many areas used for crops and pasture. Drainage of cropland improves the air-water relationship in the root zone. In areas where drainage is poor, spring planting, spraying, and harvesting are delayed and controlling weeds is difficult. Properly designed subsurface drainage systems or surface drainage systems, or both, can be used to remove excess water.

Unless drained, some soils are naturally so wet that they cannot be used for the crops commonly grown in the county. Unless drained, very poorly drained, poorly drained, and somewhat poorly drained soils are so wet that crops are damaged in most years. Examples are Houghton, Selfridge, Cohoctah, Blount, Capac, Parkhill, and Pewamo soils. Natural drainage is good in Marlette, Perrinton, and Kalamazoo soils most of the year, but these soils tend to dry slowly after rains. Small areas of the wetter soils along drainageways and in swales are commonly included in some areas of these soils, especially where slopes are 2 to 6 percent. Artificial drainage is needed in some of these wetter areas.

The design of surface and subsurface drainage systems varies with the kind of soil. A combination of surface drainage and subsurface drainage is needed in most areas of poorly drained and very poorly drained soils that are intensively row cropped. The drains should be more closely spaced in soils that are slowly permeable than in the more permeable soils. Subsurface drainage is slow or very slow in Blount, Capac, Ithaca, Saylesville, and Pewamo soils. Finding adequate outlets for subsurface drainage systems is difficult in many areas of Cohoctah, Adrian, Granby, Glendora, Houghton, and Sloan soils. Diversions can be used to remove surface runoff from some wet areas. Good soil tilth and an ample supply of organic matter also improve drainage. In low lying areas the growing season is shortened by frost late in spring and early in fall.

Organic soils oxidize and subside when their pore space is filled with air. As a result, special systems are needed to control the depth and period of drainage. Maintaining the water table at the level required by the crops during the growing season and raising it to the surface during other parts of the year minimize the oxidation and subsidence of these soils.

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

Conserving *soil moisture* during dry periods is a concern in managing Arkport, Boyer, Chelsea, Metea, Rimer, Selfridge, and Spinks soils. Moisture can be conserved by no-tillage and other kinds of conservation tillage, which leave all or part of the crop residue on the surface. Increasing the organic matter content improves the available water capacity. Irrigation improves productivity. It may become more important in the county in the future. The droughty soils and many other soils in the county are suited to irrigation if they are properly managed (fig. 15).

Soil fertility is naturally medium or high in loamy soils and low in most sandy soils on uplands. Soils on flood plains, such as Cohoctah, Sloan, Ceresco, and Shoals soils, range from slightly acid to mildly alkaline and are naturally higher in content of plant nutrients than most soils on uplands.

Many sandy soils naturally range from strongly acid to slightly acid. If lime has never been applied on these soils, applications of ground limestone are needed to

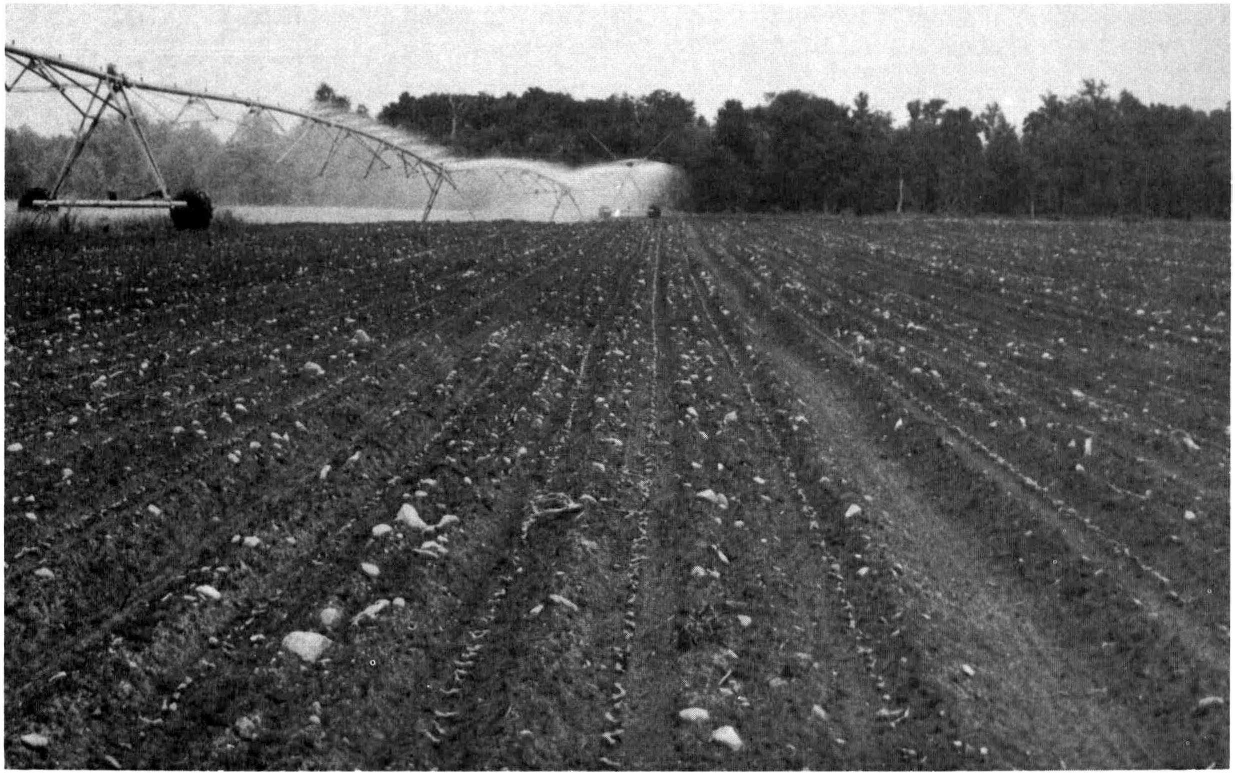

Figure 15.—Irrigated cucumbers on Boyer loamy sand, 0 to 6 percent slopes.

raise the pH level sufficiently for good growth of alfalfa and other crops that grow well only on nearly neutral soils. Available phosphorus and potash levels are naturally low or medium in most of these soils.

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 (*9*). The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime needed.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous.

Some of the soils used for crops have a loamy surface layer that is light in color and low in organic matter content. Generally, the structure of such soils is weak, and intense rainfall causes the surface to crust. This crusting hinders the emergence of plant seedlings, decreases the rate of water infiltration, and increases the runoff rate. Regular additions of crop residue, manure, and other organic material can improve tilth and can help to prevent surface crusting.

Maintaining good tilth is difficult in the dark, clayey Blount, Parkhill, and Pewamo soils because these soils stay wet until late in spring. If the soils are plowed when wet, they tend to be very cloddy when dry and are compacted. As a result, preparing a good seedbed is difficult. Cover crops, green manure crops, proper management of crop residue, conservation tillage, and applications of livestock manure help to maintain or improve tilth and the organic matter content. Fall plowing and chisel plowing at the proper moisture content can help to prevent deterioration of tilth in nearly level, poorly drained or somewhat poorly drained soils. Also, they allow the soils to be tilled earlier the following spring. Fall plowing is not suitable, however, on sloping soils or on soils that are subject to soil blowing. Good management is needed in intensively cropped areas and in areas that are cultivated year after year.

Grazing when loamy or clayey soils are wet results in soil compaction and poor tilth. The compaction caused by grazing during wet periods retards the growth of pasture plants. Proper harvesting methods, such as those for hay or silage, increase plant growth and help to prevent compaction.

The most common *row crops* suited to the soils and climate in Kent County include corn, dry beans, soybeans, and potatoes. The most common *close-grown crops* are oats and wheat. Rye, barley, and buckwheat are not so common but can be grown. Grass seed can be produced from brome, fescue, reed canarygrass, and bluegrass. Alfalfa and red clover grown in mixtures with grasses are the most common hay crops.

Specialty crops grown commercially in Kent County are apples, cherries, peaches, plums, pears, sweet corn, cucumbers, onions, snap beans, cabbage, celery, and carrots. A small acreage is used for strawberries, tomatoes, squash, and a few other vegetables.

Certain parts of the county, most notably the northwestern part, are especially well suited to fruit trees. Some sites are better suited than others, mainly because of the differences in air temperature caused by variations in elevation; because of differences in air drainage; and because of the moderating effect on air temperature caused by the proximity to Lake Michigan. Soil properties affect management practices, tree growth, and the productivity of the orchard. Local climatic conditions affect fruit-set, pollination by bees, the number of blossoms per tree, and frost damage to woody parts of the trees.

The latest information about growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields Per Acre

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

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

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of 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.

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 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 (*16*). 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, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table. Also given at the end of each map unit description is a Michigan soil management group. The soils are assigned to a group according to the need for lime and fertilizer and for artificial drainage and other practices. For soils making up a complex, the management groups are listed in the same order as the series named in the complex (*10*).

Woodland Management and Productivity

Virgin forest once covered almost all of Kent County, but the trees have been cleared from most of the land suitable for cultivation. In much of the remaining woodland, the soils are too wet, too steep, or too sandy for farming. Some areas that formerly were cultivated are being converted to woodland. The soils can produce trees of high quality if the woodland is managed properly.

About 132,000 acres in the county, or nearly 24 percent of the total land area, currently is wooded. Woodland is the dominant land use in associations 1, 2, 9, and 10, which are described in the section "General Soil Map Units." Scattered woodlots are throughout the other associations. On the upland soils, mixed hardwoods, mainly red oak, white oak, shagbark hickory, sugar maple, beech, black cherry, and white ash, are the most common trees (fig. 16). In some upland areas, white pine, basswood, and aspen are abundant. On the mineral soils in low lying areas and on bottom land, red maple, silver maple, cottonwood, sycamore, swamp white oak, and ironwood are the most common trees. On the very poorly drained, organic soils, red maple, black ash, and willow are the most common trees. Red pine is the most common tree in plantations where the soils formerly were used as cropland.

Much of the commercial woodland can be improved by thinning and by other woodland management measures, such as those that control plant competition, disease, and insects. The Soil Conservation Service and the Michigan Department of Natural Resources, Division of Forestry, can help to determine specific management needs.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. 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 7, *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

Figure 16.—A typical stand of hardwoods on Capac loam, 0 to 4 percent slopes.

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.

Environmental Plantings

Planting trees, shrubs, and vines in an urban environment presents problems that are different from those in a rural environment. There may be local regulations prohibiting the planting of certain species. Also, there may be certain hazards to plants, such as noxious fumes, high levels of salt, and soil disturbance, that are not common in a rural environment. Specialists at the Soil Conservation Service or the Cooperative Extension Service or other trained foresters can provide for more specific information about these hazards.

Table 8 lists for each soil in the survey area the species of plants that can be grown as street borders; shade trees; ornamentals; screens; plants for shaded areas, roadsides, and steep banks; and wildlife food and cover. Only the list of shade trees is considered complete. The others are partial listings of the plants that have been effectively used in recent years.

Street borders are trees planted along streets. They provide many environmental, social, architectural, engineering, and climatic benefits. The trees selected for planting should not have a shallow root system that buckles and breaks up pavement and clogs sewers and storm drains. They should not have brittle limbs that break easily under high winds or when coated with ice or covered with snow. They should have a fair tolerance to the salt used to melt ice and snow and should be able to withstand noxious fumes, dust, and smoke.

Shade trees provide many benefits. They remove carbon dioxide from the air and replace it with oxygen, and they filter dust and pollutants. They cool homes and offices and improve the appearance of the community. There are a wide variety of hardy shade trees in the survey area. The selection of which shade tree to plant depends on the desired effect, the size of the building, and the area available for tree growth. In general, trees should not be planted closer to the building than the average height at maturity. Also, they should not be planted in areas where falling limbs could cause damage.

Ornamentals are trees and shrubs planted in lawns, parks, public squares, and other areas for decorative purposes. The attractiveness of the trees and shrubs can be attributed largely to the color and shape of leaves, needles, fruit, flowers, and bark. A wide variety of ornamental trees and shrubs are suited to the survey area.

Screens for noise abatement and concealment of unsightly areas are needed in most urban areas. The species listed in table 8 can become fairly tall in a short amount of time. For the best results in abating noise, the trees and shrubs should be planted close to the noise source rather than close to the area needing protection. For year-round screening, evergreens should be planted. A combination of trees and dense shrubs may be the most effective. Some of the dense shrubs suitable as wildlife food and cover and as ornamentals also are suitable as screens. An experienced technician or a commercial nursery can provide assistance in selecting the species suitable for a specific site.

Plants for shaded areas, roadsides, and steep banks are needed in urban areas where many sites are not suitable for grasses or for woody plants. Because of the topography, the amount of shade, or the intended uses, certain ground cover plants are grown on the sites. These plants should be suited to the temperature, moisture, and other conditions at the site, should grow rapidly enough to cover and protect the area, and should be easily propagated, commercially available, low growing, and relatively resistant to foot traffic. They should require only a minimum amount of maintenance.

Wildlife food and cover can include grasses; annuals, such as wheat and corn; trees and shrubs; and vines. The list of plants in table 8, however, is limited to shrubs. No particular wildlife species was considered when the list was prepared. If habitat for a particular species of wildlife is to be created or maintained, the Soil Conservation Service, the Michigan Department of Natural Resources, the Cooperative Extension Service, or other organizations can be contacted for assistance.

A single asterisk following a species name in table 8 indicates the plants that are suitable as windbreaks. These plants can protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for some species of 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 upon 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.

Recreation

Kent County has many areas of scenic, geologic, and historic interest. These areas are used for camping, hiking, horseback riding, hunting, picnicking, and snow skiing. The county has 187 lakes (*12*) and many rivers and streams suitable for fishing, boating, and canoeing. Public lands available for recreation uses include the Rogue River State Game Area, the Cannonsburg State Game Area, and the Lowell State Game Area. Other recreation areas are in public parks throughout the county. The county has 163 of these parks, which make up more than 6,500 acres.

Many soils are well suited to the development of recreation facilities. The best suited soils are in soil associations 2, 4, 8, and 9, which are described under the heading "General Soil Map Units." These associations are characterized by nearly level to very steep terrain and by wooded, pastured, and cropped areas.

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.

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

Kent County has a varied population of fish and other wildlife. Whitetail deer, squirrel, raccoon, opossum, and thrushes and many other birds inhabit the wooded areas. Cottontail rabbits, pheasants, and many types of songbirds live in the farmed and open areas where food and cover are available. The streams and the many lakes support trout, bass, yellow perch, pike, catfish, bluegill, and other varieties of sunfish. Many of the lakes and wetlands provide cover and feeding areas for ducks, swans, Canadian geese, and herons.

In many areas the wildlife habitat can be improved by increasing the food supply and the amount of cover that wildlife need. The areas that are best suited to this improvement are in associations 4, 5, 6, 8, 12, and 14, which are described in the section on "General Soil Map Units."

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, rye, wheat, oats, and barley.

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

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 wild carrot, goldenrod, dandelion, wild mustard, burdock, and thistle.

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, poplar, cherry, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are cardinal autumn-olive, Roselow sargent or Siberian crabapple, silky dogwood, American cranberrybush, Rem-Red Amur honeysuckle, and Tatarian honeysuckle.

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, Eastern redcedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, duckweed, cattails, waterlilies, pondweeds, 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 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 bobwhite quail, woodchuck, pheasant, meadowlark, field sparrow, cottontail rabbit, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include ruffed grouse, woodcock, thrushes, woodpeckers, tree squirrels, gray fox, raccoon, and deer.

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

Engineering

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, 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 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, 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. A high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, 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 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, and flooding affect absorption of the effluent. Large stones 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 are 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, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope 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, 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 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 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, and rock fragments.

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 aquifer-fed excavated ponds. 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.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. The content of large stones affects the ease of excavation.

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 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 large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity. 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. The performance of a system is affected by the depth of the root zone and by 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, and large stones 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, and slope affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

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

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

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.

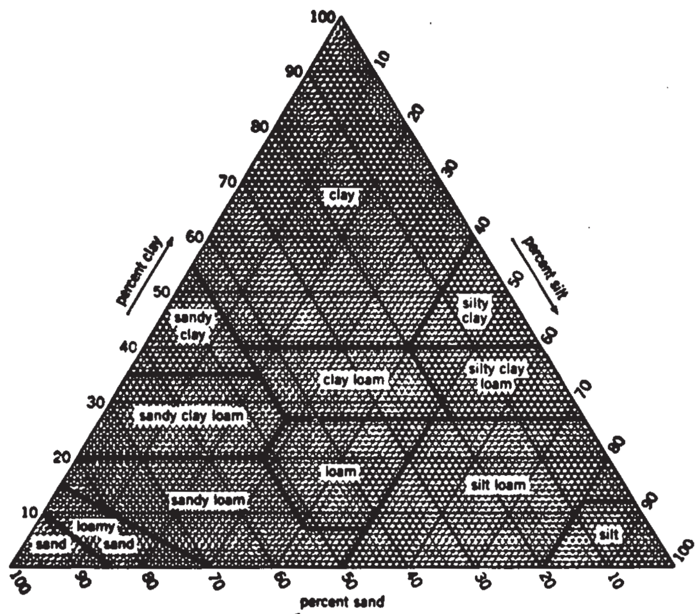

Figure 17.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

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. 17). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

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

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

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

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

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, by runoff from adjacent slopes, or by tides. 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.

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 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 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.

Soil Characterization Data for Selected Soils

Many of the soils in Kent County were sampled and laboratory data determined by the Soil Research Laboratory, Ford Forestry Center, Michigan

Technological University, L'Anse, Michigan. The laboratory data obtained from the soil samples include analyses of particle-size distribution, coarse fragments, bulk density, and moisture retention. Complete chemical analyses also were performed on each sample, and spodic horizon criteria were determined on the appropriate samples. Standard National Cooperative Soil Survey procedures were used for all analyses. Forest sites were sampled to estimate forest productivity on many of the sampled soils.

The data were used in the classification and correlation of these soils and in evaluating their behavior, especially under forestry uses. Eight profiles were selected as representative of their respective series. These series and their laboratory identification number are Capac series (S80MI081-5), Chelsea series (S80MI081-1, S79MI081-5), Grattan series (S80MI081-3, S80MI081-7), Oakville series (S79MI081-1, S79MI081-4), Okee series (S80MI081-2), Owosso series (S79MI081-3), Perrinton series (S80MI081-4, S80MI081-8), and Tekenink series (S80MI081-6). The field morphology and laboratory data for these soils were published in a separate investigations report (*13*).

In addition the Kent County data, soil characterization data and forest site data are available from nearby counties having many of the same soils that were not sampled in Kent County. These data and the Kent County data can be obtained from the Soil Research Laboratory, Ford Forestry Center, Michigan Technological University, L'Anse, Michigan; the Soil and Water Conservation Division, Michigan Department of Agriculture, Lansing, Michigan; and the Soil Conservation Service, State Office, East Lansing, Michigan.