United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with Michigan Department of Agriculture, Michigan Agricultural Experiment Station, Cooperative Extension Service, and Michigan Technological University

Soil Survey of Calhoun County, Michigan

How To Use This Soil Survey

General Soil Map

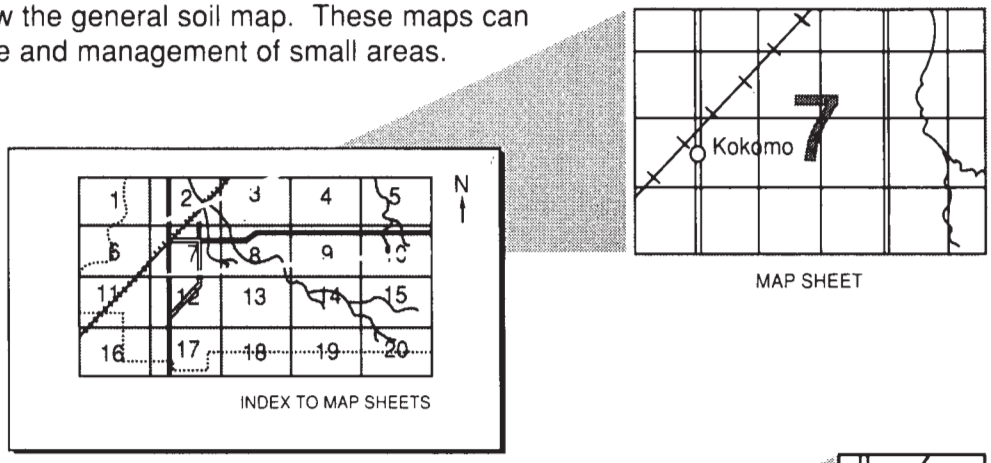
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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

Detailed Soil Maps

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

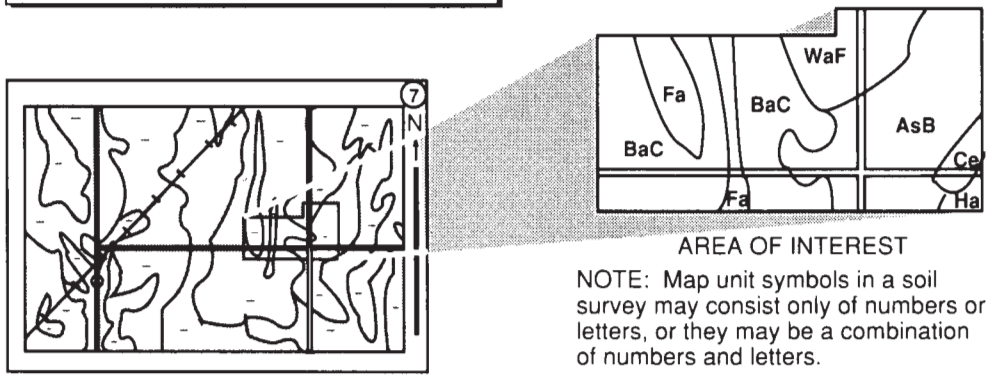
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

MAP SHEET

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



MAP SHEET

AREA OF INTEREST

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

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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1991. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1992. This survey was made cooperatively by the Natural Resources Conservation Service, the Michigan Department of Agriculture, the Michigan Agricultural Experiment Station, the Cooperative Extension Service, and Michigan Technological University. Financial assistance was provided by the Calhoun County Board of Commissioners. The survey is part of the technical assistance furnished to the Calhoun Soil Conservation District.

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.

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Cover: An area of Riddles loam, 0 to 6 percent slopes, is in the foreground. This soil is one of the most productive in the county. The buildings in the background are in an area of Hillsdale sandy loam, 0 to 6 percent slopes.

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Issued 1997

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Foreword

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

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

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

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

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Soil Survey of Calhoun County, Michigan

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United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with
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CALHOUN COUNTY is in the south-central part of Michigan's lower peninsula (fig. 1). It is bordered by Barry and Eaton Counties on the north, Jackson County on the east, Branch and Hillsdale Counties on the south, and Kalamazoo County on the west. Calhoun County has an area of 718 square miles, or 459,776 acres. Marshall is the county seat, and Battle Creek is the industrial center. In 1990, the population of Calhoun County was 135,982.

Farming is an important economic enterprise in the county. The major crops are corn, soybeans, hay, and small grain. Most of the income in the county, however, is derived from employment in manufacturing, government services, food products, recreation, tourism, and retail trade.

Soil scientists have determined that about 75 kinds of soils are in Calhoun County. The soils range widely in texture, natural drainage, slope, and other characteristics.

The undulating to rolling soils in the county are dominantly well drained. They vary widely in texture. Erosion generally is a severe hazard in unprotected areas, and measures that control erosion and prevent the sedimentation of streams are needed. Under proper management, the soils are suited to field crops and pasture. The well drained soils, which make up about half of the county, are suited to urban development.

General Nature of the County

This section provides general information about Calhoun County. It describes climate, history and development, lakes and streams, and physiography and relief.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Battle Creek 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 25.0 degrees F and the average daily minimum temperature is 17.4 degrees. The lowest temperature on record, which occurred at Battle Creek on February 12, 1899, is -24 degrees. In summer, the average temperature is 69.8 degrees and the average daily maximum temperature is 81.1 degrees. The highest recorded temperature, which occurred at Battle Creek on September 9, 1884, is 105 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

Figure 1.—Location of Calhoun County in Michigan.

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 about 34 inches. Of this, 20 inches, or 59 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 16.9 inches. The heaviest 1-day rainfall during the period of record was 6.44 inches at Battle Creek on June 26, 1978. Thunderstorms occur on about 35 days each year.

The average seasonal snowfall is 48.5 inches. The greatest snow depth at any one time during the period of record was 31 inches. On the average, 72 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 64 percent. Humidity is higher at night, and the average at dawn is about 85 percent. The sun shines 67 percent of the time possible in summer and 37 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, about 12 miles per hour, in January.

History and Development

Calhoun County's earliest residents were Indians known as Mound Builders. They lived in the southern and northwestern parts of the area. Evidence of their habitation is left in mounds located near waterways.

Later inhabitants were mainly of the Potawatomi tribe, but a few Chippewa and Ottawa lived on the level plains in the summer and moved south for the winter. The Turtle Band of the Potawatomi tribe still holds a small area of Athens Township.

In 1825, a government surveyor and his cook encountered two Indians. The shots exchanged missed their targets but gave the name of Battle Creek to a river and to the city that later spread along its banks.

Calhoun County was established in 1829. It was named for John C. Calhoun, who was at that time the Vice President of the United States.

The first permanent settlers in the area began arriving in 1830. A mill was established at the point where Rice Creek joins the Kalamazoo River. The settlement that grew up around this mill became the county seat and was eventually named Marshall (History of Calhoun County, Michigan, 1877).

The original settlers of Calhoun County were primarily farmers. They raised corn, wheat, potatoes, and other subsistence crops. Farmers began raising sheep in about 1838, and swine and cattle became important in about 1850 (Gardner, 1913). Today, the major crops are corn, soybeans, wheat, hay, and truck crops. Raising hogs and beef and dairy cattle is also a significant agricultural activity.

Lakes and Streams

Calhoun County has about 92 lakes and 3 major rivers. The lakes make up more than 4,416 acres and range in size from less than 5 acres to more than 600 acres. Some are made up of marshes that exhibit all stages of filling by vegetation. Duck Lake, the largest lake, is in the northeastern part of the county. Other large lakes include Bear Lake, Big Marsh Lake, Cedar Lake, Goguac Lake, Graham Lake, Lee Lake, Mud Lake, Nottawa Lake, and Turtle Lake. Big Marsh Lake is a 200-acre wildlife area in the north-central part of the county. It is owned and managed by the Michigan Audubon Society.

Major rivers in the Kalamazoo River basin are the Kalamazoo River, the St. Joseph River, and the Battle Creek River.

Physiography and Relief

The soils of Calhoun County were influenced by four periods of glacial activity. These glaciers were the Nebraskan, Kansan, Illinoian, and Wisconsin. The Nebraskan glaciation occurred about 1 million to 1.5 million years ago. The Wisconsin glacier retreated about 8,000 years ago. This glacier influenced the topography, relief, and soil types in the survey area (Sommers, 1977).

Four distinct types of surface features are characteristic of the survey area. These are moraine deposits, till plains, outwash plains, and lacustrine plains. They were formed as a result of the complex action of glaciers and glaciofluvial deposits.

The morainic areas are characterized by nearly level to hilly relief and uneven, knoblike hills and pothole depressions. The largest morainic areas are in Pennfield, Convis, Eckford, Albion, and Leroy Townships and in the city of Battle Creek. Till deposits in the northern part of the county are irregularly shaped. They are typically at elevations above 980 feet.

The till plains are characterized by nearly level to hilly slopes. The largest areas of till plains are in Lee and Clarence Townships. Athens and Burlington Townships have some smaller areas of till plains. Till deposits in the southern and western parts of the county are irregularly shaped or are linear or drumlin shaped. These deposits are commonly at elevations above 990 feet.

Outwash plains are intermingled with the morainic areas and till plains. The outwash areas are characterized by nearly level to sloping topography and have some pitted areas. The outwash deposits are commonly at lower elevations than the till deposits. The largest areas of outwash plains are in Bedford, Marshall, Fredonia, Newton, Merango, Athens, Burlington, Tekonsha, Clarence, Homer, Emmett, and Sheridan Townships.

Lacustrine plains occur as deposits of organic material and marl intermingled with areas of the morainic plains and outwash plains. These deposits are in old lakebeds and glacial drainageways scattered throughout the county.

The highest elevation in the county, about 1,106 feet above mean sea level, is Dixon Hill in Tekonsha Township. The lowest elevation, 800 feet above mean sea level, is the shoreline of the Kalamazoo River in Bedford Township.

How This Survey Was Made

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

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

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

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

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

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

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

Some of the boundaries on the soil maps of this survey do not match those on the soil maps of the surveys of adjacent counties, and some of the soil names and descriptions do not fully agree. Differences are the result of modifications or refinements in series concepts or of variations in the intensity of mapping or in the extent of the soils in the survey area.

Map Unit Composition

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

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

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

General Soil Map Units

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

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

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

Soil Descriptions

1. Morley-Blount Association

Nearly level to strongly sloping, well drained to somewhat poorly drained, loamy soils on till plains and moraines

The Morley soils in this association are on side slopes, knolls, and ridges. They are at higher elevations than the Blount soils. The Blount soils are on broad flats, low knolls, and low ridges. Slopes range from 1 to 18 percent but are dominantly 1 to 12 percent.

This association makes up about 5 percent of the county. It is about 51 percent Morley and similar soils, 16 percent Blount and similar soils, and 33 percent soils of minor extent.

Morley soils are nearly level to strongly sloping and are well drained or moderately well drained. Typically, the surface layer is dark brown loam about 8 inches thick. The subsoil is firm clay loam about 26 inches thick. It is yellowish brown in the upper part and dark yellowish brown and mottled in the lower part. The substratum to a depth of 60 inches or more is brown clay loam.

Blount soils are nearly level or gently undulating and are somewhat poorly drained. Typically, the surface layer is brown loam about 8 inches thick. The subsoil is about 40 inches thick. It is mottled. The upper part is dark yellowish brown and brown, firm clay; the next part is brown, firm clay; and the lower part is dark yellowish brown, firm clay loam. The substratum to a depth of 60 inches or more is dark yellowish brown, mottled clay loam.

Of minor extent in this association are the well drained Hillsdale and excessively drained Coloma soils. These soils are in landscape positions similar to those of the Morley soils.

The soils in this association are used mainly as cropland. Some areas are used as woodland or pasture. The major soils are generally well suited to corn and soybeans and to pasture. Erosion is the major management concern in areas of the Morley soils. Minimizing surface compaction, maintaining tilth, and increasing the content of organic matter are also concerns. Wetness is an additional concern in areas of the Blount soils. Grazing when the soils are too wet can cause surface compaction and poor tilth.

Generally, few limitations affect the use of these soils as woodland. Plant competition is a concern, however, and the wetness limits the use of equipment in areas of the Blount soils.

The Morley soils are fairly well suited to building site development, but the Blount soils are poorly suited. The shrink-swell potential of the Morley soils is a limitation. The slope is also a concern in some areas. The wetness in areas of the Blount soils is a major limitation. The major soils are poorly suited to septic tank absorption fields because of slow permeability. The wetness is also a limitation in areas of the Blount soils.

2. Houghton-Blount-Pewamo Association

Nearly level or gently undulating, very poorly drained to somewhat poorly drained, mucky and loamy soils on till plains and moraines

The Houghton soils in this association are on the lower parts of the landscape in drainageways and

depressions. The Blount soils are on broad flats, low knolls, and low ridges. The Pewamo soils are on low flats and in depressions. Slopes range from 0 to 4 percent.

This association makes up about 3 percent of the county. It is about 38 percent Houghton and similar soils, 17 percent Blount and similar soils, 17 percent Pewamo and similar soils, and 28 percent soils of minor extent.

Houghton soils are nearly level and are very poorly drained. Typically, the surface layer is black muck about 7 inches thick. Below this to a depth of 60 inches or more is black muck.

Blount soils are nearly level or gently undulating and are somewhat poorly drained. Typically, the surface layer is brown loam about 8 inches thick. The subsoil is about 40 inches thick. It is mottled. The upper part is dark yellowish brown and brown, firm clay; the next part is brown, firm clay; and the lower part is dark yellowish brown, firm clay loam. The substratum to a depth of 60 inches or more is dark yellowish brown, mottled clay loam.

Pewamo soils are nearly level and are poorly drained. Typically, the surface layer is very dark grayish brown clay loam about 10 inches thick. The subsoil is about 38 inches thick. It is mottled. The upper part is gray, firm clay, and the lower part is dark gray and gray, firm clay loam. The substratum to a depth of 60 inches or more is gray clay loam.

Of minor extent in this association are the well drained Morley and Hillsdale soils. These soils are on side slopes, high knolls, and ridges.

The soils in this association are used mainly as cropland. Some areas are used as woodland or pasture. A few areas are idle land. The Blount and Pewamo soils are well suited or moderately well suited to cultivated crops. Overcoming wetness, maintaining tilth, and minimizing surface compaction are the major management needs. The Houghton soils are well suited to crops if adequate drainage is provided. The Blount and Pewamo soils are well suited to pasture. Grazing when the soils are too wet can cause surface compaction and poor tilth.

The soils in this association are well suited to woodland. Plant competition is a major management concern, and the wetness limits the use of equipment.

These soils are poorly suited to building site development and septic tank absorption fields. Subsidence, low strength, and a high water table are limitations in areas of the Houghton soils. The wetness and restricted permeability are limitations in areas of the Blount and Pewamo soils. Also, the Pewamo and Houghton soils are subject to ponding.

3. Houghton-Sebewa-Matherton Association

Nearly level or gently undulating, very poorly drained to somewhat poorly drained, mucky soils on flood plains and loamy soils on stream terraces and in glacial drainageways

The Houghton soils in this association are on flood plains and in depressions. The Sebewa soils are on low flats and in depressions. The Matherton soils are on broad flats, low knolls, and low ridges. Slopes range from 0 to 3 percent.

This association makes up about 8 percent of the county. It is about 35 percent Houghton and similar soils, 27 percent Sebewa and similar soils, 14 percent Matherton and similar soils, and 24 percent soils of minor extent.

Houghton soils are nearly level and are very poorly drained. Typically, the surface layer is black muck about 7 inches thick. Below this to a depth of 60 inches or more is black muck.

Sebewa soils are nearly level and are poorly drained. Typically, the surface layer is dark brown loam about 12 inches thick. The subsoil is about 26 inches thick. It is mottled. The upper part is dark gray and grayish brown, firm clay loam, and the lower part is grayish brown, friable loam. The substratum to a depth of 60 inches or more is gray sand and grayish brown gravelly coarse sand.

Matherton soils are nearly level or gently undulating and are somewhat poorly drained. Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 28 inches thick. It is mottled. The upper part is dark yellowish brown, firm sandy clay loam; the next part is yellowish brown, friable loam; and the lower part is grayish brown, brown, and dark brown, friable gravelly clay loam. The substratum to a depth of 60 inches or more is light brownish gray very gravelly sand.

Of minor extent in this association are the well drained Oshtemo and Kalamazoo soils. These soils are on the higher knolls and ridges.

Most areas of this association support natural vegetation, including trees. They are used mainly as recreational areas or for wildlife habitat. Some areas are used as cropland.

The Sebewa and Matherton soils are generally well suited to woodland, but wetness restricts the use of equipment. The Sebewa and Matherton soils are generally well suited to crops, such as corn and soybeans, and to pasture. The wetness is the major management concern. Minimizing the loss of nutrients, maintaining tilth, and preventing surface compaction are also concerns. Grazing when the soils are too wet can cause surface compaction and poor tilth.

The major soils in this association are generally unsuited to building site development and septic tank absorption fields. The wetness is the main limitation. The instability of cutbanks is a limitation affecting shallow excavations in areas of the Sebewa and Matherton soils. A poor filtering capacity is also a limitation in areas of these soils, and the Sebewa soils are subject to ponding. Low strength, ponding, and subsidence are concerns in areas of the Houghton soils.

4. Houghton-Oshtemo-Coloma Association

Nearly level to steep, very poorly drained to excessively drained, mucky soils on flood plains and loamy and sandy soils on outwash plains, moraines, and stream terraces and in glacial drainageways

The Houghton soils in this association are on flood plains and in depressions. The Oshtemo and Coloma soils are on broad flats and on knolls and ridges. Slopes range from 0 to 40 percent but are dominantly 0 to 12 percent.

This association makes up about 12 percent of the county. It is about 35 percent Houghton and similar soils, 30 percent Oshtemo and similar soils, 17 percent Coloma and similar soils, and 18 percent soils of minor extent.

Houghton soils are nearly level and are very poorly drained. Typically, the surface layer is black muck about 7 inches thick. Below this to a depth of 60 inches or more is black muck.

Oshtemo soils are nearly level to steep and are well drained. Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 61 inches thick. The upper part is dark yellowish brown, friable sandy loam; the next part is dark yellowish brown, friable sandy loam that has bands of yellowish brown sand; and the lower part is brownish yellow sand that has bands of dark yellowish brown sandy loam. The substratum to a depth of 80 inches or more is yellowish brown sand.

Coloma soils are nearly level to steep and are excessively drained. Typically, the surface layer is brown loamy sand about 8 inches thick. The subsurface layer, to a depth of about 30 inches, is dark yellowish brown, yellowish brown, and brownish yellow sand. The subsoil extends to a depth of 80 inches or more. It is very pale brown, light yellowish brown, and pale brown sand that has bands of strong brown loamy sand.

Of minor extent in this association are the somewhat poorly drained Brady and poorly drained Sebewa soils. Brady soils are on low knolls and ridges and on the edges of flood plains. Sebewa soils are in drainageways and depressions.

Most areas of this association support natural vegetation, including trees. They are used mainly as recreational areas or for wildlife habitat. Some areas are used as cropland or pasture. In areas near Battle Creek, these soils are used for urban development.

The major soils in this association are generally well suited to woodland. In areas of the Houghton soils, wetness restricts the use of equipment. Also, plant competition and the windthrow hazard are concerns. Plant competition is also a concern in areas of the Oshtemo soils. The Oshtemo soils are generally well suited to crops, such as corn and soybeans. Water erosion, soil blowing, the loss of nutrients, and a low content of organic matter are the major management concerns. Droughtiness is a concern in areas of Oshtemo and Coloma soils used for pasture.

The Oshtemo and Coloma soils are generally well suited to building site development, but the more rolling areas of these soils are only fairly well suited. The instability of cutbanks is a limitation on sites for shallow excavations. The Houghton soils are unsuited to building site development because of subsidence, low strength, and ponding. They are also unsuited to use as sites for septic tank absorption fields because of the ponding. A poor filtering capacity is a limitation if the Coloma soils are used as sites for septic tank absorption fields. No limitations affect the use of the Oshtemo soils as sites for septic tank absorption fields.

5. Hillsdale-Kalamazoo-Oshtemo Association

Nearly level to steep, well drained, loamy soils on moraines, till plains, outwash plains, and terraces

The Hillsdale soils in this association are on knolls and ridges at the slightly higher elevations. The Kalamazoo and Oshtemo soils are on broad flats and low knolls and ridges. Slopes range from 0 to 40 percent but are dominantly 0 to 12 percent.

This association makes up about 15 percent of the county. It is about 67 percent Hillsdale and similar soils, 12 percent Kalamazoo and similar soils, 10 percent Oshtemo and similar soils, and 11 percent soils of minor extent (fig. 2).

Typically, the surface layer of the Hillsdale soils is dark brown sandy loam about 9 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable sandy loam about 57 inches thick. The substratum to a depth of 80 inches or more is yellowish brown sandy loam.

Typically, the surface layer of the Kalamazoo soils is dark brown loam about 9 inches thick. The subsoil is about 37 inches thick. In sequence downward, it is dark yellowish brown and brown, friable loam; dark yellowish brown, firm clay loam; brown, firm clay loam; brown,

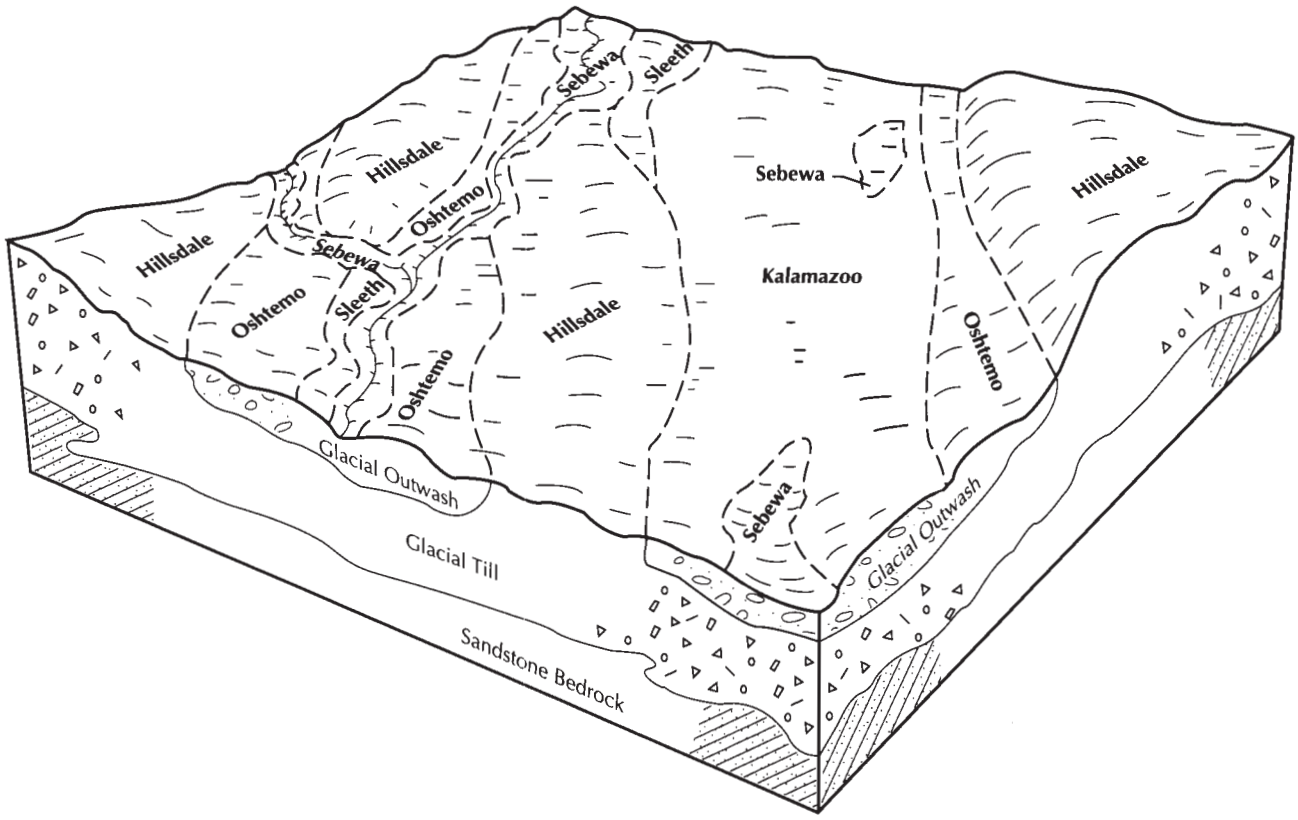

Figure 2.—Typical pattern of soils and parent material in the Hillsdale-Kalamazoo-Oshtemo association.

friable sandy loam; and dark yellowish brown, very friable gravelly loamy sand. The substratum to a depth of 60 inches or more is yellowish brown sand. It has strata of dark yellowish brown loamy sand in the upper part.

Typically, the surface layer of the Oshtemo soils is dark brown sandy loam about 9 inches thick. The subsoil is about 61 inches thick. The upper part is dark yellowish brown, friable sandy loam; the next part is dark yellowish brown, friable sandy loam that has bands of yellowish brown sand; and the lower part is brownish yellow sand that has bands of dark yellowish brown sandy loam. The substratum to a depth of 80 inches or more is yellowish brown sand.

Of minor extent in this association are the somewhat poorly drained Sleeth and poorly drained Sebewa soils. These soils are in the lower landscape positions.

Most areas of this association are used as cropland. Some areas are used as woodland or pasture. A few areas are idle land.

The major soils in this association are generally well suited to crops, such as corn and soybeans, and to pasture. The hazard of erosion is the main management concern, especially in the more rolling areas. Controlling soil blowing, minimizing the loss of nutrients, and increasing the content of organic matter are also management concerns. Droughtiness is a major concern in areas used as pasture.

Few limitations affect the use of these soils as woodland. Plant competition is the major management concern.

These soils are generally well suited to building site development, but the more rolling areas are only fairly well suited. The instability of cutbanks is a limitation on sites for shallow excavations. The Hillsdale and Oshtemo soils are generally fairly well suited to use as sites for septic tank absorption fields. The more level areas of these soils are generally well suited. A poor filtering capacity is a limitation in areas of the Hillsdale and Kalamazoo soils. Also, the slope is a concern in some areas.

6. Oshtemo-Kalamazoo Association

Nearly level to steep, well drained, loamy soils on outwash plains and stream terraces

The soils in this association are on broad flats and on knolls and ridges. Slopes range from 0 to 40 percent but are dominantly 0 to 12 percent.

This association makes up about 38 percent of the county. It is about 38 percent Oshtemo and similar soils, 37 percent Kalamazoo and similar soils, and 25 percent soils of minor extent.

Typically, the surface layer of the Oshtemo soils is dark brown sandy loam about 9 inches thick. The subsoil is about 61 inches thick. The upper part is dark yellowish brown, friable sandy loam; the next part is dark yellowish brown, friable sandy loam that has bands of yellowish brown sand; and the lower part is brownish yellow sand that has bands of dark yellowish brown sandy loam. The substratum to a depth of 80 inches or more is yellowish brown sand.

Typically, the surface layer of the Kalamazoo soils is dark brown loam about 9 inches thick. The subsoil is about 37 inches thick. In sequence downward, it is dark yellowish brown and brown, friable loam; dark yellowish brown, firm clay loam; brown, firm clay loam; brown, friable sandy loam; and dark yellowish brown, very friable gravelly loamy sand. The substratum to a depth of 60 inches or more is yellowish brown sand that has strata of dark yellowish brown loamy sand in the upper part.

Of minor extent in this association are the well drained Hillsdale and very poorly drained Houghton soils. Hillsdale soils are on the higher knolls and ridges. Houghton soils are in drainageways and depressions.

Most areas of this association are used for crops, including hay. Some areas are used as pasture or woodland. Areas near Battle Creek are used for urban development. Some areas are idle land.

The major soils in this association are generally well suited to crops, such as corn and soybeans, and to pasture. Erosion is the main management concern, especially in the more rolling areas used for crops. Minimizing the loss of nutrients and increasing the content of organic matter are also management needs. Droughtiness is the main limitation in areas used as pasture.

Few limitations affect the use of these soils as woodland. Plant competition is the major management concern.

These soils are generally well suited to building site development, but the moderately sloping areas are only fairly well suited. The instability of cutbanks is a limitation on sites for shallow excavations. The shrink-swell potential is also a concern in areas of the Kalamazoo soils. The Oshtemo soils are generally well suited to septic tank absorption fields, but in the more rolling areas they are only fairly well suited. A poor filtering capacity limits the use of the Kalamazoo soils as sites for septic tank absorption fields. Also, the slope is a concern in some areas.

7. Oshtemo-Spinks Association

Gently rolling to steep, well drained, loamy and sandy soils on outwash plains

The soils in this association are on side slopes, knolls, and ridges. Slopes range from 6 to 40 percent.

This association makes up about 9 percent of the county. It is about 39 percent Oshtemo and similar soils, 31 percent Spinks and similar soils, and 30 percent soils of minor extent.

Typically, the surface layer of the Oshtemo soils is dark brown sandy loam about 9 inches thick. The subsoil is about 61 inches thick. The upper part is dark yellowish brown, friable sandy loam; the next part is dark yellowish brown, friable sandy loam that has bands of yellowish brown sand; and the lower part is brownish yellow sand that has bands of dark yellowish brown sandy loam. The substratum to a depth of 80 inches or more is yellowish brown sand.

Typically, the surface layer of the Spinks soils is dark brown loamy sand about 9 inches thick. The subsurface layer is dark yellowish brown loamy sand and yellowish brown sand about 21 inches thick. The subsoil to a depth of 70 inches or more is yellowish brown sand. It has bands of strong brown, yellowish brown, and brown loamy sand and sandy loam.

Of minor extent in this association are the well drained Kalamazoo and Hillsdale soils. These soils are in landscape positions similar to those of the Oshtemo and Spinks soils.

Most areas of this association are used as woodland. Some areas are used as pasture or are idle land. Moderately sloping areas are used for crops, including hay.

The major soils are generally well suited to woodland and pasture. Plant competition is the major management concern affecting woodland. The erosion hazard and equipment limitations are also concerns in areas where slopes are more than 18 percent. Droughtiness is the main limitation in areas used as pasture. These soils are generally unsuited to cultivated crops, but in the less sloping areas they are fairly well suited. The slope and the hazard of erosion are the main limitations affecting crops.

These soils are generally unsuited to building site development. The instability of cutbanks is a limitation on sites for shallow excavations. The slope is also a

major concern. Areas on the lower slopes are fairly well suited to building site development. Because of the slope, the soils in this association are generally unsuited to use as sites for septic tank absorption fields. Areas of the Oshtemo soils on the lower slopes may be fairly well suited.

8. Matherton-Sebewa-Hillsdale Association

Nearly level to steep, poorly drained, somewhat poorly drained, and well drained, loamy soils on outwash plains and moraines

The Matherton soils in this association are on low knolls, on ridges, and on broad flats. The Sebewa soils are in depressions, on low flats, and in drainageways. The Hillsdale soils are on side slopes, knolls, and ridges at the higher elevations. Slopes range from 0 to 25 percent but are dominantly 0 to 12 percent.

This association makes up about 5 percent of the county. It is about 35 percent Matherton and similar soils, 28 percent Sebewa and similar soils, 24 percent Hillsdale and similar soils, and 13 percent soils of minor extent.

Matherton soils are nearly level and are somewhat poorly drained. Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 28 inches thick. It is mottled. The upper part is dark yellowish brown, firm sandy clay loam; the next part is yellowish brown, friable loam; and the lower part is grayish brown, brown, and dark brown, friable gravelly clay loam. The substratum to a depth of 60 inches or more is light brownish gray very gravelly sand.

Sebewa soils are nearly level and are poorly drained. Typically, the surface layer is black loam about 12 inches thick. The subsoil is about 26 inches thick. It is mottled. The upper part is dark gray and grayish brown, firm clay loam, and the lower part is grayish brown, friable loam. The substratum to a depth of 60 inches or more is gray sand and grayish brown gravelly sand.

Hillsdale soils are nearly level to steep and are well drained. Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable sandy loam about 57 inches thick. The substratum to a depth of 80 inches or more is yellowish brown sandy loam.

Of minor extent in this association are the well drained Oshtemo and very poorly drained Houghton soils. Oshtemo soils are in landscape positions similar to those of the Hillsdale soils. Houghton soils are in depressions and drainageways.

Most areas of this association are used for crops. Some areas are used as pasture or woodland. A few areas are idle land.

These soils are generally well suited to crops, such as corn and soybeans, and to pasture. Overcoming wetness, preventing surface compaction, and minimizing the loss of nutrients are the main management needs in areas of the Matherton and Sebewa soils. Controlling erosion and minimizing the loss of nutrients are the main concerns in areas of the Hillsdale soils. The wetness is the main limitation in areas of the Matherton and Sebewa soils used as pasture, and droughtiness is a limitation affecting pasture in areas of the Hillsdale soils.

Generally, few limitations affect the use of these soils as woodland. Because of the wetness, however, the use of equipment is limited in areas of the Matherton and Sebewa soils.

The Matherton and Sebewa soils are generally unsuited to building site development. The Hillsdale soils are generally well suited to this use, but in the more rolling areas they may be only fairly well suited. The instability of cutbanks is a limitation on sites for shallow excavations in areas of all of the major soils. Also, the wetness is a concern in areas of the Matherton soils and the ponding is a limitation in areas of the Sebewa soils. The Matherton and Sebewa soils are generally unsuited to use as sites for septic tank absorption fields because of a poor filtering capacity, the wetness, and the ponding. The Hillsdale soils are generally fairly well suited to use as sites for septic tank absorption fields. A poor filtering capacity is the main concern.

9. Bronson-Sebewa-Houghton Association

Nearly level to gently rolling, moderately well drained, poorly drained, and very poorly drained, loamy soils on lake plains and mucky soils in glacial drainageways

The Bronson soils in this association are on broad flats, low knolls, and low ridges. The Sebewa soils are in depressions, on low flats, and in drainageways. The Houghton soils are in depressions and drainageways. Slopes range from 0 to 6 percent.

This association makes up about 5 percent of the county. It is about 36 percent Bronson and similar soils, 27 percent Sebewa and similar soils, 25 percent Houghton and similar soils, and 12 percent soils of minor extent.

Bronson soils are nearly level to gently rolling and are moderately well drained. Typically, the surface layer is dark brown sandy loam about 8 inches thick. The subsoil is about 39 inches thick. It is mottled. The upper part is yellowish brown, friable sandy loam and sandy clay loam, and the lower part is brown, friable sandy loam and loamy sand. The substratum to a depth of 60 inches or more is brown gravelly coarse sand.

Sebewa soils are nearly level and are poorly drained. Typically, the surface layer is black loam about 12 inches thick. The subsoil is about 26 inches thick. It is mottled. The upper part is dark gray and grayish brown, firm clay loam, and the lower part is grayish brown, friable loam. The substratum to a depth of 60 inches or more is gray sand and grayish brown gravelly sand.

Houghton soils are nearly level and are very poorly drained. Typically, the surface layer is black muck about 7 inches thick. Below this to a depth of 60 inches or more is black muck.

Of minor extent in this association are the well drained Oshtemo and Boyer soils. These soils are on side slopes, high knolls, and ridges.

Most areas of this association are used for crops. Some areas are used as pasture or woodland. The undrained mucky areas support a cover of natural vegetation, including trees. Some areas are idle land.

The Bronson and Sebewa soils are generally well suited to crops, such as corn and soybeans, and to pasture. Controlling wetness, minimizing the loss of nutrients, and preventing surface compaction are the main limitations in areas of the Sebewa soils. The erosion hazard and droughtiness are concerns in areas of the Bronson soils. Wetness is the major concern affecting pasture in areas of the Sebewa soils, and droughtiness is a limitation in areas of the Bronson soils.

The major soils are generally well suited to woodland. Equipment limitations, the windthrow hazard, and plant competition are the main concerns in areas of the Sebewa and Houghton soils. Plant competition is the main concern in areas of the Bronson soils.

The Bronson soils are generally well suited to building site development, but the Sebewa and Houghton soils are generally unsuited to this use. The wetness and the instability of cutbanks are limitations affecting shallow excavations in areas of the Bronson and Sebewa soils. Also, the Sebewa soils are subject to ponding. Subsidence, low strength, and ponding are limitations in areas of the Houghton soils. All of the major soils are poorly suited or unsuited to use as sites for septic tank absorption fields because of the wetness, a poor filtering capacity, and the ponding.

Detailed Soil Map Units

The map units on the detailed soil maps in 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 is given under the heading "Use and Management of the Soils."

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, 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, Oshtemo sandy loam, 0 to 6 percent slopes, is a phase of the Oshtemo series.

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

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Coloma-Boyer loamy sands, 0 to 6 percent slopes, is an example.

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

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

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

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

Soil Descriptions

2—Houghton muck, undrained

Setting

Landform: Depressions and drainageways on till plains, outwash plains, and lake plains
Slope: 0 to 2 percent
Shape of areas: Oval and linear
Size of areas: 3 to 1,500 acres

Typical Profile

Surface layer:
0 to 7 inches—black muck

Substratum:
7 to 60 inches—black muck

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow to moderately rapid
Available water capacity: Very high
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Very high
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Houghton soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Granby soils in landscape positions similar to those of the Houghton soil

Similar inclusions:
• Soils that contain woody fragments
• Soils that have layers of mucky peat

Use and Management

Land use: Dominant uses—woodland, wildlife habitat

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition
Management measures:
• Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.

Building sites

Major management concerns: Subsidence, low strength, ponding
Suitability:
• Because of subsidence, low strength, and ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Subsidence, permeability, ponding
Suitability:
• Because of subsidence, the restricted permeability, and ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: Mc

4—Adrian muck

Setting

Landform: Depressions and drainageways on moraines, till plains, and outwash plains
Slope: 0 to 2 percent
Shape of areas: Oval and irregular
Size of areas: 3 to 800 acres

Typical Profile

Surface layer:
0 to 7 inches—black muck

Subsoil:
7 to 25 inches—black muck

Substratum:
25 to 60 inches—dark grayish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow to moderately rapid in the upper part of the profile and rapid in the lower part
Available water capacity: High
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Very high
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Adrian soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Granby soils in landscape positions similar to those of the Adrian soil

Similar inclusions:
- Soils that have layers of mucky peat
- Soils that have less than 16 inches of organic material
- Soils that have a substratum of gravelly sand

Use and Management

Land use: Dominant uses—woodland, wildlife habitat

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:
- Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
- Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
- After cutting, competition from brush can delay or prevent the natural regeneration of desired species.

Building sites

Major management concerns: Subsidence, low strength, ponding, cutbanks cave

Suitability:
- Because of subsidence, low strength, ponding, and cutbanks caving, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Subsidence, permeability, ponding

Suitability:
- Because of subsidence, the restricted permeability, and ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: M/4c

5—Palms muck

Setting

Landform: Depressions and drainageways on outwash plains, lake plains, and till plains
Slope: 0 to 2 percent
Shape of areas: Oval and irregular
Size of areas: 3 to 600 acres

Typical Profile

Surface layer:
0 to 9 inches—black muck

Subsoil:
9 to 18 inches—black muck

Substratum:
18 to 28 inches—dark gray loam
28 to 35 inches—gray, mottled clay loam
35 to 60 inches—dark grayish brown, mottled sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow to moderately rapid in the upper part of the profile and moderately slow or moderate in the lower part
Available water capacity: Very high
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Very high
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Palms soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
- The poorly drained Barry and very poorly drained Gilford soils in the slightly higher landscape positions

Similar inclusions:
- Soils that have layers of mucky peat
- Soils that have less than 16 inches of organic material
- Soils that have a sandy substratum

Use and Management

Land use: Dominant uses—woodland, wildlife habitat

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:
- Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
- Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely

spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.

Building sites

Major management concerns: Subsidence, low strength, ponding
Suitability:
• Because of subsidence, low strength, and ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Subsidence, permeability, ponding
Suitability:
• Because of subsidence, the restricted permeability, and ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: M/3c

7—Houghton muck, drained

Setting

Landform: Depressions and drainageways on till plains, outwash plains, and lake plains
Slope: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 900 acres

Typical Profile

Surface layer:
0 to 7 inches—black muck
Substratum:
7 to 60 inches—black muck

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow to moderately rapid
Available water capacity: Very high
Drainage class: Very poorly drained
Seasonal high water table: At a depth of 1 to 2 feet
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Very high
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Houghton soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Adrian soils at the edges of the mapped areas
• The very poorly drained Granby soils in the slightly higher landscape positions

Similar inclusions:
• Soils that contain woody fragments
• Soils that have layers of mucky peat

Use and Management

Land use: Dominant uses—cropland

Cropland

Major management concerns: Soil blowing, wetness, subsidence
Management measures:
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, and ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Excess water can be removed by open ditches, subsurface drains, surface drains, pumps, or a combination of these.
• Management of the water table determines the rate of subsidence (fig. 3). Overdrainage increases the rate.
• Delaying planting in the spring until the danger of frost passes helps to minimize crop damage.

Building sites

Major management concerns: Subsidence, low strength, high water table
Suitability:
• Because of subsidence, low strength, and the high water table, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Subsidence, high water table, permeability, low strength
Suitability:
• Because of subsidence, the high water table, the restricted permeability, and low strength, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: 2W
Michigan soil management group: Mc

Figure 3.—Onions in an area of Houghton muck, drained. Careful control of the water table is needed to minimize subsidence on this soil.

8—Edwards muck

Setting

Landform: Depressions, drainageways, and lake borders on outwash plains or till plains
Slope: 0 to 2 percent
Shape of areas: Oval and irregular
Size of areas: 3 to 400 acres

Typical Profile

Surface layer:
0 to 5 inches—black muck
Subsoil:
5 to 21 inches—black and very dark gray muck
Substratum:
21 to 60 inches—light gray and dark grayish brown, mottled marl

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow to moderately rapid
Available water capacity: Moderate
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Very high
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Edwards soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Houghton soils in landscape positions similar to those of the Edwards soil
• The very poorly drained Gilford soils in the slightly higher landscape positions

Similar inclusions:
• Soils that have layers of mucky peat
• Soils that have mineral layers in the subsoil

Use and Management

Land use: Dominant uses—woodland and wildlife habitat

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition
Management measures:
• Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.

Building sites

Major management concerns: Subsidence, low strength, ponding
Suitability:
• Because of subsidence, low strength, and ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Subsidence, permeability, ponding
Suitability:
• Because of subsidence, the restricted permeability, and ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: M/mc

9—Martisco muck

Setting

Landform: Depressions, drainageways, and lake borders on outwash plains, lake plains, and till plains
Slope: 0 to 2 percent
Shape of areas: Oval and irregular
Size of areas: 3 to 100 acres

Typical Profile

Surface layer:
0 to 6 inches—black muck
Subsoil:
6 to 13 inches—black muck
Substratum:
13 to 48 inches—light gray, dark grayish brown, and gray, mottled marl
48 to 60 inches—gray marl

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate or moderately rapid in the upper part of the profile and slow in the lower part
Available water capacity: Low
Drainage class: Very poorly drained
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Very high
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Martisco soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Edwards soils in landscape positions similar to those of the Martisco soil
• The very poorly drained Gilford soils in the slightly higher landscape positions

Similar inclusions:
• Soils that have mineral layers in the subsoil

Use and Management

Land use: Dominant uses—wildlife habitat; other uses—woodland

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition
Management measures:
• Because of wetness and low strength, special

harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.

Building sites

Major management concerns: Low strength, ponding
Suitability:
• Because of low strength and ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Permeability, ponding
Suitability:
• Because of the restricted permeability and ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: M/mc

12B—Coloma loamy sand, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on outwash plains, terraces, and moraines
Shape of areas: Irregular
Size of areas: 3 to 600 acres

Typical Profile

Surface layer:
0 to 8 inches—brown loamy sand
Subsurface layer:
8 to 30 inches—dark yellowish brown, yellowish brown, and brownish yellow sand
Subsoil:
30 to 56 inches—very pale brown and light yellowish brown sand that has bands of strong brown loamy sand
56 to 80 inches—pale brown sand that has bands of strong brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Rapid
Available water capacity: Low
Drainage class: Excessively drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Coloma soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Boyer and Oshtemo soils in landscape positions similar to those of the Coloma soil
Similar inclusions:
• Soils that are moderately well drained
• Soils that do not have bands in the subsoil

Use and Management

Land use: Dominant uses—pasture; other uses—woodland, building sites

Pasture

Major management concerns: Droughtiness
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water.
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: None

Building sites

Major management concerns: Cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 2A
Michigan soil management group: 5a

12C—Coloma loamy sand, 6 to 12 percent slopes

Setting

Landform: Rolling areas on ridges and knolls on outwash plains, terraces, and moraines
Shape of areas: Irregular
Size of areas: 3 to 150 acres

Typical Profile

Surface layer:
0 to 8 inches—brown loamy sand
Subsurface layer:
8 to 30 inches—dark yellowish brown, yellowish brown, and brownish yellow sand
Subsoil:
30 to 56 inches—very pale brown and light yellowish brown sand that has bands of strong brown loamy sand
56 to 80 inches—pale brown sand that has bands of strong brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Rapid
Available water capacity: Low
Drainage class: Excessively drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Coloma soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Boyer and Oshtemo soils in landscape positions similar to those of the Coloma soil
Similar inclusions:
• Soils that do not have bands in the subsoil
• Soils that have thicker bands in the subsoil

Use and Management

Land use: Dominant uses—pasture; other uses—woodland

Pasture

Major management concerns: Droughtiness
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water.
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: None

Building sites

Major management concerns: Cutbanks cave, slope
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

Septic tank absorption fields

Major management concerns: Rapid permeability, slope
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: 2A
Michigan soil management group: 5a

12D—Coloma loamy sand, 12 to 18 percent slopes

Setting

Landform: Rolling areas on ridges and knolls on outwash plains, terraces, and moraines
Shape of areas: Irregular and linear
Size of areas: 3 to 800 acres

Typical Profile

Surface layer:
0 to 6 inches—dark brown loamy sand

Subsurface layer:
6 to 25 inches—dark yellowish brown, yellowish brown, and brownish yellow sand

Subsoil:
25 to 50 inches—very pale brown and light yellowish brown sand that has bands of strong brown loamy sand
50 to 80 inches—pale brown sand that has bands of strong brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Rapid
Available water capacity: Low
Drainage class: Excessively drained
Depth to the water table: More than 60 inches
Surface runoff: Medium
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Coloma soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils on side slopes

Similar inclusions:
• Soils that do not have bands in the subsoil
• Soils that have thicker bands in the subsoil

Use and Management

Land use: Dominant uses—woodland; other uses—pasture

Pasture

Major management concerns: Droughtiness
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water.
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: None

Building sites

Major management concerns: Slope, cutbanks cave
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability, slope
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: 2A
Michigan soil management group: 5a

12E—Coloma loamy sand, 18 to 40 percent slopes

Setting

Landform: Hilly and steep areas on ridges and knolls on outwash plains, terraces, and moraines
Shape of areas: Linear
Size of areas: 3 to 100 acres

Typical Profile

Surface layer:
0 to 3 inches—very dark grayish brown loamy sand

Subsurface layer:
3 to 30 inches—yellowish brown and brownish yellow sand

Substratum:
30 to 80 inches—very pale brown and light yellowish brown sand that has bands of strong brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Rapid
Available water capacity: Low
Drainage class: Excessively drained
Depth to the water table: More than 60 inches
Surface runoff: Rapid
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate

Shrink-swell potential: Low

Composition

Coloma soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils on side slopes

Similar inclusions:
• Soils that do not have bands in the subsoil
• Soils that have thicker bands in the subsoil

Use and Management

Land use: Dominant uses—woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation
Management measures:
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• Gullying can be prevented by the safe disposal of concentrated runoff.
• Logging methods that do not disturb the layers of forest litter help to control erosion.
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Cable yarding systems are generally safer than other logging methods and result in less surface disturbance, especially in the steeper areas.
• Because the slope and loose sand can hinder the traction of wheeled equipment, skid roads should be built on the contour or on the gentler slopes.
• Small areas of included nearly level soils, if any are available, or suitable nearly level adjacent areas should be selected as sites for landings.

Building sites

Major management concerns: Slope, cutbanks cave
Suitability:
• Because of the slope, this soil is generally unsuited for building site development.

Septic tank absorption fields

Major management concerns: Slope, rapid permeability
Suitability:
• Because of the slope and a poor filtering capacity, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIs
Woodland ordination symbol: 2R
Michigan soil management group: 5a

13B—Spinks loamy sand, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on lake plains, outwash plains, and moraines
Shape of areas: Irregular
Size of areas: 3 to 400 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown loamy sand

Subsurface layer:
9 to 18 inches—dark yellowish brown loamy sand
18 to 30 inches—yellowish brown sand

Subsoil:
30 to 41 inches—yellowish brown sand that has bands of strong brown loamy sand
41 to 70 inches—yellowish brown sand that has bands of brown sandy loam and dark yellowish brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Very slow
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Spinks soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Boyer and Oshtemo soils in landscape positions similar to those of the Spinks soil

Similar inclusions:
• Soils that are moderately well drained
• Soils that have thinner bands in the subsoil

Use and Management

Land use: Dominant uses—pasture; other uses—woodland, building sites

Pasture

Major management concerns: Droughtiness
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water.
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: None

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 4A
Michigan soil management group: 4a

13C—Spinks loamy sand, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on lake plains, outwash plains, and moraines
Shape of areas: Irregular
Size of areas: 3 to 350 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown loamy sand

Subsurface layer:
9 to 18 inches—dark yellowish brown loamy sand
18 to 30 inches—yellowish brown sand

Subsoil:
30 to 41 inches—yellowish brown sand that has bands of strong brown loamy sand
41 to 70 inches—yellowish brown sand that has bands of brown sandy loam and dark yellowish brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Spinks soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Boyer and Oshtemo soils in landscape positions similar to those of the Spinks soil

Similar inclusions:
• Soils that have thinner bands in the subsoil

Use and Management

Land use: Dominant uses—pasture; other uses—woodland, building sites

Pasture

Major management concerns: Droughtiness
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water.
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Cutbanks cave, slope

Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

Septic tank absorption fields

Major management concerns: Slope
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: 4a

13D—Spinks loamy sand, 12 to 18 percent slopes

Setting

Landform: Rolling areas on ridges and knolls on lake plains, outwash plains, and moraines
Shape of areas: Irregular and linear
Size of areas: 3 to 300 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown loamy sand

Subsurface layer:
8 to 16 inches—dark yellowish brown loamy sand
16 to 30 inches—brownish yellow sand that has bands of brown sandy loam

Subsoil:
30 to 48 inches—very pale brown sand that has bands of brown sandy loam
48 to 70 inches—yellowish brown sand that has bands of dark yellowish brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Medium
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Spinks soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Boyer soils on side slopes
• The well drained Oshtemo soils in landscape positions similar to those of the Spinks soil

Similar inclusions:
• Soils that have less clay in the subsoil

Use and Management

Land use: Dominant uses—woodland; other uses—pasture

Pasture

Major management concerns: Droughtiness, water erosion
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water.
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition and reduce the hazard of erosion.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Slope, cutbanks cave
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Slope
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 4A
Michigan soil management group: 4a

13E—Spinks loamy sand, 18 to 40 percent slopes

Setting

Landform: Hilly and steep areas on high ridges and knolls on lake plains, outwash plains, and moraines
Shape of areas: Linear
Size of areas: 3 to 250 acres

Typical Profile

Surface layer:
0 to 6 inches—dark brown loamy sand

Subsurface layer:
6 to 16 inches—dark yellowish brown sand
16 to 30 inches—brownish yellow sand that has bands of brown sandy loam

Subsoil:
30 to 48 inches—very pale brown sand that has bands of brown sandy loam
48 to 70 inches—yellowish brown sand that has bands of dark yellowish brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Spinks soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Boyer soils on side slopes
• The well drained Oshtemo soils in landscape positions similar to those of the Spinks soil

Similar inclusions:
• Soils that have less clay in the subsoil

Use and Management

Land use: Dominant uses—woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation, plant competition
Management measures:
• Constructing logging roads at midslope results in excessive cutting and filling, which increase the hazard of erosion.
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• Gullying can be prevented by the safe disposal of concentrated runoff.
• Because the slope and loose sand can hinder the traction of wheeled equipment, skid roads should be built on the contour or on the gentler slopes.
• Cable yarding systems are generally safer than other logging methods and result in less surface disturbance, especially in the steeper areas.
• Small areas of nearly level included soils, if any are available, or suitable nearly level adjacent areas should be selected as sites for landings.
• Special harvest methods may be needed to control undesirable plants.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Slope
Suitability:
• Because of the slope, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Slope
Suitability:
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIe
Woodland ordination symbol: 4R
Michigan soil management group: 4a

14B—Bronson sandy loam, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown sandy loam

Subsoil:
8 to 30 inches—yellowish brown, mottled sandy loam
30 to 37 inches—yellowish brown, mottled sandy clay loam
37 to 47 inches—brown, mottled sandy loam and loamy sand

Substratum:
47 to 60 inches—brown gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid
Available water capacity: Moderate
Drainage class: Moderately well drained
Seasonal high water table: At a depth of 2.0 to 3.5 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Bronson soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Matherton soils in depressions and along drainageways
• The well drained Spinks soils on slight rises

Similar inclusions:
• Soils that have less clay in the subsoil
• Soils that do not have gravel in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Water erosion, soil blowing, nutrient loss, moderately low content of organic matter
Management measures:
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control water erosion.
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, and ridge till; limiting the width of unprotected strips; or growing a cover crop. A combination of these measures may be needed.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Irrigation may be needed.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Including green manure crops in the cropping sequence, applying a system of no-till planting, and managing crop residue increase the content of organic matter.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Wetness, cutbanks cave
Management measures:
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Seasonal high water table
Management measures:
• Mounding or adding suitable fill material raises the absorption field an adequate distance above the water table.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 4A
Michigan soil management group: 3a

15B—Eleva sandy loam, 1 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on till plains
Shape of areas: Irregular
Size of areas: 3 to 40 acres

Typical Profile

Surface layer:
0 to 9 inches—brown sandy loam

Subsurface layer:
9 to 16 inches—yellowish brown sandy loam

Subsoil:
16 to 29 inches—dark yellowish brown and brown sandy loam

Substratum:
29 to 45 inches—weathered sandstone that breaks into dark yellowish brown very channery loamy sand

Bedrock:
45 inches—dark yellowish brown sandstone

Soil Properties and Qualities

Depth class: Moderately deep
Permeability: Moderate
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Medium
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Eleva soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in landscape positions similar to those of the Eleva soil

Similar inclusions:
• Soils that have more clay in the solum
• Soils that have more sand in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland, building sites

Cropland

Major management concerns: Water erosion, soil blowing, nutrient loss, droughtiness, moderately low content of organic matter

Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, grassed waterways, and cover crops help to control water erosion.
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, and ridge till; limiting the width of unprotected strips; or growing a cover crop. A combination of these measures may be needed.
• Timing fertilizer applications to meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands can minimize the leaching of nutrients.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Planting cover crops or green manure crops protects the soil surface, minimizes the leaching of nutrients from the root zone, and increases the content of organic matter.
• Irrigation may be needed.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Using a system of crop rotation and including legumes in the rotation may reduce the need for commercial fertilizer. Sod-based rotations significantly reduce losses of dissolved and particulate nitrogen and phosphorus by reducing the runoff rate.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.

Pasture

Major management concerns: Seasonal droughtiness
Management measures:
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Windthrow, plant competition
Management measures:
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely

spaced and by using such harvest methods as selective cutting and strip cutting.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Cutbanks cave, depth to rock
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Excavation is hampered by the moderate depth to bedrock.

Septic tank absorption fields

Major management concerns: Depth to rock, seepage
Management measures:
• Excavation is hampered by the moderate depth to bedrock.
• The seepage of effluent between rock fractures and the thin layer of soil material result in a poor filtering capacity and can cause the pollution of ground water.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 2D
Michigan soil management group: 2/Ra

16B—Oshtemo sandy loam, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 1,500 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown sandy loam
Subsoil:
9 to 33 inches—dark yellowish brown sandy loam
33 to 47 inches—dark yellowish brown sandy loam and yellowish brown sand
47 to 70 inches—brownish yellow sand that has bands of dark yellowish brown sandy loam
Substratum:
70 to 80 inches—yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Oshtemo soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in the higher landscape positions
• The well drained Kalamazoo soils in landscape positions similar to those of the Oshtemo soil
Similar inclusions:
• Oshtemo soils that have a surface layer of loamy sand
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland, building sites

Cropland

Major management concerns: Water erosion, soil blowing, nutrient loss, low content of organic matter
Management measures:
• A system of conservation tillage that leaves crop residue on the surface helps to control water erosion, helps to prevent crusting during periods of heavy rainfall, and increases the rate of water infiltration.
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Including green manure crops in the cropping sequence, applying a system of no-till planting, and

managing crop residue increase the content of organic matter.

Pasture

Major management concerns: None
Management measures:
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: None

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 4A
Michigan soil management group: 3a

16C—Oshtemo sandy loam, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown sandy loam

Subsoil:
9 to 33 inches—dark yellowish brown sandy loam
33 to 47 inches—dark yellowish brown sandy loam and yellowish brown sand
47 to 70 inches—brownish yellow sand that has bands of dark yellowish brown sandy loam

Substratum:
70 to 80 inches—yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Oshtemo soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in the higher positions on the landscape
• The well drained Kalamazoo soils in landscape positions similar to those of the Oshtemo soil

Similar inclusions:
• Oshtemo soils that have a surface layer of loamy sand
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Dominant uses—pasture; other uses—cropland, woodland, building sites

Cropland

Major management concerns: Water erosion, soil blowing, nutrient loss, low content of organic matter
Management measures:
• Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations that include grasses and legumes, grade-stabilization structures, or a combination of these.
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.

• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Including green manure crops in the cropping sequence, applying a system of no-till planting, and managing crop residue increase the content of organic matter.

Pasture

Major management concerns: None
Management measures:
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Special harvest methods may be needed to control undesirable plants.

Building sites

Major management concerns: Cutbanks cave, slope
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

Septic tank absorption fields

Major management concerns: Slope
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: 3a

16D—Oshtemo sandy loam, 12 to 18 percent slopes

Setting

Landform: Rolling areas on ridges and knolls on outwash plains and terraces
Shape of areas: Irregular and linear
Size of areas: 3 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown sandy loam

Subsoil:
8 to 33 inches—dark yellowish brown sandy loam
33 to 40 inches—dark yellowish brown sandy loam and yellowish brown sand

Substratum:
40 to 80 inches—dark yellowish brown gravelly sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Moderate
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Oshtemo soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in the higher positions on the landscape

Similar inclusions:
• Soils that have less clay in the subsoil

Use and Management

Land use: Dominant uses—woodland; other uses—pasture

Pasture

Major management concerns: Water erosion
Management measures:
• Proper stocking rates and short-duration grazing minimize compaction, maintain plant density and hardiness, and reduce the hazard of water erosion.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Slope, cutbanks cave
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Slope
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 4A
Michigan soil management group: 3a

16E—Oshtemo sandy loam, 18 to 40 percent slopes

Setting

Landform: Hilly and steep areas on high ridges and knolls on outwash plains and terraces
Shape of areas: Linear
Size of areas: 3 to 150 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown sandy loam

Subsoil:
8 to 33 inches—dark yellowish brown sandy loam
33 to 40 inches—dark yellowish brown sandy loam and yellowish brown sand

Substratum:
40 to 80 inches—dark yellowish brown gravelly sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Rapid
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Oshtemo soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in the higher positions on the landscape

Similar inclusions:
• Soils that have less clay in the subsoil
• Soils that do not have gravel in the substratum

Use and Management

Land use: Dominant uses—woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation, plant competition
Management measures:
• Constructing logging roads at midslope results in excessive cutting and filling, which increase the hazard of erosion.
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• Cable yarding systems are generally safer than other logging methods and result in less surface disturbance, especially in the steeper areas.
• Gullying can be prevented by the safe disposal of concentrated runoff.
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Slope, cutbanks cave
Suitability:
• Because of the slope, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Slope

Suitability:
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIe
Woodland ordination symbol: 4R
Michigan soil management group: 3a

17B—Boyer sandy loam, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 1,500 acres

Typical Profile

Surface layer:
0 to 10 inches—dark brown sandy loam
Subsoil:
10 to 14 inches—yellowish brown loamy sand
14 to 29 inches—strong brown and brown sandy loam
29 to 37 inches—yellowish brown loamy sand
Substratum:
37 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Boyer soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in the higher landscape positions
• The well drained Spinks soils on side slopes and toe slopes
Similar inclusions:
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland, building sites

Cropland

Major management concerns: Water erosion, soil blowing, nutrient loss, droughtiness, low content of organic matter
Management measures:
• A system of conservation tillage that leaves crop residue on the surface helps to control water erosion, helps to prevent crusting during periods of heavy rainfall, and increases the rate of water infiltration.
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Irrigation may be needed.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Including green manure crops in the cropping sequence, applying a system of no-till planting, and managing crop residue increase the content of organic matter.

Pasture

Major management concerns: Droughtiness
Management measures:
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Cutbanks cave

Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability in the substratum
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 4A
Michigan soil management group: 4a

17C—Boyer sandy loam, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown sandy loam
Subsoil:
9 to 15 inches—yellowish brown loamy sand
15 to 29 inches—strong brown and brown sandy loam
29 to 35 inches—yellowish brown loamy sand
Substratum:
35 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Boyer soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in the higher positions on the landscape
• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Dominant uses—pasture; other uses—cropland, woodland, building sites

Cropland

Major management concerns: Water erosion, soil blowing, nutrient loss, droughtiness, low content of organic matter
Management measures:
• Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations that include grasses and legumes, grade-stabilization structures, or a combination of these.
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Irrigation may be needed.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Including green manure crops in the cropping sequence, applying a system of no-till planting, and managing crop residue increase the content of organic matter.

Pasture

Major management concerns: Droughtiness
Management measures:
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests

helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Slope, cutbanks cave
Management measures:
• Some land grading may be needed.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability in the substratum
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.
• Some land shaping may be needed.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: 4a

17D—Boyer sandy loam, 12 to 18 percent slopes

Setting

Landform: Rolling areas on ridges and knolls on outwash plains and terraces
Shape of areas: Irregular and linear
Size of areas: 3 to 300 acres

Typical Profile

Surface layer:
0 to 4 inches—very dark gray sandy loam

Subsoil:
4 to 17 inches—yellowish brown loamy sand
17 to 29 inches—dark yellowish brown sandy loam
29 to 35 inches—brownish yellow loamy sand

Substratum:
35 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Medium
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Boyer and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Dominant uses—woodland; other uses—pasture

Pasture

Major management concerns: Droughtiness
Management measures:
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Slope, cutbanks cave
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability in the substratum, slope

Management measures:

• The poor filtering capacity of this soil can result in the pollution of ground water.

• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.

• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 4A
Michigan soil management group: 4a

17E—Boyer sandy loam, 18 to 40 percent slopes

Setting

Landform: Hilly and steep areas on high ridges and knolls on outwash plains and terraces
Shape of areas: Linear
Size of areas: 3 to 150 acres

Typical Profile

Surface layer:
0 to 4 inches—very dark gray sandy loam

Subsoil:
4 to 17 inches—yellowish brown loamy sand
17 to 29 inches—dark yellowish brown sandy loam
29 to 35 inches—brownish yellow loamy sand

Substratum:
35 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Boyer soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:

• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation, plant competition

Management measures:

• Constructing logging roads at midslope results in excessive cutting and filling, which increase the hazard of erosion.

• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.

• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.

• Cable yarding systems are generally safer than other logging methods and result in less surface disturbance, especially in the steeper areas.

• Gullying can be prevented by the safe disposal of concentrated runoff.

• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

• Special harvest methods may be needed to control undesirable plants.

• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Slope
Suitability:

• Because of the slope, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Slope
Suitability:

• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIe
Woodland ordination symbol: 4R
Michigan soil management group: 4a

21B—Leoni gravelly loam, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 5 to 1,000 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown gravelly loam
Subsoil:
9 to 26 inches—brown very gravelly clay loam
26 to 34 inches—strong brown very gravelly clay loam
34 to 38 inches—strong brown gravelly sandy loam
Substratum:
38 to 60 inches—yellowish brown very gravelly coarse sand and light yellowish brown gravelly sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part of the profile and rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Very slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Low

Composition

Leoni soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in landscape positions similar to those of the Leoni soil
Similar inclusions:
• Soils that have less gravel in the surface layer
• Soils that are moderately well drained
• Soils that have more sand in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Nutrient loss, tilth
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage maintain or improve tilth and increase the available water capacity and the organic matter content.

Pasture

Major management concerns: Seasonal droughtiness, compaction
Management measures:
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability in the substratum
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 4A
Michigan soil management group: Ga

21C—Leoni gravelly loam, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown gravelly loam
Subsoil:
8 to 25 inches—brown very gravelly clay loam and very gravelly sandy clay loam
25 to 34 inches—strong brown very gravelly clay loam
34 to 38 inches—strong brown gravelly sandy loam
Substratum:
38 to 60 inches—yellowish brown very gravelly coarse sand and light yellowish brown gravelly sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part of the profile and rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Low

Composition

Leoni soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in landscape positions similar to those of the Leoni soil
Similar inclusions:
• Soils that have less gravel in the surface layer

Use and Management

Land use: Dominant uses—pasture; other uses—crops, woodland

Cropland

Major management concerns: Water erosion, nutrient loss, tilth
Management measures:
• Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations that include grasses and legumes, grade-stabilization structures, or a combination of these.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage maintain or improve tilth and increase the available water capacity and the organic matter content.

Pasture

Major management concerns: Seasonal droughtiness, compaction
Management measures:
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Cutbanks cave, slope
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

Septic tank absorption fields

Major management concerns: Rapid permeability in the substratum, slope
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the

perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: Ga

22A—Dowagiac loam, 0 to 2 percent slopes

Setting

Landform: Nearly level areas on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 5 to 1,200 acres

Typical Profile

Surface layer:
0 to 9 inches—very dark grayish brown loam
Subsoil:
9 to 25 inches—dark yellowish brown and strong brown clay loam and yellowish brown sandy clay loam
25 to 34 inches—dark brown sandy loam
34 to 44 inches—strong brown sand, dark brown loamy sand, and dark yellowish brown gravelly loamy sand
Substratum:
44 to 60 inches—yellowish brown very gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part of the profile and rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Dowagiac soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Matherton soils in slight depressions and on the lower parts of the landscape
Similar inclusions:
• Soils that are moderately well drained
• Soils that have less clay in the subsoil

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Nutrient loss, tilth
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Minimizing tillage (fig. 4) and tilling at the proper soil moisture content help to maintain good tilth.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage maintain or improve tilth and increase the available water capacity and the organic matter content.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Cutbanks cave, the shrink-swell potential
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Extending footings and foundations into the sandy substratum helps to prevent the damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Rapid permeability in the substratum
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the

Figure 4.—Minimum tillage helps to maintain good tilth in this area of Dowagiac loam, 0 to 2 percent slopes.

perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.

Interpretive Groups

Land capability classification: IIs
Woodland ordination symbol: 4A
Michigan soil management group: 3/5a

23B—Hixton loam, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on outwash plains and terraces
Shape of areas: Irregular and linear
Size of areas: 3 to 300 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown loam

Subsoil:
9 to 20 inches—dark yellowish brown loam
20 to 28 inches—brown loam
28 to 34 inches—dark yellowish brown sandy loam

Substratum:
34 to 38 inches—yellowish brown sand

Bedrock:
38 to 60 inches—yellowish brown sandstone

Soil Properties and Qualities

Depth class: Moderately deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Low

Composition

Hixton soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Kalamazoo soils in landscape positions similar to those of the Hixton soil

Similar inclusions:
• Soils that have less clay in the subsoil
• Soils that have gravel in the subsoil

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Water erosion, nutrient loss, tilth, compaction
Management measures:
• Crop rotations that include grasses or legumes,

conservation tillage, grassed waterways, and cover crops help to control water erosion.
• Timing fertilizer applications to meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands can minimize the leaching of nutrients.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Planting cover crops or green manure crops helps to protect the soil surface and helps to minimize the leaching of nutrients from the root zone.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability and tilth.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Depth to rock, cutbanks cave
Management measures:
• Excavation is hampered by the moderate depth to bedrock.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Depth to rock, seepage
Management measures:
• Excavation is hampered by the moderate depth to bedrock.
• The seepage of effluent between rock fractures and the thin layer of soil material result in a poor filtering capacity and can cause the pollution of ground water.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 4A
Michigan soil management group: 2/Ra

25A—Kalamazoo loam, 0 to 2 percent slopes

Setting

Landform: Nearly level areas on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 1,000 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown loam

Subsoil:
9 to 15 inches—dark yellowish brown loam
15 to 29 inches—dark yellowish brown and brown clay loam
29 to 35 inches—brown sandy loam
35 to 46 inches—brown gravelly loamy sand

Substratum:
46 to 60 inches—yellowish brown sand and thin strata of dark yellowish brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part of the profile and rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Kalamazoo soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The moderately well drained Bronson soils in the slightly lower landscape positions
• The somewhat poorly drained Matherton soils in slight depressions and on the lower parts of the landscape

• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that are moderately well drained
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland, building sites

Cropland

Major management concerns: Nutrient loss, tilth, moderately low content of organic matter
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage maintain or improve tilth and increase the available water capacity and the organic matter content.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Cutbanks cave, the shrink-swell potential
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Extending footings and foundations into the sandy substratum helps to prevent the damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Rapid permeability in the substratum
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.

Interpretive Groups

Land capability classification: IIs
Woodland ordination symbol: 4A
Michigan soil management group: 3/5a

25B—Kalamazoo loam, 2 to 6 percent slopes

Setting

Landform: Gently undulating and undulating areas on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 2,500 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown loam

Subsoil:
9 to 15 inches—dark yellowish brown loam
15 to 29 inches—dark yellowish brown and brown clay loam
29 to 35 inches—brown sandy loam
35 to 46 inches—brown gravelly loamy sand

Substratum:
46 to 60 inches—yellowish brown sand and thin strata of dark yellowish brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part of the profile and rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Kalamazoo soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The moderately well drained Bronson soils in the slightly lower landscape positions
• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that have a surface layer of sandy loam
• Soils that are moderately well drained
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland, building sites

Cropland

Major management concerns: Water erosion, nutrient loss, tilth, moderately low content of organic matter
Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, grassed waterways, and cover crops help to control water erosion.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage maintain or improve tilth and increase the available water capacity and the organic matter content.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Cutbanks cave, the shrink-swell potential
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Extending footings and foundations into the sandy substratum helps to prevent the damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Rapid permeability in the substratum
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 4A
Michigan soil management group: 3/5a

25C—Kalamazoo loam, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 500 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown loam

Subsoil:
8 to 15 inches—dark yellowish brown loam
15 to 29 inches—dark yellowish brown and brown clay loam
29 to 35 inches—brown sandy loam
35 to 48 inches—brown gravelly loamy sand

Substratum:
48 to 60 inches—yellowish brown sand and thin strata of dark yellowish brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part of the profile and rapid in the lower part
Available water capacity: Moderate

Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Kalamazoo soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in landscape positions similar to those of the Kalamazoo soil
• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that have a surface layer of sandy loam
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland, building sites

Cropland

Major management concerns: Water erosion, nutrient loss, tilth, low content of organic matter
Management measures:
• Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations that include grasses and legumes, grade-stabilization structures, or a combination of these.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage maintain or improve tilth and increase the available water capacity and the organic matter content.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Cutbanks cave, slope, the shrink-swell potential
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.
• Extending footings and foundations into the sandy substratum helps to prevent the damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Rapid permeability in the substratum
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: 3/5a

25D—Kalamazoo loam, 12 to 18 percent slopes

Setting

Landform: Rolling areas on ridges and knolls on outwash plains and terraces
Shape of areas: Irregular and linear
Size of areas: 3 to 300 acres

Typical Profile

Surface layer:
0 to 7 inches—dark brown loam
Subsoil:
7 to 13 inches—dark yellowish brown loam
13 to 27 inches—dark yellowish brown and brown clay loam
27 to 32 inches—brown sandy loam
32 to 46 inches—brown gravelly loamy sand
Substratum:
46 to 60 inches—yellowish brown sand and thin strata of dark yellowish brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part of the profile and rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Medium
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Kalamazoo soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in landscape positions similar to those of the Kalamazoo soil
• The well drained Spinks soils on side slopes and toe slopes
Similar inclusions:
• Soils that have a surface layer of sandy loam
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Dominant uses—woodland; other uses—pasture

Pasture

Major management concerns: Water erosion, compaction
Management measures:
• Proper stocking rates and short-duration grazing minimize compaction, maintain plant density and hardiness, and reduce the hazard of water erosion.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Cutbanks cave, slope, the shrink-swell potential
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Extending footings and foundations into the sandy substratum helps to prevent the damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Rapid permeability in the substratum, slope
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 4A
Michigan soil management group: 3/5a

28B—Elmdale sandy loam, 2 to 6 percent slopes

Setting

Landform: Gently undulating and undulating areas on low ridges and knolls on till plains and moraines
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown sandy loam

Subsoil:
9 to 43 inches—yellowish brown, dark yellowish brown, and brown, mottled sandy loam
43 to 75 inches—brown, mottled sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Moderately well drained
Seasonal high water table: At a depth of 2 to 3 feet
Surface runoff: Moderate
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Elmdale soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Teasdale soils in depressions and along drainageways

Similar inclusions:
• Soils that have more clay in the subsoil
• Soils that have a sandy subsoil

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Water erosion, soil blowing, nutrient loss, moderately low content of organic matter
Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, grassed waterways, and cover crops help to control water erosion.
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Including green manure crops in the cropping sequence, applying a system of no-till planting, and managing crop residue increase the content of organic matter.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Wetness, cutbanks cave
Management measures:
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Seasonal high water table
Management measures:
• Mounding or adding suitable fill material raises the absorption field above the water table.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 5A
Michigan soil management group: 3a

29B—Hillsdale sandy loam, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on moraines and till plains
Shape of areas: Irregular
Size of areas: 3 to 1,500 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown sandy loam

Subsoil:
9 to 66 inches—dark yellowish brown and yellowish brown sandy loam

Substratum:
66 to 80 inches—yellowish brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Hillsdale soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in the lower landscape positions
• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that have less clay in the substratum
• Soils that have sand in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland, building sites

Cropland

Major management concerns: Water erosion, soil blowing, nutrient loss, moderately low content of organic matter
Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, grassed waterways, and cover crops help to control water erosion.
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Including green manure crops in the cropping sequence, applying a system of no-till planting, and managing crop residue increase the content of organic matter.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Moderate permeability
Management measures:
• Increasing the size of the absorption area and backfilling the trenches with porous material help to compensate for the restricted permeability.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 4A
Michigan soil management group: 3a

29C—Hillsdale sandy loam, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on moraines and till plains
Shape of areas: Irregular
Size of areas: 3 to 500 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown sandy loam
Subsoil:
8 to 66 inches—dark yellowish brown and yellowish brown sandy loam
Substratum:
66 to 80 inches—yellowish brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Hillsdale soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in landscape positions similar to those of the Hillsdale soil
• The well drained Spinks soils on side slopes and toe slopes
Similar inclusions:
• Soils that have less clay in the substratum
• Soils that have more sand in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland, building sites

Cropland

Major management concerns: Water erosion, soil blowing, nutrient loss, moderately low content of organic matter
Management measures:
• Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations that include grasses and legumes, grade-stabilization structures, or a combination of these.
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Including green manure crops in the cropping sequence, applying a system of no-till planting, and managing crop residue increase the content of organic matter.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Cutbanks cave, slope
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

Septic tank absorption fields

Major management concerns: Moderate permeability, slope
Management measures:
• Increasing the size of the absorption area and backfilling the trenches with porous material help to

compensate for the restricted permeability.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: 3a

29D—Hillsdale sandy loam, 12 to 18 percent slopes

Setting

Landform: Rolling areas on ridges and knolls on moraines and till plains
Shape of areas: Irregular and linear
Size of areas: 3 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown sandy loam

Subsoil:
8 to 66 inches—dark yellowish brown and yellowish brown sandy loam

Substratum:
66 to 80 inches—yellowish brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Moderate
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Hillsdale soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in the lower landscape positions
• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that have less clay in the substratum
• Soils that have more sand in the substratum

Use and Management

Land use: Dominant uses—woodland; other uses—pasture

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Slope, cutbanks cave
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Moderate permeability, slope
Management measures:
• Increasing the size of the absorption area and backfilling the trenches with porous material help to compensate for the moderate permeability.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 4A
Michigan soil management group: 3a

29E—Hillsdale sandy loam, 18 to 25 percent slopes

Setting

Landform: Hilly and steep areas on high ridges and knolls on moraines and till plains
Shape of areas: Linear

Size of areas: 3 to 150 acres

Typical Profile

Surface layer:
0 to 7 inches—dark brown sandy loam

Subsoil:
7 to 65 inches—dark yellowish brown and yellowish brown sandy loam

Substratum:
65 to 80 inches—yellowish brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Hillsdale soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in the lower landscape positions
• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that have less clay in the substratum
• Soils that have more sand in the substratum

Use and Management

Land use: Dominant uses—woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation, plant competition
Management measures:
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• Gullying can be prevented by the safe disposal of concentrated runoff.
• Logging methods that do not disturb the layers of forest litter help to control erosion.
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Included areas, if available, or nearly level adjacent areas should be selected as sites for landings.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Slope, cutbanks cave
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Slope
Suitability:
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 4R
Michigan soil management group: 3a

33B—Riddles loam, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on till plains and moraines
Shape of areas: Irregular
Size of areas: 3 to 1,000 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown loam

Subsoil:
9 to 23 inches—dark yellowish brown clay loam
23 to 31 inches—strong brown loam
31 to 60 inches—dark yellowish brown loam and sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: High
Drainage class: Well drained

Depth to the water table: More than 60 inches
Surface runoff: Moderate
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Riddles soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Blount soils in depressions and along drainageways
• The well drained Kalamazoo soils in the lower landscape positions
• The well drained Oshtemo soils in landscape positions similar to those of the Riddles soil

Similar inclusions:
• Soils that have a surface layer of sandy loam
• Soils that are moderately well drained

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland, building sites

Cropland

Major management concerns: Water erosion, nutrient loss, tilth
Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, grassed waterways, and cover crops help to control water erosion.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.

Pasture

Major management concerns: None
Management measures:
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: The shrink-swell potential
Management measures:
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Moderate permeability
Management measures:
• Increasing the size of the absorption area and backfilling the trenches with porous material help to compensate for the restricted permeability.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 5A
Michigan soil management group: 2.5a

33C—Riddles loam, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on till plains and moraines
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown loam

Subsoil:
9 to 23 inches—dark yellowish brown clay loam
23 to 60 inches—dark yellowish brown loam and sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: High
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Moderate
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Riddles soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Kalamazoo and Oshtemo soils in the lower landscape positions

Similar inclusions:
• Soils that have a surface layer of sandy loam

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland, building sites

Cropland

Major management concerns: Water erosion, nutrient loss, tilth, moderately low content of organic matter
Management measures:
• Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations that include grasses and legumes, grade-stabilization structures, or a combination of these.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Slope, the shrink-swell potential
Management measures:
• Some land grading may be needed.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Moderate permeability, slope
Management measures:
• Increasing the size of the absorption area and backfilling the trenches with porous material help to compensate for the restricted permeability.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 5A
Michigan soil management group: 2.5a

33E—Riddles loam, 12 to 30 percent slopes

Setting

Landform: Rolling to steep areas on high ridges and knolls on till plains and moraines
Shape of areas: Irregular and linear
Size of areas: 3 to 100 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown loam

Subsoil:
9 to 23 inches—dark yellowish brown clay loam
23 to 60 inches—dark yellowish brown loam and sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: High
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderately low
Shrink-swell potential: Moderate

Composition

Riddles soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Kalamazoo and Oshtemo soils in the lower landscape positions
Similar inclusions:
• Soils that have a surface layer of sandy loam

Use and Management

Land use: Dominant uses—woodland; other uses—pasture

Pasture

Major management concerns: Compaction, water erosion
• Proper stocking rates and short-duration grazing minimize compaction, maintain plant density and hardiness, and reduce the hazard of water erosion.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Erosion hazard, equipment limitation, plant competition
Management measures:
• Because of the erosion hazard in the steeper areas, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• Gullying can be prevented by the safe disposal of concentrated runoff.
• Logging methods that do not disturb the layers of forest litter help to control erosion.
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• The nearly level areas should be selected as sites for landings.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Slope, the shrink-swell potential
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Moderate permeability, slope
Management measures:
• Areas that have slopes of more than about 18 percent are generally unsuited to septic tank absorption fields.
• Increasing the size of the absorption area and backfilling the trenches with porous material help to compensate for the restricted permeability.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 5R
Michigan soil management group: 2.5a

38B—Morley loam, moderately wet, 2 to 6 percent slopes

Setting

Landform: Gently undulating and undulating areas on till plains and moraines
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

Surface layer:
0 to 9 inches—very dark grayish brown loam
Subsoil:
9 to 26 inches—yellowish brown clay loam and dark yellowish brown, mottled clay loam
Substratum:
26 to 60 inches—brown, mottled clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Slow
Available water capacity: Moderate
Drainage class: Moderately well drained
Seasonal high water table: At a depth of 3 to 6 feet
Surface runoff: Medium
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Morley soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in landscape positions similar to those of the Morley soil
• The poorly drained Pewamo soils in depressions and along drainageways

Similar inclusions:
• Soils that have less clay in the subsoil

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland, building sites

Cropland

Major management concerns: Water erosion, tilth
Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, grassed waterways, and cover crops help to control water erosion.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Wetness, the shrink-swell potential
Management measures:
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Seasonal high water table, slow permeability
Management measures:
• Mounding or adding suitable fill material raises the absorption field above the water table.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.
• Backfilling the trenches with porous material also helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 5A
Michigan soil management group: 1.5a

39B—Morley loam, 2 to 6 percent slopes

Setting

Landform: Gently undulating and undulating areas on till plains and moraines
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown loam

Subsoil:
8 to 34 inches—yellowish brown clay loam and dark yellowish brown, mottled clay loam

Substratum:
34 to 60 inches—brown clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Slow
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Medium
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Morley soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Blount soils in depressions and along drainageways

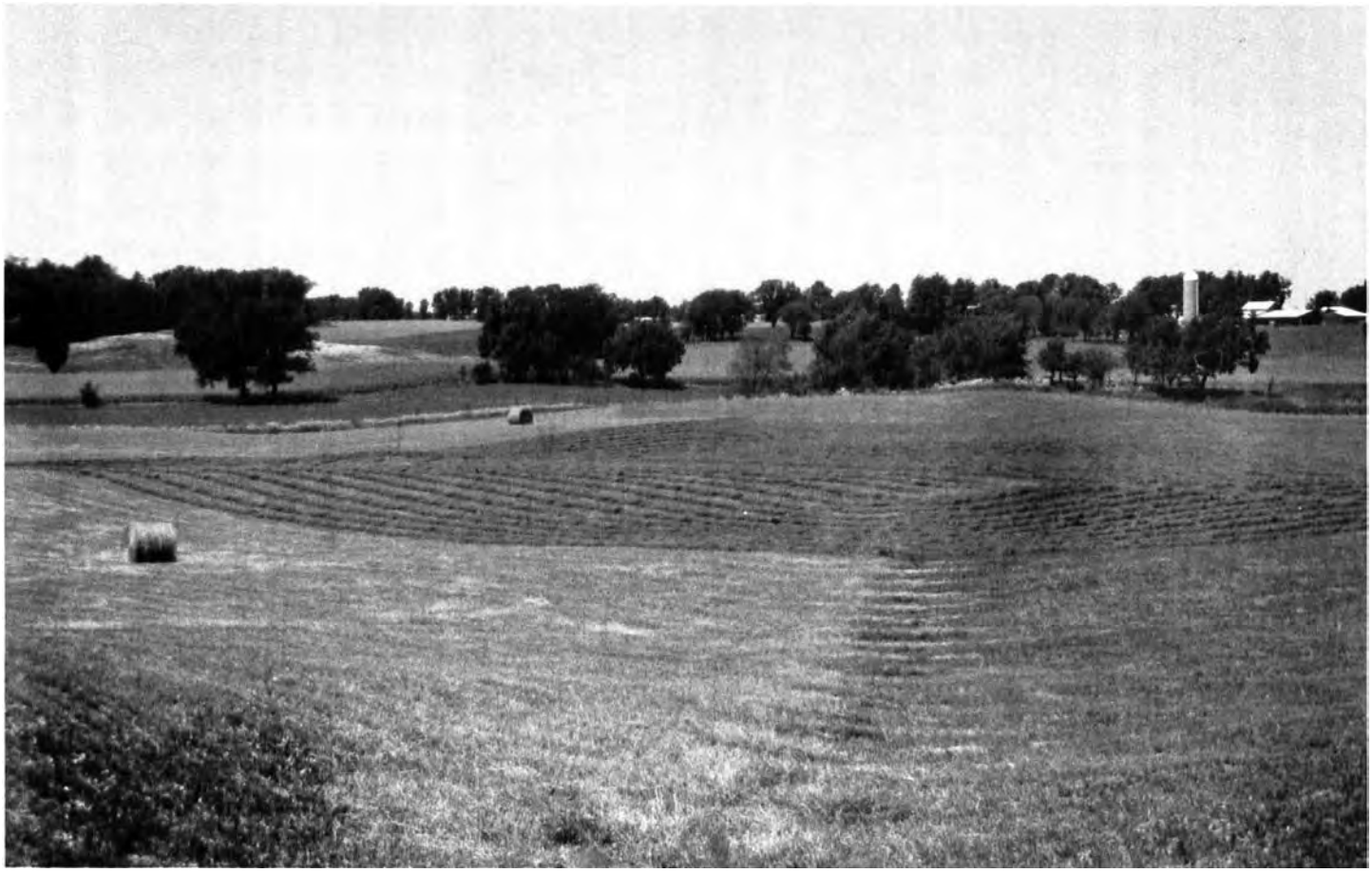

Figure 5.—Hay in an area of Morley loam, 2 to 6 percent slopes. Maintaining a cover of vegetation helps to control erosion.

• The well drained Hillsdale soils in landscape positions similar to those of the Morley soil

Similar inclusions:
• Soils that have less clay in the subsoil

Use and Management

Land use: Dominant uses—cropland; other uses—woodland, building sites, pasture

Cropland

Major management concerns: Water erosion, tilth
Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, grassed waterways, and cover crops help to control water erosion (fig. 5).
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage maintain or improve tilth and increase the available water capacity and the organic matter content.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: The shrink-swell potential

Management measures:
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Slow permeability
Management measures:
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.
• Backfilling the trenches with porous material also helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 5A
Michigan soil management group: 1.5a

39C—Morley loam, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on till plains and moraines
Shape of areas: Irregular
Size of areas: 3 to 150 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown loam

Subsoil:
8 to 34 inches—yellowish brown and dark yellowish brown, mottled clay loam

Substratum:
34 to 60 inches—brown clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Slow
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Morley soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in landscape positions similar to those of the Morley soil
• The well drained Oshtemo soils in the lower landscape positions

Similar inclusions:
• Soils that have less clay in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Water erosion, tilth, moderately low content of organic matter
Management measures:
• Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations that include grasses and legumes, grade-stabilization structures, or a combination of these.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage maintain or improve tilth and increase the available water capacity and the organic matter content.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.

Pasture

Major management concerns: Compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: The shrink-swell potential, slope
Management measures:
• Properly designing and strengthening footings and foundations can help to prevent the structural damage

caused by shrinking and swelling.
• Some land grading may be needed.

Septic tank absorption fields

Major management concerns: Slow permeability
Management measures:
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.
• Backfilling the trenches with porous material also helps to overcome the restricted permeability.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 5A
Michigan soil management group: 1.5a

39D—Morley loam, 12 to 18 percent slopes

Setting

Landform: Rolling areas on high ridges and knolls on till plains and moraines
Shape of areas: Irregular and linear
Size of areas: 3 to 100 acres

Typical Profile

Surface layer:
0 to 6 inches—brown loam
Subsoil:
6 to 20 inches—dark yellowish brown clay loam
Substratum:
20 to 60 inches—brown clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Slow
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Morley soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in landscape positions similar to those of the Morley soil
• The well drained Oshtemo soils in the slightly lower landscape positions

Similar inclusions:
• Soils that have less clay in the substratum

Use and Management

Land use: Dominant uses—pasture; other uses—woodland

Pasture

Major management concerns: Compaction, water erosion
Management measures:
• Proper stocking rates and short-duration grazing minimize compaction, maintain plant density and hardiness, and reduce the hazard of water erosion.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Slope, the shrink-swell potential
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Slow permeability, slope
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• Backfilling the trenches with porous material helps to overcome the restricted permeability.
• Enlarging or pressurizing the absorption field or installing alternating drain fields also helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 5A

Michigan soil management group: 1.5a

43B—Brady sandy loam, 1 to 4 percent slopes

Setting

Landform: Nearly level and gently undulating areas in slight depressions on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown sandy loam
Subsoil:
9 to 33 inches—yellowish brown and brown, mottled sandy loam
33 to 38 inches—brownish yellow, mottled loamy sand
Substratum:
38 to 60 inches—yellowish brown, mottled sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Low
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 3 feet
Surface runoff: Very slow
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Brady soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Gilford soils in the lower landscape positions
• The poorly drained Granby soils in depressions and along drainageways
Similar inclusions:
• Soils that have more clay in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Soil blowing, water erosion, nutrient loss, wetness, compaction
Management measures:
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control water erosion.
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• A combination of subsurface drains and surface drains is effective in removing excess water.
• If subsurface drains are installed, a suitable filtering material may be needed to keep sand from flowing into the tile line.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.

Pasture

Major management concerns: Wetness, compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Pasture plants that can tolerate seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitation, plant competition
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.

• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Wetness, cutbanks cave
Management measures:
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Wetness
Management measures:
• Mounding or adding suitable fill material raises the absorption field above the water table.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 3W
Michigan soil management group: 3b

44A—Matherton loam, 0 to 3 percent slopes

Setting

Landform: Nearly level and gently undulating areas in slight depressions on terraces and outwash plains
Shape of areas: Irregular
Size of areas: 3 to 400 acres

Typical Profile

Surface layer:
0 to 8 inches—very dark grayish brown loam

Subsoil:
8 to 14 inches—dark yellowish brown, mottled sandy clay loam
14 to 20 inches—yellowish brown, mottled loam
20 to 36 inches—grayish brown, brown, and dark brown, mottled gravelly clay loam

Substratum:
36 to 60 inches—light brownish gray, mottled very gravelly sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part of the profile and rapid in the lower part
Available water capacity: Moderate
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 2 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Matherton soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Granby soils in depressions and along drainageways
• The poorly drained Sebewa soils in slight depressions and on the lower parts of the landscape

Similar inclusions:
• Soils that are moderately well drained

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Wetness, nutrient loss, tilth, compaction
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Most adapted crops can be grown if an adequate drainage system is installed.
• Excess water can be removed by a combination of subsurface drains and surface drains.
• Minimizing tillage and tilling at the proper soil moisture content help to prevent excessive compaction and maintain good tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.

Pasture

Major management concerns: Wetness, compaction

Management measures:
• Pasture plants that can tolerate seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitation, plant competition
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Wetness, cutbanks cave
Management measures:
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Wetness, rapid permeability in the substratum
Management measures:
• Mounding or adding suitable fill material raises the absorption field above the water table.
• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 4W
Michigan soil management group: 3/5b

45A—Sleeth loam, 0 to 2 percent slopes

Setting

Landform: Nearly level areas in slight depressions on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 400 acres

Typical Profile

Surface layer:
0 to 9 inches—brown loam
Subsoil:
9 to 15 inches—yellowish brown, mottled loam
15 to 41 inches—light brownish gray, mottled sandy clay loam and loam
41 to 45 inches—light brownish gray, mottled loam
45 to 58 inches—gray, mottled sandy loam
Substratum:
58 to 70 inches—yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: High
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 3 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Sleeth soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Gilford soils in the lower landscape positions
• The poorly drained Sebewa soils in slight depressions and on the lower parts of the landscape
Similar inclusions:
• Soils that have gravel in the substratum
• Soils that have a thinner subsoil

Use and Management

Land use: Dominant uses—cropland; other uses—woodland, pasture

Cropland

Major management concerns: Wetness, tilth, moderately low organic matter, compaction
Management measures:
• Most adapted crops can be grown if an adequate drainage system is installed.

• Excess water can be removed by a combination of subsurface drains and surface drains.
• Minimizing tillage and tilling at the proper soil moisture content help to prevent excessive compaction and maintain good tilth.
• Including green manure crops in the cropping sequence, applying a system of no-till planting, and managing crop residue increase the content of organic matter.

Pasture

Major management concerns: Wetness
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Pasture plants that can tolerate seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Wetness, cutbanks cave
Management measures:
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Wetness
Management measures:
• Mounding or adding suitable fill material raises the absorption field above the water table.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 4W
Michigan soil management group: 2.5b

46B—Crosier loam, 1 to 4 percent slopes

Setting

Landform: Nearly level and gently undulating areas in slight depressions on till plains and moraines
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

Surface layer:
0 to 10 inches—dark brown loam

Subsoil:
10 to 21 inches—brown, mottled loam
21 to 36 inches—grayish brown and brown, mottled loam
36 to 42 inches—yellowish brown, mottled sandy loam

Substratum:
42 to 60 inches—brown, mottled sandy loam and loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow
Available water capacity: High
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 3 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Crosier soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Granby soils in depressions and drainageways
• The poorly drained Gilford soils in depressions and drainageways

Similar inclusions:
• Soils that are moderately well drained
• Soils that have more clay in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Water erosion, wetness, tilth, compaction

Management measures:

• Crop rotations that include grasses or legumes, conservation tillage, grassed waterways, and cover crops help to control water erosion.

• Most adapted crops can be grown if an adequate drainage system is installed.

• Excess water can be removed by a combination of subsurface drains and surface drains.

• Minimizing tillage and tilling at the proper soil moisture content help to prevent excessive compaction and maintain good tilth.

• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.

Pasture

Major management concerns: Wetness, compaction

Management measures:

• Hay and pasture plants that can tolerate seasonal wetness should be seeded.

• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitation, windthrow, plant competition

Management measures:

• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.

• Skidders should not be used during wet periods, when ruts form easily.

• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.

• Special harvest methods may be needed to control undesirable plants.

• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

Building sites

Major management concerns: Wetness

Management measures:

• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.

• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.

Septic tank absorption fields

Major management concerns: Wetness, moderately low permeability

Management measures:

• Mounding or adding suitable fill material raises the absorption field above the water table.

• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 4W
Michigan soil management group: 2.5b

47B—Teasdale sandy loam, 1 to 4 percent slopes

Setting

Landform: Nearly level and gently undulating areas in slight depressions on till plains and moraines
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

Surface layer:
0 to 9 inches—dark grayish brown sandy loam

Subsoil:
9 to 51 inches—yellowish brown and brown, mottled sandy loam

Substratum:
51 to 60 inches—brown, mottled sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 2 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Teasdale soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Barry soils in slight depressions and on the lower parts of the landscape
• The moderately well drained Elmdale soils in the higher positions on the landscape

Similar inclusions:
• Soils that have sand in the substratum
• Soils that have more clay in the subsoil

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Soil blowing, nutrient loss, wetness, compaction
Management measures:
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Most adapted crops can be grown if an adequate drainage system is installed.
• Excess water can be removed by a combination of subsurface drains and surface drains.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.
• Minimizing tillage and tilling at the proper moisture content help to prevent excessive compaction and maintain good tilth.

Pasture

Major management concerns: Wetness, compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Pasture plants that can tolerate seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitation, plant competition
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Wetness, cutbanks cave
Management measures:
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Wetness, moderate permeability
Management measures:
• Mounding or adding suitable fill material raises the absorption field above the water table.
• Increasing the size of the absorption area helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 4W
Michigan soil management group: 3b

53A—Kibbie loam, 0 to 2 percent slopes

Setting

Landform: Nearly level areas in slight depression on outwash plains, lake plains, and till plains
Shape of areas: Irregular
Size of areas: 3 to 150 acres

Typical Profile

Surface layer:
0 to 9 inches—very dark grayish brown loam
Subsoil:
9 to 18 inches—yellowish brown, mottled clay loam
18 to 24 inches—yellowish brown, mottled loam
24 to 30 inches—pale brown, mottled silt loam
30 to 32 inches—yellowish brown, mottled silty clay loam
Substratum:
32 to 60 inches—light yellowish brown, mottled silt loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: High
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 2 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Slight
Shrink-swell potential: Low

Composition

Kibbie soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Morley soils in the higher positions on the landscape
• The poorly drained Pewamo soils in landscape positions similar to those of the Kibbie soil
Similar inclusions:
• Soils that are moderately well drained
• Soils that have less silt in the subsoil

Use and Management

Land use: Dominant uses—cropland; other uses—woodland, pasture

Cropland

Major management concerns: Nutrient loss, wetness, tilth, compaction
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Planting cover crops or green manure crops helps to protect the soil surface and minimizes the leaching of nutrients from the root zone.
• Most adapted crops can be grown if an adequate drainage system is installed.
• Excess water can be removed by a combination of subsurface drains and surface drains.
• Minimizing tillage and tilling at the proper soil moisture content help to prevent excessive compaction and maintain good tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.

Pasture

Major management concerns: Wetness, compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Pasture plants that can tolerate seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitation, plant competition
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Wetness, cutbanks cave
Management measures:
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.

• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.

Septic tank absorption fields

Major management concerns: Wetness, moderate permeability
Management measures:
• Mounding or adding suitable fill material raises the absorption field above the water table.
• Increasing the size of the absorption area helps to compensate for the restricted permeability.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 4W
Michigan soil management group: 2.5b-s

58B—Blount loam, 1 to 4 percent slopes

Setting

Landform: Nearly level and gently undulating areas in slight depressions on till plains and moraines
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—brown loam

Subsoil:
8 to 21 inches—dark yellowish brown and brown, mottled clay
21 to 48 inches—dark yellowish brown, mottled clay loam

Substratum:
48 to 60 inches—dark yellowish brown, mottled clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Slow
Available water capacity: Moderate
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 3 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Blount soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The moderately well drained Elmdale soils on slight rises
• The well drained Morley soils in the higher positions on the landscape

Similar inclusions:
• Soils that have less clay throughout

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Water erosion, wetness, tilth, compaction
Management measures:
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control water erosion.
• Most adapted crops can be grown if an adequate drainage system is installed.
• Excess water can be removed by a combination of subsurface drains and surface drains.
• Minimizing tillage and tilling at the proper soil moisture content help to prevent excessive compaction and maintain good tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.

Pasture

Major management concerns: Wetness, compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Pasture plants that can tolerate seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitation, seedling mortality
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.

• Because of the slow permeability and the sticky and plastic subsoil, logging roads should be graveled. Also, in some areas landings should be stabilized.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Wetness
Management measures:
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.

Septic tank absorption fields

Major management concerns: Wetness, slow permeability
Management measures:
• Mounding or adding suitable fill material raises the absorption field above the water table.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 3C
Michigan soil management group: 1.5b

61—Algansee fine sand, occasionally flooded

Setting

Landform: Nearly level areas in drainageways along rivers and streams on flood plains
Slope: 0 to 2 percent
Shape of areas: Irregular and linear
Size of areas: 3 to 500 acres

Typical Profile

Surface layer:
0 to 9 inches—black fine sand
Subsoil:
9 to 30 inches—brown, mottled fine sand and sand
30 to 52 inches—dark grayish brown, grayish brown, and brown, mottled sand
Substratum:
52 to 60 inches—pale brown, mottled coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Rapid
Available water capacity: Low
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 2 feet
Surface runoff: Slow
Flooding: Common
Organic matter content: Moderate
Hazard of soil blowing: Severe
Shrink-swell potential: Low

Composition

Algansee soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The moderately well drained Brady soils on slight rises and low knolls
• The poorly drained Gilford soils in depressions and along drainageways
Similar inclusions:
• Soils that have more organic matter in the surface layer
• Soils that have more clay in the subsoil

Use and Management

Land use: Dominant uses—woodland; other uses—pasture

Pasture

Major management concerns: Wetness, flooding
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitation and plant competition
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or

midwinter, when the soil is frozen.
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Wetness, flooding, and cutbanks cave
Suitability:
• Because of wetness and flooding, this soil is generally unsuited to building site development.

Septic tank absorption fields
• Major management concerns: Wetness, flooding, rapid permeability
Suitability:
• Because of wetness, a poor filtering capacity, and flooding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: 4W
Michigan soil management group: L-4c

62—Granby loamy sand

Setting

Landform: Nearly level areas in depressions and along drainageways on outwash plains and lake plains
Slope: 0 to 2 percent
Shape of areas: Irregular and linear
Size of areas: 3 to 400 acres

Typical Profile

Surface layer:
0 to 10 inches—black loamy sand

Subsoil:
10 to 33 inches—light brownish gray and grayish brown, mottled sand
33 to 40 inches—grayish brown sand

Substratum:
40 to 60 inches—gray fine sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Rapid
Available water capacity: Low
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: High
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Granby soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Gilford soils on slight rises and low knolls
• The somewhat poorly drained Brady soils in depressions and along drainageways

Similar inclusions:
• Soils that have a lower content of organic matter in the surface layer
• Soils that have more clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Dominant uses—woodland, cropland; other uses—pasture

Cropland

Major management concerns: Wetness, soil blowing, droughtiness
Management measures:
• Most adapted crops can be grown if an adequate drainage system is installed.
• Excess water can be removed by open ditches, subsurface drains, surface drains, pumps, or a combination of these.
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Irrigation may be needed.
• Including green manure crops in the cropping sequence, applying a system of no-till planting, and

managing crop residue help to maintain the organic matter content.

Pasture

Major management concerns: Wetness, droughtiness
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Pasture plants that can tolerate periodic inundation and seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Ponding, cutbanks cave
Suitability:
• Because of ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding, rapid permeability
Suitability:
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: 5c

63—Gilford fine sandy loam, gravelly substratum

Setting

Landform: Nearly level areas in depressions and along drainageways on outwash plains and lake plains
Slope: 0 to 2 percent
Shape of areas: Irregular and linear
Size of areas: 3 to 800 acres

Typical Profile

Surface layer:
0 to 11 inches—very dark gray fine sandy loam

Subsoil:
11 to 35 inches—dark gray, grayish brown, and dark grayish brown, mottled sandy loam
35 to 38 inches—dark grayish brown, mottled loamy sand

Substratum:
38 to 60 inches—dark gray gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and rapid in the lower part
Available water capacity: Low
Drainage class: Poorly drained
Seasonal high water table: 0.5 foot above to 1.0 foot below the surface
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Gilford soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Brady soils on slight rises and low knolls
• The poorly drained Sebewa soils in landscape positions similar to those of the Gilford soil

Similar inclusions:
• Soils that have more clay in the subsoil
• Soils that have more sand in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—woodland, pasture

Cropland

Major management concerns: Wetness, soil blowing, droughtiness

Management measures:

• Most adapted crops can be grown if an adequate drainage system is installed.

• Excess water can be removed by open ditches, subsurface drains, surface drains, pumps, or a combination of these.

• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.

• Irrigation may be needed.

Pasture

Major management concerns: Wetness, compaction

Management measures:

• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

• Pasture plants that can tolerate periodic inundation and seasonal wetness should be seeded.

• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.

• Skidders should not be used during wet periods, when ruts form easily.

• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.

• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.

• Special harvest methods may be needed to control undesirable plants.

• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.

• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Ponding, cutbanks cave

Suitability:

• Because of ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding, rapid permeability in the substratum

Suitability:

• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIIw

Woodland ordination symbol: 2W

Michigan soil management group: 4c

64—Cohoctah loam, gravelly substratum, frequently flooded

Setting

Landform: Nearly level areas in drainageways along rivers and streams on flood plains

Slope: 0 to 2 percent

Shape of areas: Irregular and linear

Size of areas: 3 to 300 acres

Typical Profile

Surface layer:

0 to 11 inches—black loam

Subsoil:

11 to 29 inches—gray, mottled loam

29 to 32 inches—grayish brown, mottled sandy loam

32 to 38 inches—dark gray, mottled loamy sand

Substratum:

38 to 60 inches—gray gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part

Available water capacity: Moderate

Drainage class: Poorly drained

Seasonal high water table: 0.5 foot above to 1.0 foot below the surface

Surface runoff: Very slow

Figure 6.—Flooding in an area of Cohoctah loam, gravelly substratum, frequently flooded.

Flooding: Frequent (fig. 6)
Organic matter content: High
Hazard of soil blowing: Slight
Shrink-swell potential: Low

Composition

Cohoctah soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Granby and very poorly drained Palms soils in landscape positions similar to those of the Cohoctah soil
• The very poorly drained Houghton soils on the lowest parts of the landscape

Similar inclusions:
• Soils that have a surface layer of loam
• Soils that have more clay in the subsoil

Use and Management

Land use: Dominant uses—woodland; other uses—pasture

Pasture

Major management concerns: Wetness, flooding
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Pasture plants that can tolerate periodic inundation and seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Because of wetness, flooding, seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Wetness, flooding, cutbanks cave
Suitability:
• Because of ponding, flooding, and the hazard of cutbanks caving, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding, flooding, very rapid permeability in the substratum
Suitability:
• Because of ponding and flooding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: L-2c

65—Sebewa loam

Setting

Landform: Nearly level areas in depressions and along drainageways on outwash plains and terraces
Slope: 0 to 2 percent
Shape of areas: Irregular and linear
Size of areas: 3 to 1,200 acres

Typical Profile

Surface layer:
0 to 12 inches—black loam
Subsoil:
12 to 32 inches—dark gray and grayish brown, mottled clay loam
32 to 38 inches—grayish brown, mottled loam
Substratum:
38 to 45 inches—gray, mottled sand
45 to 60 inches—grayish brown, mottled gravelly sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part of the profile and rapid or very rapid in the lower part
Available water capacity: Moderate in the upper part of the profile and rapid in the lower part
Drainage class: Poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface
Surface runoff: Very slow or ponded (fig. 7)
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Sebewa soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Gilford soils in landscape positions similar to those of the Sebewa soil
• The somewhat poorly drained Matherton soils on slight rises and low knolls
Similar inclusions:
• Soils that have a surface layer of sandy loam
• Soils that have more organic matter in the surface layer
• Soils that have less gravel in the substratum

Use and Management

Land use: Dominant uses—cropland; other uses—woodland, pasture

Cropland

Major management concerns: Wetness, tilth, compaction
Management measures:
• Most adapted crops can be grown if an adequate drainage system is installed.
• Excess water can be removed by open ditches, subsurface drains, surface drains, pumps, or a combination of these.
• Minimizing tillage and tilling at the proper soil moisture content help to prevent excessive compaction and maintain good tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.

Pasture

Major management concerns: Wetness
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Pasture plants that can tolerate periodic inundation and seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow, plant competition
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely

Figure 7.—Ponding may occur in areas of Sebewa loam after heavy rains. Excessive water can be removed by tile or ditches.

spaced and by using such harvest methods as selective cutting and strip cutting.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Cutbanks cave, ponding
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Because of the ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding, rapid permeability in the substratum
Suitability:
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 3W
Michigan soil management group: 3/5c

72—Barry loam

Setting

Landform: Nearly level areas in depressions and along drainageways on till plains and moraines
Slope: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Surface layer:
0 to 9 inches—black loam
9 to 14 inches—very dark gray loam
Subsoil:
14 to 24 inches—very dark gray and dark gray, mottled loam
24 to 29 inches—brown, mottled sandy loam
29 to 46 inches—light brownish gray, mottled loam and sandy loam
Substratum:
46 to 60 inches—brown, mottled sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: High
Drainage class: Poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: High
Hazard of soil blowing: Slight
Shrink-swell potential: Low

Composition

Barry soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Brady soils on slight rises and low knolls
• The poorly drained Gilford soils in depressions and along drainageways
Similar inclusions:
• Soils that have a surface layer of sandy loam
• Soils that have a lower content of organic matter in the surface layer

Use and Management

Land use: Dominant uses—woodland; other uses—pasture, cropland

Cropland

Major management concerns: Wetness, tilth, compaction
Management measures:
• Most adapted crops can be grown if an adequate drainage system is installed.
• Excess water can be removed by open ditches, subsurface drains, surface drains, pumps, or a combination of these.
• Minimizing tillage and tilling at the proper soil moisture content help to prevent excessive compaction and maintain good tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.

Pasture

Major management concerns: Wetness, compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Pasture plants that can tolerate periodic inundation and seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Ponding

Suitability:
• Because of ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding
Suitability:
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 2W
Michigan soil management group: 3c

73—Pella silt loam

Setting

Landform: Nearly level areas in depressions and along drainageways on outwash plains and lake plains
Slope: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Surface layer:
0 to 11 inches—black silt loam

Subsurface layer:
11 to 13 inches—very dark gray, mottled silty clay loam

Subsoil:
13 to 27 inches—olive gray, mottled silty clay loam
27 to 39 inches—olive gray and light olive gray, mottled silt loam

Substratum:
39 to 60 inches—gray, mottled silt loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: High
Drainage class: Poorly drained
Seasonal high water table: 0.5 foot above to 2.0 feet below the surface
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: High
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Pella soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Barry soils in landscape positions similar to those of the Pella soil
• The somewhat poorly drained Kibbie soils in the slightly higher landscape positions

Similar inclusions:
• Soils that have a surface layer of loam
• Soils that have more clay in the subsoil

Use and Management

Land use: Dominant uses—cropland; other uses—pasture, woodland

Cropland

Major management concerns: Wetness, tilth, compaction
Management measures:
• Most adapted crops can be grown if an adequate drainage system is installed.
• Excess water can be removed by open ditches, subsurface drains, surface drains, pumps, or a combination of these.
• Minimizing tillage and tilling at the proper soil moisture content help to prevent excessive compaction and maintain good tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.

Pasture

Major management concerns: Wetness, compaction
Management measures:
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Ponding
Suitability:
• Because of ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding
Suitability:
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 3W
Michigan soil management group: 2.5c-s

78—Pewamo clay loam

Setting

Landform: Nearly level areas in depressions and along drainageways on till plains and moraines
Slope: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 3 to 250 acres

Typical Profile

Surface layer:
0 to 10 inches—very dark grayish brown clay loam
Subsoil:
10 to 17 inches—gray, mottled clay
17 to 48 inches—dark gray and gray, mottled clay loam
Substratum:
48 to 60 inches—gray, mottled clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow
Available water capacity: High
Drainage class: Poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Moderate
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Pewamo soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Blount and Kibbie soils in the slightly higher positions on the landscape

Similar inclusions:
• Soils that have a surface layer of loam
• Soils that have less clay in the subsoil

Use and Management

Land use: Dominant uses—cropland; other uses—woodland, pasture

Cropland

Major management concerns: Wetness, tilth, compaction
Management measures:
• Most adapted crops can be grown if an adequate drainage system is installed.
• Excess water can be removed by open ditches, subsurface drains, surface drains, pumps, or a combination of these.
• Minimizing tillage and tilling at the proper soil moisture content help to prevent excessive compaction and maintain good tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, increase the rate of water infiltration, and improve permeability.

Pasture

Major management concerns: Wetness, compaction
Management measures:
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Pasture plants that can tolerate periodic inundation and seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• Special harvest methods may be needed to control undesirable plants.
• Exposing the soil just prior to the production of a seed crop or prior to artificial seeding can help desirable tree seedlings to become established quickly and to compete better with undesirable vegetation.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Ponding
Suitability:
• Because of ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding, moderately slow permeability
Suitability:
• Because of ponding and the restricted permeability, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 3W
Michigan soil management group: 1.5c

82—Udipsamments and Udorthents, nearly level to steep

Setting

Landform: Nearly level to steep areas on flats, ridges, and knolls on outwash plains, lake plains, terraces, moraines, till plains, and flood plains
Slope: 0 to 25 percent
Shape of areas: Square, rectangular, irregular, and oval
Size of areas: 3 to 1,500 acres

Typical Profile

Udipsamments
0 to 60 inches—sand, loamy sand

Udorthents
0 to 60 inches—loam
60 to 80 inches—variable

Soil Properties and Qualities

Depth class: Very deep
Permeability: Slow to very rapid
Available water capacity: Low to high
Drainage class: Moderately well drained to excessively well drained
Depth to the water table: Variable, depending on the site
Surface runoff: Slow to rapid
Flooding: None to common
Organic matter content: Low
Hazard of soil blowing: Slight to severe
Shrink-swell potential: Low to moderate

Composition

Udipsamments, Udorthents, and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale, Oshtemo, and Kalamazoo soils in landscape positions similar to those of the major soils
• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that are somewhat poorly drained
• Soils that are poorly drained
• Soils that are ponded
• Areas of manmade materials

Use and Management

Land use: Former use—source of borrow material, oil drilling sites, cut and fill sites; current use—abandoned areas, pasture
Management measures:
• Onsite investigation is needed to determine the suitability for specific uses.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned

83—Pits, sand and gravel

Setting

Landform: Nearly level to steep areas on hills and ridges on outwash plains, lake plains, and terraces
Slope: 0 to 40 percent
Shape of areas: Square, rectangular, and irregular
Size of areas: 3 to 200 acres

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid to very rapid
Available water capacity: Low
Drainage class: Moderately well drained to excessively drained
Depth to the water table: Variable, depending on the site
Surface runoff: Slow to rapid
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Slight to severe
Shrink-swell potential: Low

Composition

Pits, sand and gravel: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The well drained Boyer, Kalamazoo, Oshtemo, and Spinks soils at the edges of the mapped areas
• Areas of loamy soils

Use and Management

Land use: Source of sand and gravel
Management measures:
• Onsite investigation is needed to determine the suitability for specific uses.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned

84—Histosols and Aquents, ponded

Setting

Landform: Nearly level areas in depressions, drainageways, and marshes on outwash plains, lake plains, terraces, moraines, till plains, and flood plains
Slope: 0 to 1 percent
Shape of areas: Irregular and oval
Size of areas: 3 to 500 acres

Typical Profile

Histosols
0 to 51 inches—muck
51 to 60 inches—variable

Aquents
0 to 60 inches—variable

Soil Properties and Qualities

Texture: Histosols—muck; Aquents—variable
Depth class: Very deep
Permeability: Moderately slow to moderately rapid
Available water capacity: Variable
Drainage class: Very poorly drained
Seasonal high water table: 2.0 feet above to 0.5 foot below the surface
Surface runoff: Ponded
Flooding: None
Organic matter content: High
Hazard of soil blowing: Slight
Shrink-swell potential: Low

Composition

Histosols and Aquents, ponded, and similar soils: 90 to 100 percent
Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:
• Small areas of poorly drained mineral soils at the edges of the mapped areas

Similar inclusions:
• Soils that have a lower water table

Use and Management

Land use: Wildlife habitat (fig. 8)
Management measures:
• Onsite investigation is needed to determine the suitability for specific uses.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned

85—Histosols and Fluvaquents, frequently flooded

Setting

Landform: Nearly level areas along rivers and streams on flood plains
Slope: 0 to 1 percent
Shape of areas: Irregular and linear
Size of areas: 3 to 400 acres

Figure 8.—Areas of Histosols and Aquents, ponded, provide good habitat for wildlife.

Typical Profile

Histosols
0 to 51 inches—muck
51 to 60 inches—variable

Fluvaquents
0 to 60 inches—variable

Soil Properties and Qualities

Texture: Histosols—muck; Fluvaquents—variable
Depth class: Very deep
Permeability: Moderately slow to moderately rapid
Available water capacity: Variable
Drainage class: Very poorly drained
Seasonal high water table: 2 feet above to 1 foot below the surface
Surface runoff: Very slow
Flooding: Frequent
Organic matter content: High
Hazard of soil blowing: Slight
Shrink-swell potential: Low

Composition

Histosols and Fluvaquents, frequently flooded, and similar soils: 90 to 100 percent
Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:
• The poorly drained Granby soils on slight rises and low knolls
• The poorly drained Sebewa soils on isolated ridges and knolls

Similar inclusions:
• Soils that have less than 16 inches of organic material

Use and Management

Land use: Woodland, wildlife habitat
Management measures:
• Onsite investigation is needed to determine the suitability for specific uses.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned

87—Hapludalfs-Udipsamments-Histosols complex, nearly level to steep

Setting

Landform: Nearly level to steep areas on flats, ridges, and knolls on outwash plains, lake plains, terraces, moraines, till plains, and flood plains
Slope: 0 to 40 percent
Shape of areas: Rectangular
Size of areas: 3 to 300 acres

Typical Profile

Hapludalfs
0 to 60 inches—variable

Udipsamments
0 to 60 inches—sand, loamy sand

Histosols
0 to 51 inches—muck
51 to 60 inches—variable

Soil Properties and Qualities

Depth class: Very deep
Permeability: Hapludalfs and Udipsamments—moderate to rapid; Histosols—moderately slow to moderately rapid
Available water capacity: Hapludalfs and Udipsamments—low to high; Histosols—high or very high
Drainage class: Hapludalfs and Udipsamments—well drained or excessively drained; Histosols—very poorly drained
Seasonal high water table: Hapludalfs and Udipsamments—at a depth of more than 60 inches; Histosols—1 foot above to 1 foot below the surface from October through June
Surface runoff: Hapludalfs and Udipsamments—very slow to rapid; Histosols—very slow or ponded
Flooding: None
Organic matter content: Hapludalfs and Udipsamments—low or moderately low; Histosols—high
Hazard of soil blowing: Hapludalfs and Udipsamments—slight or moderate; Histosols—moderate
Shrink-swell potential: Low to moderate

Composition

Hapludalfs, Udipsamments, Histosols, and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• Dumps and unexploded ammunition

Use and Management

Land use: Practice firing range for military units

Management considerations:
• This unit is generally too dangerous in its present condition for general use. Unexploded ammunition that may include bombs, bullets, grenades, mines, and shells presents a hazard for other uses.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned

90B—Coloma-Boyer loamy sands, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on outwash plains, terraces, and moraines
Shape of areas: Irregular
Size of areas: 3 to 1,000 acres

Typical Profile

Coloma

Surface layer:
0 to 8 inches—brown loamy sand

Subsurface layer:
8 to 30 inches—dark yellowish brown, yellowish brown, and brownish yellow sand

Subsoil:
30 to 56 inches—very pale brown and light yellowish brown sand that has bands of strong brown loamy sand
56 to 80 inches—pale brown sand that has bands of strong brown loamy sand

Boyer

Surface layer:
0 to 10 inches—dark brown loamy sand

Subsoil:
10 to 14 inches—yellowish brown loamy sand
14 to 29 inches—strong brown and brown sandy loam
29 to 37 inches—yellowish brown loamy sand

Substratum:
37 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Coloma—rapid; Boyer—moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Low
Drainage class: Coloma—excessively drained; Boyer—well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Coloma soil and similar soils: 55 to 60 percent
Boyer soil and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Spinks and Oshtemo soils in landscape positions similar to those of the major soils

Similar inclusions:
• Soils that are moderately well drained
• Soils that have more clay in the substratum

Use and Management

Land use: Dominant uses—pasture; other uses—cropland, woodland

Cropland

Major management concerns: Soil blowing, nutrient loss, droughtiness, low content of organic matter
Management measures:
• The hazard of soil blowing can be reduced by planting crops in narrow strips at right angles to the prevailing wind; maintaining crop residue on the surface; establishing vegetative barriers; planting field windbreaks; stripcropping; applying a system of conservation tillage, such as mulch tillage, no-till, or ridge till; limiting the width of unprotected strips; and growing a cover crop. A combination of these measures may be needed.
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and can minimize the pollution of ground water.
• Irrigation may be needed.
• Proper management of irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Including green manure crops in the cropping sequence, applying a system of no-till planting, and managing crop residue increase the content of organic matter.

Pasture

Major management concerns: Droughtiness
Management measures:
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition on the Boyer soil
• Special harvest methods may be needed to control undesirable plants.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability
Management measures:
• The poor filtering capacity of these soils can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: Coloma—2A; Boyer—4A
Michigan soil management group: Coloma—5a; Boyer—4a

90C—Coloma-Boyer loamy sands, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on outwash plains, terraces, and moraines
Shape of areas: Irregular
Size of areas: 3 to 800 acres

Typical Profile

Coloma

Surface layer:
0 to 8 inches—brown loamy sand

Subsurface layer:
8 to 30 inches—dark yellowish brown, yellowish brown, and brownish yellow sand

Subsoil:
30 to 56 inches—very pale brown and light yellowish brown sand that has bands of strong brown loamy sand
56 to 80 inches—pale brown sand that has bands of strong brown loamy sand

Boyer

Surface layer:
0 to 9 inches—dark brown loamy sand

Subsoil:
9 to 15 inches—yellowish brown loamy sand
15 to 35 inches—strong brown sandy loam
35 to 37 inches—yellowish brown loamy sand

Substratum:
37 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Coloma—rapid; Boyer—moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Low
Drainage class: Coloma—excessively drained; Boyer—well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Coloma soil and similar soils: 55 to 60 percent
Boyer soil and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in landscape positions similar to those of the major soils
• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that have more clay in the substratum

Use and Management

Land use: Dominant uses—pasture; other uses—woodland

Pasture

Major management concerns: Droughtiness
Management measures:
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition on the Boyer soil
• Special harvest methods may be needed to control undesirable plants.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Slope, cutbanks cave
Management measures:
• Some land grading may be needed.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability, slope
Management measures:
• The poor filtering capacity of these soils can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: Coloma—2A; Boyer—4A
Michigan soil management group: Coloma—5a; Boyer—4a

90D—Coloma-Boyer loamy sands, 12 to 18 percent slopes

Setting

Landform: Rolling areas on ridges and knolls on outwash plains, terraces, and moraines
Shape of areas: Irregular
Size of areas: 3 to 400 acres

Typical Profile

Coloma

Surface layer:
0 to 6 inches—dark brown loamy sand

Subsurface layer:
6 to 25 inches—dark yellowish brown, yellowish brown, and brownish yellow sand

Subsoil:
25 to 50 inches—brownish yellow and very pale brown sand that has bands of strong brown loamy sand
50 to 80 inches—pale brown sand that has bands of strong brown loamy sand

Boyer

Surface layer:
0 to 4 inches—very dark gray loamy sand

Subsoil:
4 to 17 inches—yellowish brown loamy sand
17 to 35 inches—dark yellowish brown sandy loam
35 to 37 inches—brownish yellow loamy sand

Substratum:
37 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Coloma—rapid; Boyer—moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Low
Drainage class: Coloma—excessively drained; Boyer—well drained
Depth to the water table: More than 60 inches
Surface runoff: Medium
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Coloma soil and similar soils: 55 to 60 percent
Boyer soil and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in landscape positions similar to those of the major soils

Similar inclusions:
• Soils that have more clay in the substratum

Use and Management

Land use: Dominant uses—woodland; other uses—pasture

Pasture

Major management concerns: Droughtiness
Management measures:
• Increasing the content of organic matter in the root zone may increase the ability of the soil to hold water.
• Proper stocking rates, controlled grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Plant competition on the Boyer soil
Management measures:
• Special harvest methods may be needed to control undesirable plants.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

Building sites

Major management concerns: Slope, cutbanks cave
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability, slope
Management measures:
• The poor filtering capacity of these soils can result in the pollution of ground water.
• Enlarging the lots, installing an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and using low, uniform application rates help to prevent the pollution of ground water.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: Coloma—2A; Boyer—4A
Michigan soil management group: Coloma—5a; Boyer—4a

95B—Urban land-Kalamazoo complex, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on low ridges and knolls on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 800 acres

Typical Profile

Kalamazoo

Surface layer:
0 to 9 inches—dark brown loam

Subsoil:
9 to 15 inches—dark yellowish brown loam
15 to 29 inches—dark yellowish brown and brown clay loam
29 to 35 inches—brown sandy loam
35 to 46 inches—brown gravelly loamy sand

Substratum:
46 to 60 inches—yellowish brown sand and thin strata of dark yellowish brown loamy sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part of the profile and rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Urban land: 55 to 60 percent
Kalamazoo soil and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The moderately well drained Bronson soils in landscape positions similar to those of the Kalamazoo soil
• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that have a surface layer of sandy loam
• Soils that are moderately well drained
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Urban land—streets, parking lots, building sites, and other structures; Kalamazoo—building sites, lawns, playgrounds, gardens, idle land

Gardens, lawns, and environmental plantings

Major management concerns: Kalamazoo—droughtiness, nutrient loss
Management measures:
• Perennial plants that can tolerate periodic droughty conditions should be selected.
• Irrigation is needed during years of limited precipitation.
• Applying lime and fertilizer according to soil tests helps to ensure maximum growth and minimizes the leaching of nutrients.

Building sites

Major management concerns: Kalamazoo—cutbanks cave, the shrink-swell potential
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Extending footings and foundations into the sandy substratum helps to prevent the damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Kalamazoo—rapid permeability in the substratum
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water. Municipal sewer systems should be utilized.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: Urban land—none assigned; Kalamazoo—4A
Michigan soil management group: None assigned

95C—Urban land-Kalamazoo complex, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 500 acres

Typical Profile

Kalamazoo

Surface layer:
0 to 8 inches—dark brown loam

Subsoil:
8 to 15 inches—dark yellowish brown loam
15 to 29 inches—dark yellowish brown and brown clay loam
29 to 35 inches—brown sandy loam
35 to 46 inches—brown gravelly loamy sand

Substratum:
46 to 60 inches—yellowish brown sand and thin strata of dark yellowish brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part of the profile and rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Slight
Shrink-swell potential: Moderate

Composition

Urban land: 55 to 60 percent
Kalamazoo soil and similar soils: 30 to 40 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Oshtemo soils in landscape positions similar to those of the Kalamazoo soil
• The well drained Spinks soils on side slopes and toe slopes

Similar inclusions:
• Soils that have a surface layer of sandy loam
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Urban land—streets, parking lots, building sites, other structures; Kalamazoo—building sites, lawns, playgrounds, gardens, idle land

Gardens, lawns, and environmental plantings

Major management concerns: Kalamazoo—droughtiness, nutrient loss
• Perennial plants that can tolerate periodic droughty conditions should be selected.
• Irrigation is needed during years of limited precipitation.
• Applying lime and fertilizer according to soil tests helps to ensure maximum growth and minimizes the leaching of nutrients.

Building sites

Major management concerns: Kalamazoo—cutbanks cave, slope, the shrink-swell potential
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.
• Extending footings and foundations into the sandy substratum helps to prevent the damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Kalamazoo—rapid permeability in the substratum
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water. Municipal sewage systems should be utilized.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: Urban land—none assigned; Kalamazoo—4A
Michigan soil management group: None assigned

96B—Urban land-Oshtemo complex, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 900 acres

Typical Profile

Oshtemo

Surface layer:
0 to 9 inches—dark brown sandy loam

Subsoil:
9 to 33 inches—dark yellowish brown sandy loam
33 to 47 inches—dark yellowish brown sandy loam and yellowish brown sand
47 to 70 inches—brownish yellow sand that has bands of dark yellowish brown sandy loam

Substratum:
70 to 80 inches—yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Urban land: 55 to 60 percent
Oshtemo soil and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in the higher positions on the landscape
• The well drained Kalamazoo soils in landscape positions similar to those of the Oshtemo soil

Similar inclusions:
• Oshtemo soils that have a surface layer of loamy sand
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Urban land—streets, parking lots, building sites, other structures; Oshtemo—building sites, lawns, playgrounds, gardens, idle land

Gardens, lawns, and environmental plantings

Major management concerns: Oshtemo—droughtiness, nutrient loss
• Perennial plants that can tolerate periodic droughty conditions should be selected.
• Irrigation is needed during years of limited precipitation.
• Applying lime and fertilizer according to soil tests helps to ensure maximum growth and minimizes the leaching of nutrients.

Building sites

Major management concerns: Oshtemo—cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Oshtemo—none
Management measures:
• Municipal sewer systems should be utilized.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: Urban land—none assigned; Oshtemo—4A
Michigan soil management group: None assigned

96C—Urban land-Oshtemo complex, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on outwash plains and terraces
Shape of areas: Irregular
Size of areas: 3 to 400 acres

Typical Profile

Oshtemo

Surface layer:
0 to 9 inches—dark brown sandy loam

Subsoil:
9 to 33 inches—dark yellowish brown sandy loam
33 to 47 inches—dark yellowish brown sandy loam and yellowish brown sand
47 to 70 inches—brownish yellow sand that has bands of dark yellowish brown sandy loam

Substratum:
70 to 80 inches—yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Urban land: 55 to 60 percent
Oshtemo soil and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in the higher positions on the landscape
• The well drained Kalamazoo soils in landscape positions similar to those of the Oshtemo soil

Similar inclusions:
• Oshtemo soils that have a surface layer of loamy sand
• Soils that have less clay in the subsoil
• Soils that have gravel in the substratum

Use and Management

Land use: Urban land—streets, parking lots, building sites, other structures; Oshtemo—building sites, lawns, playgrounds, gardens, idle land

Gardens, lawns, and environmental plantings

Major management concerns: Oshtemo—droughtiness, nutrient loss
• Perennial plants that can tolerate periodic droughty conditions should be selected.
• Irrigation is needed during years of limited precipitation.
• Applying lime and fertilizer according to soil tests helps to ensure maximum growth and minimizes the leaching of nutrients.

Building sites

Major management concerns: Oshtemo—cutbanks cave, slope
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

Septic tank absorption fields

Major management concerns: Oshtemo—slope
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• Municipal sewer systems should be utilized.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: Urban land—none assigned; Oshtemo—4A
Michigan soil management group: None assigned

96D—Urban land-Oshtemo complex, 12 to 18 percent slopes

Setting

Landform: Rolling areas on ridges and knolls on outwash plains and terraces
Shape of areas: Irregular and linear
Size of areas: 3 to 250 acres

Typical Profile

Oshtemo

Surface layer:
0 to 8 inches—dark brown sandy loam

Subsoil:
8 to 32 inches—dark yellowish brown sandy loam
32 to 46 inches—dark yellowish brown sandy loam and yellowish brown sand
46 to 69 inches—brownish yellow sand that has bands of dark yellowish brown sandy loam

Substratum:
69 to 80 inches—dark yellowish brown gravelly sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: More than 60 inches
Surface runoff: Moderate
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Urban land: 55 to 60 percent
Oshtemo soil and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale soils in the higher positions on the landscape

Similar inclusions:
• Oshtemo soils that have a substratum of loamy sand
• Soils that have more sand in the substratum
• Soils that have less clay in the subsoil

Use and Management

Land use: Urban land—streets, parking lots, building sites, other structures; Oshtemo—building sites, lawns, playgrounds, gardens, idle land

Gardens, lawns, and environmental plantings

Major management concerns: Oshtemo—droughtiness, nutrient loss, water erosion
• Perennial plants that can tolerate periodic droughty conditions should be selected.
• Irrigation is needed during years of limited precipitation.
• Applying lime and fertilizer according to soil tests helps to ensure maximum growth and minimizes the leaching of nutrients.
• Construction sites and other exposed areas are subject to water erosion. Sites should be stabilized as soon as possible after disturbance.

Building sites

Major management concerns: Oshtemo—slope, cutbanks cave
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Oshtemo—slope
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: Urban land—none assigned; Oshtemo—4A
Michigan soil management group: None assigned

99—Urban land

Setting

Landform: Nearly level to undulating areas on outwash plains, terraces, and moraines
Slope range: 0 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 250 acres

Composition

Urban land: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Boyer, Kalamazoo, and Oshtemo soils used as lawns, gardens, or empty lots

Use and Management

Land use: Streets, parking lots, building sites, and other structures

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management: None assigned

113B—Urban land-Coloma complex, 0 to 6 percent slopes

Setting

Landform: Nearly level to undulating areas on outwash plains, terraces, and moraines
Shape of areas: Irregular
Size of areas: 5 to 700 acres

Typical Profile

Coloma

Surface layer:
0 to 8 inches—brown loamy sand

Subsurface layer:
8 to 30 inches—dark yellowish brown, yellowish brown, and brownish yellow sand

Subsoil:
30 to 56 inches—very pale brown and light yellowish brown sand that has bands of strong brown loamy sand
56 to 80 inches—pale brown sand that has bands of strong brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Rapid
Available water capacity: Low
Drainage class: Excessively drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Urban land: 55 to 60 percent
Coloma soil and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Boyer and Oshtemo soils in landscape positions similar to those of the Coloma soil

Similar inclusions:
• Soils that are moderately well drained
• Soils that have thicker bands in the substratum
• Soils that do not have bands in the substratum

Use and Management

Land use: Urban land—streets, parking lots, building sites, other structures; Coloma—building sites, lawns, playgrounds, gardens, idle land

Gardens, lawns, and environmental plantings

Major management concerns: Coloma—droughtiness, nutrient loss
• Perennial plants that can tolerate periodic droughty conditions should be selected.
• Irrigation is needed during years of limited precipitation.
• Applying lime and fertilizer according to soil tests helps to ensure maximum growth and minimizes the leaching of nutrients.

Building sites

Major management concerns: Coloma—cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Coloma—rapid permeability
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water. Municipal sewer systems should be utilized.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: Urban land—none assigned; Coloma—2A
Michigan soil management group: None assigned

113C—Urban land-Coloma complex, 6 to 12 percent slopes

Setting

Landform: Gently rolling areas on ridges and knolls on outwash plains, terraces, and moraines
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

Surface layer:
0 to 8 inches—brown loamy sand
Subsurface layer:
8 to 30 inches—dark yellowish brown, yellowish brown, and brownish yellow sand
Subsoil:
30 to 56 inches—very pale brown and light yellowish brown sand that has bands of strong brown loamy sand
56 to 80 inches—pale brown sand that has bands of strong brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Rapid
Available water capacity: Low
Drainage class: Excessively drained
Depth to the water table: More than 60 inches
Surface runoff: Slow
Flooding: None
Organic matter content: Low
Hazard of soil blowing: Moderate
Shrink-swell potential: Low

Composition

Urban land: 55 to 60 percent
Coloma soil and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Boyer and Oshtemo soils in landscape positions similar to those of the Coloma soil
Similar inclusions:
• Soils that have thicker bands in the substratum
• Soils that do not have bands in the substratum

Use and Management

Land use: Urban land—streets, parking lots, building sites, other structures; Coloma—lawns, playgrounds, gardens, idle land

Gardens, lawns, and environmental plantings

Major management concerns: Coloma—droughtiness, nutrient loss
• Perennial plants that can tolerate periodic droughty conditions should be selected.
• Irrigation is needed during years of limited precipitation.
• Applying lime and fertilizer according to soil tests helps to ensure maximum growth and minimizes the leaching of nutrients.

Building sites

Major management concerns: Cutbanks cave
Management measures:
• Some land grading may be needed.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Coloma—rapid permeability, slope
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• Municipal sewer systems should be utilized.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: Urban land—none assigned; Coloma—2A
Michigan soil management group: None assigned

Prime Farmland

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

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

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

criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

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. 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 and all soils that are frequently flooded during the growing season qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have 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 to prevent soil-related failures in land uses.

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

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

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

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

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

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables.

Crops and Pasture

Daniel Kesselring, district conservationist, Natural Resources 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 Natural Resources 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 the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

In 1982, 228,800 acres, or about 50 percent of the land in Calhoun County, was cropland (USDA, 1982). In 1985, the county was ranked 16th in the State in terms of the number of farms (U.S. Department of Commerce, 1987). The county was the 10th largest producer of corn in the State in 1990; about 78,000 acres of corn was planted and 8.6 million bushels produced. More than 1 million bushels of wheat was grown on 21,500 acres, 1 million bushels of soybeans on 24,900 acres, and 225,000 bushels of oats on 4,700 acres (Michigan Agricultural Reporting Service, 1991). Other crops in the county include hay, barley, rye, canola, and navy beans; vegetable crops, including onions, celery, carrots, sweet corn, potatoes, pumpkins, squash, melons, and tomatoes; and fruit crops, including apples, pears, peaches, and strawberries.

Calhoun County also has a major livestock production industry. The county ranks 10th in the State in production of hogs and pigs and 14th in production of cattle and calves. In 1990, about 90 million pounds of milk was produced in the county.

The primary management concerns affecting cropland in the county are erosion, water management, nutrient management, and pesticide management. According to the 1982 National Resources Inventory, erosion was occurring on much of the cropland in the county. More than half of the cropland (about 122,300 acres) is eroding at a rate that is more rapid than the land can tolerate and still remain productive. More than

42,000 acres is eroding twice as fast as the soil can be regenerated.

Although the hazard of soil blowing is severe in some parts of the county, sheet and rill erosion caused by heavy rainfall on tilled fields accounts for most of the erosion. Sheet and rill erosion slowly removes the highly productive topsoil layer and results in decreased production potential. Agronomic practices, such as conservation cropping systems, conservation tillage, and crop residue management, are most effective in controlling sheet and rill erosion. These practices leave a protective cover of crop residue or growing plants on the surface. The vegetative cover helps to cushion the impact of raindrops during heavy storms. Cover crops help to protect the soil in areas where crops that produce little protective residue are grown. Grassed waterways and critical area plantings are needed in the more severely eroding areas.

Some soils, such as Kalamazoo loam, Morley loam, Blount loam, and Sebewa loam, are more susceptible to erosion than other soils and thus require more careful management. Other soils, such as Oshtemo sandy loam, Leoni gravelly loam, Hillsdale sandy loam, and Riddles loam, are also susceptible to erosion, especially where slopes are more than 6 percent. All of these soils occur on much of the county's best cropland.

The effects of soil blowing can be severe on the sandier soils, such as Coloma loamy sand, Spinks loamy sand, and Boyer loamy sand, but the most severe problems occur on the organic soils, such as Adrian, Palms, and Houghton mucks. Crop residue management practices can typically control soil blowing on these soils. If low-residue crops, such as some vegetable crops, are grown, however, other forms of protection from soil blowing may be needed. Examples are windbreaks, grass wind barriers, cover crops, and buffer strips.

Management of excess water is a major concern on about 18 percent of the cropland in Calhoun County. Drainage of cropland improves the air-water-temperature relationships in the root zone. Poor drainage impedes timely fieldwork and retards plant growth and development. Properly designed subsurface and surface drainage systems can remove excess water and improve field efficiency, crop growth, and net returns.

According to the 1982 National Resources Inventory, an artificial drainage system has been installed on 13 percent of the cropland in the county. Additional drainage is needed on 5 percent of the county. Nearly 40 percent of the existing drainage systems have deteriorated, are poorly designed, or are malfunctioning and need repairs or improvements. Consequently, improved drainage is needed on about 10 percent of the cropland. Any improvements must be in compliance with local, State, and Federal regulations.

Some of the important cropland soils in the county on which artificial drainage is needed for efficient crop production are Barry, Blount, Brady, Crosier, Gilford, Kibbie, Matherton, Pella, Pewamo, Sleeth, Teasdale, and Sebewa soils and the organic Adrian, Houghton, and Palms soils. Many of these soils are also considered prime farmland.

Agricultural drainage can impact important wetland ecosystems. Wetlands provide food and shelter for wildlife and are essential to the life cycle of many species. Wetlands also influence the supply and quality of water. They act as storage basins that reduce flooding along rivers and streams during periods of heavy runoff. These storage basins also help to recharge ground-water supplies. In addition, the wetlands act as natural filters that improve or maintain the quality of the water.

Wetlands are most likely in areas of the organic Adrian, Edwards, Houghton, Martisco, and Palms soils or in the mineral Algansee, Barry, Cohoctah, Gilford, Granby, Pella, Pewamo, and Sebewa soils. Wetlands may also occur in included areas of the somewhat poorly drained Blount, Brady, Crosier, Kibbie, Matherton, Sleeth, and Teasdale soils.

Adrian, Houghton, and Palms soils are used for specialty crops, such as onions, celery, carrots, and radishes. Because these organic soils tend to oxidize and subside when drained, special management of drainage systems is necessary. Maintaining the water table at the level required by crops during the growing season and then raising it to the surface during other parts of the year help to minimize oxidation and prolong the usefulness of the soils.

Insufficient water or an inadequate moisture-holding capacity is a major management concern on Boyer, Coloma, Eleva, and Spinks soils. To a lesser extent, it is also a concern on Dowagiac, Elmdale, Hillsdale, Hixton, Kalamazoo, Leoni, Oshtemo, and Riddles soils. Irrigation can be used effectively on all of these soils, but it is essential for the efficient production of crops on Boyer, Coloma, Eleva, and Spinks soils. Irrigation is practical on these soils where water is available from manmade wells or from streams, rivers, and lakes. In some areas of these soils, however, locating adequate supplies of either surface or subsurface water is difficult. Other parts of the county have abundant ground-water supplies for irrigation.

Certain conservation practices can conserve soil moisture and increase the efficiency of irrigation systems. A system of conservation tillage provides a moisture-conserving surface mulch and allows more rainfall to infiltrate the soil, thereby increasing the

amount of moisture available to plants. By minimizing the amount of tillage needed, such a system also reduces the evaporation rate. Proper management of irrigation systems includes the careful scheduling of irrigation so that water is not wasted. Also, regular maintenance of the system is needed to ensure that water is applied uniformly. The permeability of the soil and the ability of the soil to hold moisture are important factors that should be considered when an irrigation system is planned.

Soil fertility is also an important management concern in areas used for crops. Fertility is naturally medium in loamy soils and low in most sandy soils. Many sandy soils are naturally slightly acid or moderately acid. Lime and marl are needed to maintain the pH level needed for the growth of crops. Alfalfa is more sensitive to a low pH level than most crops, but management problems affecting many other crops may gradually increase as pH decreases. Testing the soils to determine pH and applying lime or marl to maintain the pH at a level near neutral are important management needs.

Although natural fertility is only low or medium in many good agricultural soils, past farming practices have raised the fertility levels so that many soils have medium or high levels of phosphorus. In some soils the level of phosphorus is excessive. Phosphorus levels in some agricultural soils have reached levels high enough to raise concerns about phosphates moving into surface water. Phosphates promote accelerated weed growth and eutrophication in surface water bodies. Current recommendations advise reduced levels of phosphorus fertilizer (Michigan State University).

Soil tilth is an important management concern in many agricultural areas in the county. Soils that have good tilth are granular and porous. Good soil tilth improves the rate of water infiltration, improves seed germination and root development, minimizes surface crusting, improves soil structure, and makes the soil easier to till.

Maintaining good soil structure is the primary tilth problem on the medium textured or moderately fine textured soils, such as Barry, Blount, Crosier, Kibbie, Matherton, Morley, Pewamo, Pella, Sebewa, and Sleeth loams. These soils are more likely to stay wet later in the spring and after rains. If tilled when wet, they tend to become compacted and very cloddy when they dry. As a result, preparing a good seedbed is difficult, the germination of seeds is hindered, and crop yields can be reduced. Cover crops, green manure crops, crop residue management, conservation tillage, manure, and drainage systems improve tilth.

Soil structure can also be a problem in the moderately coarse textured, well drained sandy loams. These soils can have a low content of organic matter and may have weak structure. During periods of heavy rain, a surface crust can form that dries and hardens following the rain. This crust can impede crop emergence and increase the runoff rate, thereby reducing crop yields. Practices that increase and maintain the content of organic matter in the surface layer, such as conservation tillage, cover crops and green manure crops, and crop rotations, can improve tilth and minimize crusting.

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 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.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

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

Crops other than those shown in table 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 Natural Resources 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. 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 (USDA, 1961). 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 or 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 hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

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

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units" and in the yields table.

At the end of each map unit description under the heading "Detailed Soil Map Units," the Michigan soil management group is listed. The soils in each map unit are assigned to a group according to the dominant texture, the drainage class, and the main management concerns (Mokma and others, 1978). More detailed information about these groups is available from the local office of the Michigan State University Cooperative Extension Service.

Woodland Management and Productivity

Virgin forest once covered most of Calhoun County, but the trees have been cleared from most of the land that is suitable for farming. The remaining woodlands are mostly in areas that are too wet, too steep, or too sandy for cultivation.

About 62,000 acres in the county, or nearly 14 percent of the total acreage, is wooded. Common tree species in areas of well drained soils are red maple, American beech, northern red oak, black cherry, quaking aspen, bigtooth aspen, and white ash. Some of the soils associated with these species are Boyer, Hillsdale, Kalamazoo, Morley, Oshtemo, Riddles, and Spinks soils. Common species in areas of moderately well drained to somewhat poorly drained soils, such as Blount, Brady, Bronson, and Matherton soils, are sugar maple, American beech, northern red oak, basswood, and red maple. Trees in poorly drained or very poorly drained areas include green ash, American elm, silver maple, swamp white oak, and basswood. Soils associated with these areas are Adrian, Gilford, Houghton, Palms, and Sebewa soils. Most of the American elm trees have succumbed to Dutch elm disease.

Pine plantations have been established on the sandier and steeper soils. The major species are Scotch pine, red pine, and eastern white pine. Examples of the soils in these areas are Spinks and Coloma soils.

Many of the woodlands can be improved by thinning and by applying other woodland management practices, such as controlling erosion, controlling competing vegetation, improving the seedling survival rate, minimizing the hazard of windthrow, harvesting in a timely manner, controlling insects and disease, removing poorly formed trees and undesirable species, and maintaining the optimum basal area.

Table 8 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 soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

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

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

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

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

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

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site

index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand. The volume was determined through the use of standard yield tables (USDA/NRCS).

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

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

Windbreaks and Environmental Plantings

The hazard of soil blowing is severe on sandy soils that are used for row crops in Calhoun County. In many years, windstorms during April and May can remove as much as 15 tons of soil from areas of these soils. In addition to soil losses, many young plants can be severely damaged by the windblown soil particles.

Windbreaks protect livestock, buildings, and yards from wind and snow. They shelter an area downwind equal to about 10 times the height of the windbreak. The sheltering effect minimizes soil losses and crop damage, reduces the evapotranspiration rate, prevents livestock exposure, minimizes farmstead damage, and reduces home heating costs. Windbreaks also provide shelter, food, and nesting areas for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

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

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

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Personnel from the Calhoun County Department of Planning helped prepare this section.

More than 1,200 acres in Calhoun County is designated as public and private recreational areas. Included are playgrounds, campgrounds, public and private golf courses, picnic areas, and hiking trails. County and city governments operate a number of parks, and the county has a fairgrounds.

There are 19 lakes in the county, which provide boat launches, fishing areas, and swimming areas. The county also has cross-country ski trails, ice rinks, and sledding areas.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping

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

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

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

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

Wildlife Habitat

Lynn C. Sampson, biologist, Natural Resources Conservation Service, helped prepare this section.

The habitat for wildlife in Calhoun County is diverse. It ranges from heavily wooded areas to open farmland. Many streams, inland lakes, and diverse wetlands support a variety of fish and wildlife.

Before the county was settled, many species of wildlife, such as black bear, mountain lion, bobcat, and timber wolf, roamed the area. The passenger pigeon and eastern wild turkey were abundant in the forests. As agricultural development progressed, wildlife species that were adapted to second-growth forest and brushy edge habitat became more abundant. The populations of white-tailed deer, red fox, cottontail rabbit, and raccoon increased.

The heavily wooded areas support white-tailed deer and eastern wild turkey. These areas also provide food and cover for raccoons, skunks, tree squirrels, cardinals, wrens, woodpeckers, and mice. The farmed areas and associated idle areas of grass and brush are inhabited by pheasants, quail, cottontail rabbit, woodchucks, red fox, gray fox, opossum, hawk, owls, and numerous songbirds. The woodland streams and diverse wetlands support blue herons, green herons, sandhill cranes, belted kingfishers, woodcock, marsh hawks, muskrats, and mink. The streams and lakes of the county support good populations of sunfish, perch, largemouth bass, smallmouth bass, northern pike, and bullhead.

The plant and animal communities of Calhoun County include many species recognized by the State of Michigan as rare, threatened, or endangered. These are the least shrew, ironcolor shiner, king rail, Indiana bat, prairie false indigo, white lady-slipper, flattened spike-rush, golden seal, and whorled pogonia.

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

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and

features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, rye, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, reed canarygrass, bromegrass, red clover, alfalfa, redtop, and orchardgrass.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are nightshade, ragweed, dandelion, wild carrot, thistle, goldenrod, and lambsquarters.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, aspen, maple, cherry, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are honeysuckle, dogwood, silver buffaloberry, Russian-olive, autumn-olive, American cranberrybush, and crabapple.

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

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

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

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

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, ring-necked 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 opossum, wild turkey, warblers, woodcock, thrushes, woodpeckers, 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, 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. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

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

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

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

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey,

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

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

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

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

Building Site Development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and 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, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

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

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, 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 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations

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

Table 13 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

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

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

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

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit

revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of 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. They are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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 high water table at or near the surface.

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

Water Management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and 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, and grassed waterways.

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

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

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

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

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 and permeability of the aquifer. Depth to bedrock and the content of large stones affect 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 bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. Availability of drainage outlets is not considered in the ratings.

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

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

Soil Properties

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 to characterize key soils.

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

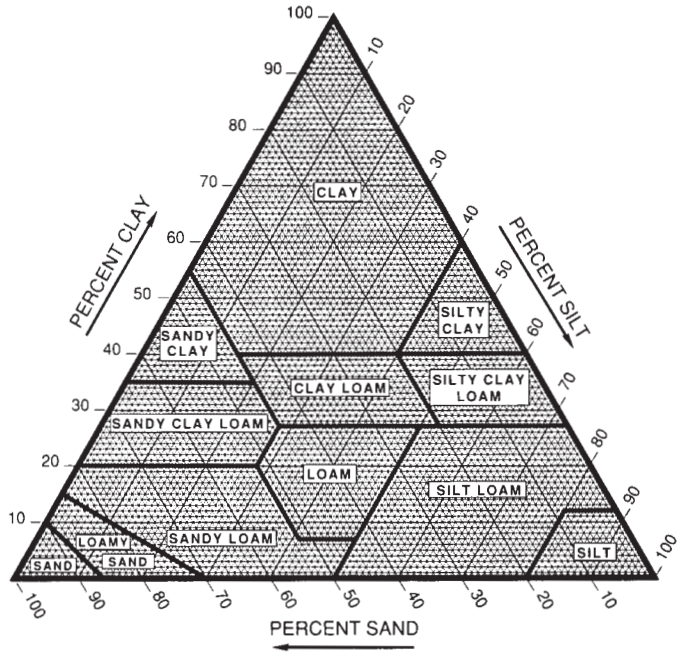

Figure 9.—Percentages of clay, sand, and silt in the basic USDA soil textural classes.

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "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. 9). "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 (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

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, SP-SM.

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 fragrnents 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

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

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

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

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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

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 classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

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

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

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

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained

sands or gravelly sands. These soils have a high rate of water transmission.

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

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

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

If a soil is assigned to two hydrologic groups in table 18, the first letter is for drained areas and the second is for undrained areas.

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

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). *Common* is used when the occasional and frequent classes are grouped for certain purposes. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

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 little or no horizon development.

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 estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

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

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

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

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 18 shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

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 results in a severe hazard of corrosion. 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 and acidity in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 19 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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

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

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

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

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

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

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

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

Adrian Series

The Adrian series consists of very deep, very poorly drained soils in swales and depressions on moraines, till plains, and outwash plains. These soils formed in 16 to 51 inches of organic material overlying sandy

outwash and glacial till. Permeability is moderately slow to moderately rapid in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Adrian muck, 2,280 feet south and 680 feet west of the northeast corner of sec. 33, T. 3 S., R. 7 W.

Oa1—0 to 7 inches; muck, black (N 2/0) broken face and rubbed; about 4 percent fiber, about 2 percent rubbed; moderate fine granular structure; very friable; common very fine and fine roots; strongly acid; abrupt wavy boundary.

Oa2—7 to 17 inches; muck, black (5YR 2.5/1) broken face and very dark brown (10YR 2/2) rubbed; about 7 percent fiber, about 4 percent rubbed; weak medium angular blocky structure parting to weak very coarse granular; friable; common fine and few medium roots; strongly acid; gradual wavy boundary.

Oa3—17 to 25 inches; muck, black (10YR 2/1) and very dark brown (10YR 2/2) rubbed; about 10 percent fiber, about 2 percent rubbed; weak fine and medium angular blocky structure; very friable; common fine and few medium roots; strongly acid; abrupt wavy boundary.

Cg—25 to 60 inches; dark grayish brown (10YR 4/2) sand; single grain; loose; slightly acid.

The organic material is 16 to 51 inches thick.

The surface tier is typically muck, but the range includes mucky peat. The surface and subsurface tiers have hue of 5YR to 10YR or are neutral in hue. They have value of 2, 2.5, or 3 and chroma of 0 or 1. The subsurface tiers are typically muck, but some pedons have up to 10 inches of mucky peat.

The Cg horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is dominantly sand, but the range includes fine sand, loamy sand, and the gravelly analogs of these textures.

Algansee Series

The Algansee series consists of very deep, somewhat poorly drained, rapidly permeable soils on outwash plains and flood plains. These soils formed in sandy alluvial material. Slopes range from 0 to 2 percent.

Typical pedon of Algansee fine sand, occasionally flooded, 1,040 feet west and 2,560 feet south of the northeast corner of sec. 18, T. 4 S., R. 7 W.

A—0 to 9 inches; black (10YR 2/1) fine sand, very dark gray (10YR 3/1) dry; common fine prominent dark brown (7.5YR 3/4) mottles; moderate medium granular structure; very friable; common very fine to medium and few coarse roots; about 2 percent gravel; strongly acid; abrupt wavy boundary.

C1—9 to 17 inches; brown (10YR 4/3) fine sand; common fine distinct brown (7.5YR 4/2) mottles; weak medium fine subangular blocky structure; very friable; common very fine to coarse roots; about 1 percent gravel; moderately acid; abrupt wavy boundary.

C2—17 to 30 inches; brown (10YR 5/3) sand; common medium faint dark yellowish brown (10YR 4/4) mottles; weak medium granular structure; very friable; common very fine to medium and few coarse roots; about 1 percent gravel; moderately acid; clear wavy boundary.

Cg1—30 to 35 inches; dark grayish brown (10YR 4/2) sand; common fine and medium prominent brownish yellow (10YR 6/6) and common fine prominent dark yellowish brown (10YR 4/6) mottles; single grain; loose; common very fine to medium and few coarse roots; about 2 percent gravel; neutral; clear wavy boundary.

Cg2—35 to 39 inches; grayish brown (10YR 5/2) sand; common medium and coarse prominent dark reddish brown (5YR 3/4) and common fine prominent yellowish brown (10YR 5/8) mottles; single grain; loose; few fine to coarse roots; common distinct very dark brown (10YR 2/2) patchy organic coatings; about 1 percent gravel; neutral; clear wavy boundary.

C'1—39 to 52 inches; brown (10YR 5/3) sand; few fine prominent strong brown (7.5YR 5/8) and common fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; common fine to coarse roots; few distinct black (10YR 2/1) and very dark brown (10YR 2/2) continuous organic coatings; about 3 percent gravel; neutral; clear wavy boundary.

C'2—52 to 60 inches; pale brown (10YR 6/3) coarse sand; few fine prominent dark brown (7.5YR 3/2) and common fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; common fine to coarse roots; about 3 percent gravel; slightly effervescent; slightly alkaline.

The content of gravel ranges from 1 to 3 percent throughout the profile.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly fine sand, but the range includes loamy fine sand and loamy sand.

The C horizons have hue of 10YR, value of 4 to 6, and chroma of 2 to 4. They are fine sand, sand, and coarse sand and have thin strata of loam and sandy loam.

Barry Series

The Barry series consists of very deep, poorly drained, moderately permeable soils on till plains and moraines. These soils formed in loamy glacial till. Slopes range from 0 to 2 percent.

Typical pedon of Barry loam, 220 feet east and 2,460 feet north of the southwest corner of sec. 34, T. 1 S., R. 4 W.

A1—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine and medium granular structure; very friable; common very fine to coarse roots; neutral; clear wavy boundary.

A2—9 to 14 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; common fine prominent yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; very friable; few coarse and common fine and very fine roots; about 1 percent gravel; neutral; abrupt wavy boundary.

Btg—14 to 24 inches; dark gray (10YR 4/1) loam; common fine prominent dark yellowish brown (10YR 4/6) mottles; moderate medium and coarse subangular blocky structure; firm; common coarse and fine and few very fine roots; very few faint dark gray (10YR 4/1) clay films on vertical faces of peds; about 3 percent cobbles; neutral; clear wavy boundary.

Bt—24 to 29 inches; brown (10YR 5/3) sandy loam; common coarse prominent strong brown (7.5YR 5/8) and yellowish red (5YR 5/8) and common fine prominent grayish brown (2.5Y 5/2) mottles; weak medium and coarse subangular blocky structure; very friable; common fine and few very fine roots; very few distinct brownish yellow (10YR 6/6) patchy clay bridges between sand grains; about 1 percent gravel; slightly alkaline; abrupt wavy boundary.

B'tg—29 to 40 inches; light brownish gray (2.5Y 6/2) loam; common coarse prominent yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; few very fine roots; very few faint grayish brown (2.5Y 5/2) clay films on vertical faces of peds; about 1 percent gravel; slightly alkaline; clear wavy boundary.

BCg—40 to 46 inches; light brownish gray (10YR 6/2) sandy loam; common medium and coarse prominent yellowish brown (10YR 5/8) and common medium prominent dark yellowish brown (10YR 4/6) mottles; weak fine and medium subangular blocky structure; friable; about 1 percent gravel; slightly alkaline; clear irregular boundary.

C—46 to 60 inches; brown (10YR 5/3) sandy loam; common fine and medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; about 1 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 36 to 50 inches. The content of gravel and cobbles ranges from 1 to 10 percent throughout the profile.

The A horizon is 10 to 15 inches thick. It has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The Bt horizons have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. They are dominantly loam and have subhorizons of sandy loam.

The C horizon has hue of 10YR, value of 5, and chroma of 1 to 3. It is sandy loam or loam.

Blount Series

The Blount series consists of very deep, somewhat poorly drained, slowly permeable soils on till plains and moraines. These soils formed in calcareous, loamy glacial till. Slopes range from 1 to 4 percent.

Typical pedon of Blount loam, 1 to 4 percent slopes, 80 feet east and 1,460 feet south of the northwest corner of sec. 25, T. 1 S., R. 5 W.

Ap—0 to 8 inches; brown (10YR 4/3) loam, light yellowish brown (10YR 6/4) dry; moderate medium granular structure; friable; common fine and medium roots; 5 percent mixing of material from the Bt horizon; about 5 percent gravel and 2 percent cobbles; slightly acid; abrupt smooth boundary.

Bt1—8 to 11 inches; dark yellowish brown (10YR 4/4) clay; common medium prominent strong brown (7.5YR 5/8) and common medium and fine prominent light brownish gray (2.5Y 6/2) mottles; moderate medium subangular blocky structure; firm; common fine roots; common prominent light brownish gray (2.5Y 6/2) clay films on vertical and horizontal faces of peds; brown (10YR 4/3) coatings of material from the Ap horizon in root channels; about 3 percent gravel; slightly acid; gradual smooth boundary.

Bt2—11 to 14 inches; brown (10YR 5/3) clay; common medium and coarse distinct grayish brown (2.5Y 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; brown (10YR 4/3) coatings of material from the Ap horizon in root channels; about 2 percent gravel; neutral; gradual smooth boundary.

Bt3—14 to 21 inches; brown (10YR 4/3) clay; common medium prominent yellowish brown (10YR 5/8) and common medium distinct grayish brown (2.5Y 5/2)

mottles; moderate medium angular blocky structure parting to moderate fine and medium subangular blocky; firm; few fine roots; common faint dark grayish brown (10YR 4/2) and light brownish gray (10YR 6/2) clay films on vertical and horizontal faces of peds; about 5 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

BC—21 to 48 inches; dark yellowish brown (10YR 4/4) clay loam; common medium prominent grayish brown (2.5Y 5/2) and common fine prominent strong brown (7.5YR 5/8) mottles; moderate fine and medium angular blocky structure; firm; light gray (10YR 7/1) carbonate coatings on faces of peds; about 5 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—48 to 60 inches; dark yellowish brown (10YR 4/4) clay loam; common medium prominent grayish brown (2.5Y 5/2) and common fine prominent strong brown (7.5YR 5/8) mottles; massive; firm; about 1 percent gravel; strongly effervescent; slightly alkaline.

The thickness of the solum ranges from 20 to 50 inches. The content of gravel ranges from 0 to 5 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3.

The Bt and BC horizons have hue of 10YR, value of 3 to 5, and chroma of 2 to 4. They are clay loam, silty clay loam, or clay.

The C horizon has colors similar to those of the B horizons. It is clay loam or silty clay loam.

Boyer Series

The Boyer series consists of very deep, well drained soils on outwash plains and terraces. These soils formed in sandy and loamy outwash material. Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Slopes range from 0 to 40 percent.

Typical pedon of Boyer sandy loam, 0 to 6 percent slopes, 150 feet south and 145 feet west of the northeast corner of sec. 7, T. 1 S., R. 6 W.

Ap—0 to 10 inches; dark brown (10YR 3/3) sandy loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure parting to weak coarse granular; friable; common very fine to medium roots; about 3 percent gravel; neutral; abrupt smooth boundary.

E—10 to 14 inches; yellowish brown (10YR 5/6) loamy sand; weak medium subangular blocky structure; very friable; few fine and very fine roots; about 5 percent gravel; slightly acid; clear smooth boundary.

Bt1—14 to 20 inches; strong brown (7.5YR 4/6) sandy loam; weak medium subangular blocky structure; very friable; few fine roots; few distinct brown (7.5YR 4/4) clay bridges between sand grains; about 5 percent gravel; neutral; clear wavy boundary.

Bt2—20 to 29 inches; brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure parting to weak medium subangular blocky; friable; common faint brown (7.5YR 4/4) clay bridges between sand grains; about 3 percent gravel; slightly acid; clear irregular boundary.

BC—29 to 37 inches; yellowish brown (10YR 5/6) loamy sand; weak fine and medium subangular blocky structure; very friable; about 2 percent gravel; slightly alkaline; clear wavy boundary.

2C—37 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; few strata of yellowish brown (10YR 5/8) loamy sand and pockets of yellowish brown (10YR 5/6) gravelly sand; about 5 percent gravel; slightly effervescent; moderately alkaline.

The thickness of the solum and the depth to the 2C horizon range from 24 to 40 inches. The content of gravel ranges from 2 to 20 percent in the solum and from 2 to 25 percent in the 2C horizon.

The Ap horizon has hue of 10YR, value of 3, and chroma of 2 or 3. It is sandy loam or loamy sand. The E horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6.

The Bt horizons have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. They are dominantly sandy loam, but the range includes gravelly sandy loam. Some pedons have an E and Bt horizon or a Bt and E horizon below the Bt horizon.

The BC horizon has hue of 5YR to 10YR and value and chroma of 4 to 6. It is dominantly loamy sand, but the range includes gravelly loamy sand and loamy coarse sand.

The 2C horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is sand, coarse sand, or gravelly sand.

Brady Series

The Brady series consists of very deep, somewhat poorly drained soils on outwash plains and terraces. These soils formed in loamy and sandy outwash material. Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Slopes range from 1 to 4 percent.

Typical pedon of Brady sandy loam, 1 to 4 percent slopes, 1,850 feet west and 2,000 feet north of the southeast corner of sec. 10, T. 3 S., R. 6 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) sandy loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure parting to moderate coarse granular; friable; common fine and medium roots; slightly acid; abrupt smooth boundary.

Bt1—9 to 15 inches; yellowish brown (10YR 5/4) sandy loam; common medium distinct yellowish brown (10YR 5/6) and common medium prominent grayish brown (2.5Y 5/2) and strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; friable; common fine and few very fine roots; common distinct grayish brown (10YR 5/2) continuous clay bridges between sand grains; about 1 percent gravel; neutral; clear wavy boundary.

Bt2—15 to 23 inches; yellowish brown (10YR 5/4) sandy loam; common medium distinct light brownish gray (10YR 6/2) and dark yellowish brown (10YR 4/6) and common fine distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; friable; few very fine and medium roots; common distinct light brownish gray (10YR 6/2) clay bridges between sand grains; about 1 percent gravel; neutral; clear wavy boundary.

Bt3—23 to 33 inches; brown (10YR 5/3) sandy loam; common medium faint light brownish gray (10YR 6/2) and common medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; few medium roots; common faint light brownish gray (10YR 6/2) clay bridges between sand grains; neutral; clear wavy boundary.

BC—33 to 38 inches; brownish yellow (10YR 6/6) loamy sand; few medium distinct light gray (10YR 7/2) and common medium prominent strong brown (7.5YR 4/6) mottles; weak medium subangular blocky structure parting to weak medium granular; very friable; about 5 percent gravel and cobbles; neutral; abrupt smooth boundary.

2C—38 to 60 inches; yellowish brown (10YR 5/4) sand; common medium distinct grayish brown (10YR 5/2) and brownish yellow (10YR 6/8) and few fine prominent strong brown (7.5YR 4/6) mottles; single grain; loose; neutral.

The thickness of the solum ranges from 36 to 55 inches. The content of gravel ranges from 0 to 10 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3, and chroma of 2 or 3. It is dominantly sandy loam, but the range includes loamy sand.

The Bt horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. Some pedons do not have a BC horizon.

The 2C horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4.

Bronson Series

The Bronson series consists of very deep, moderately well drained, moderately rapidly permeable soils on outwash plains and terraces. These soils formed in loamy outwash material overlying sandy outwash material. Slopes range from 0 to 6 percent.

Typical pedon of Bronson sandy loam, 0 to 6 percent slopes, 200 feet east and 100 feet north of the southwest corner of sec. 15, T. 4 S., R. 5 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) sandy loam, light gray (10YR 7/2) dry; moderate medium granular structure; friable; common very fine and fine roots; about 5 percent gravel; slightly acid; abrupt smooth boundary.

BE—8 to 14 inches; yellowish brown (10YR 5/4) sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; very friable; common very fine and fine roots; about 5 percent gravel; neutral; clear wavy boundary.

Bt1—14 to 20 inches; yellowish brown (10YR 5/4) sandy loam; few fine prominent strong brown (7.5YR 5/8), few fine distinct yellowish brown (10YR 5/6), and common medium faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; very friable; common very fine and few fine roots; few distinct brown (10YR 4/3) clay bridges between sand grains; about 5 percent gravel; neutral; clear wavy boundary.

Bt2—20 to 30 inches; yellowish brown (10YR 5/6) sandy loam; common medium distinct pale brown (10YR 6/3), common fine and medium prominent strong brown (7.5YR 5/8), and common medium prominent grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure parting to moderate medium subangular blocky; friable; common very fine roots; common distinct brown (10YR 4/3) clay bridges between sand grains; about 5 percent gravel; neutral; gradual wavy boundary.

Bt3—30 to 37 inches; yellowish brown (10YR 5/6) sandy clay loam; common medium prominent yellowish red (5YR 5/8) and strong brown (7.5YR 5/8), common coarse distinct grayish brown (10YR 5/2), and common medium distinct pale brown (10YR 6/3) mottles; moderate medium subangular blocky structure; friable; common very fine roots; few distinct brown (10YR 4/3) patchy clay bridges between sand grains; about 5 percent gravel; neutral; clear wavy boundary.

Bt4—37 to 44 inches; brown (10YR 5/3) sandy loam; common medium prominent yellowish red (5YR 5/8) and strong brown (7.5YR 5/8), common medium faint pale brown (10YR 6/3), and common coarse faint grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; friable; few very fine roots; common faint dark yellowish brown (10YR 4/4) clay coatings on vertical faces of peds; about 5 percent gravel; neutral; abrupt smooth boundary.

BC—44 to 47 inches; brown (10YR 4/3) loamy sand; common fine prominent strong brown (7.5YR 5/8) and common medium faint dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; friable; about 10 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

2C—47 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; about 20 percent gravel; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 40 to 50 inches. The content of gravel ranges from 0 to 10 percent in the solum and from 10 to 25 percent in the 2C horizon.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is sandy loam or sandy clay loam.

The 2C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3. It is sand or gravelly coarse sand.

Cohoctah Series

The Cohoctah series consists of very deep, poorly drained, moderately rapidly permeable soils on flood plains. These soils formed in loamy alluvial material. Slopes range from 0 to 2 percent.

Typical pedon of Cohoctah loam, gravelly substratum, frequently flooded, 1,460 feet west and 120 feet north of the southeast corner of sec. 27, T. 4 S., R. 6 W.

A—0 to 11 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; few medium distinct brown (10YR 4/3) mottles; moderate fine subangular blocky structure: friable; common fine and medium roots; about 5 percent gravel; moderately acid; abrupt smooth boundary.

Cg1—11 to 29 inches; gray (10YR 5/1) loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; friable; common fine and medium roots; about 5 percent gravel; slightly alkaline; clear wavy boundary.

Cg2—29 to 32 inches; grayish brown (10YR 5/2) sandy loam; common medium prominent yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; common medium roots; about 5 percent gravel; slightly alkaline; clear wavy boundary.

Cg3—32 to 38 inches; dark gray (10YR 4/1) loamy sand; common medium distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; very friable; common fine and few medium roots; slightly effervescent; slightly alkaline; clear wavy boundary.

2Cg4—38 to 60 inches; gray (10YR 5/1) gravelly sand; single grain; loose; about 15 percent gravel; effervescent; moderately alkaline.

The content of gravel ranges from 0 to 10 percent in the solum and from 10 to 25 percent in the 2Cg horizon.

The A horizon is 10 to 14 inches thick. It has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly loam, but the range includes silt loam and sandy loam.

The Cg horizon has hue of 10YR or 7.5YR, value of 3 to 6, and chroma of 1 to 3. It is loam, sandy loam, or loamy sand.

The 2Cg horizon has colors similar to those of the Cg horizon. It is sand or gravelly sand.

Coloma Series

The Coloma series consists of very deep, excessively drained, rapidly permeable soils on outwash plains, terraces, and moraines. These soils formed in sandy glacial drift. Slopes range from 0 to 40 percent.

Typical pedon of Coloma loamy sand, 0 to 6 percent slopes, 1,200 feet west and 1,100 feet north of the southeast corner of sec. 24, T. 2 S., R. 8 W.

Ap—0 to 8 inches; brown (10YR 4/3) loamy sand, grayish brown (10YR 5/2) dry; weak coarse granular structure; very friable; common very fine and fine and few medium roots; strongly acid; abrupt smooth boundary.

E1—8 to 10 inches; dark yellowish brown (10YR 4/6) sand; weak very coarse granular structure; very friable; few fine roots; moderately acid; clear wavy boundary.

E2—10 to 16 inches; yellowish brown (10YR 5/6) sand; single grain; loose; few very fine roots; moderately acid; gradual wavy boundary.

E3—16 to 30 inches; brownish yellow (10YR 6/6) sand; single grain; loose; few very fine roots; slightly acid; clear wavy boundary.

E and Bt1—30 to 56 inches; very pale brown (10YR 7/4) and light yellowish brown (10YR 6/4) sand (E); single grain; loose; lamellae of strong brown (7.5YR 5/6) loamy sand (Bt) ⅛ to ¼ inch thick; weak medium subangular blocky structure; friable; few very fine roots; common distinct brown (7.5YR 4/4) clay bridges between sand grains; moderately acid; gradual wavy boundary.

E and Bt2—56 to 80 inches; pale brown (10YR 6/3) sand (E); single grain; loose; lamellae of strong brown (7.5YR 5/6) loamy sand (Bt) ⅛ to ¼ inch thick; weak medium subangular blocky structure; friable; common prominent brown (7.5YR 4/4) clay bridges between sand grains; moderately acid.

The thickness of the solum ranges from 50 to more than 80 inches. The combined thickness of the lamellae is about 4½ inches.

The Ap horizon has hue of 7.5YR or 10YR, value of 2 to 4, and chroma of 1 to 3. The E horizon has hue of 10YR and value and chroma of 4 to 6.

The Bt part of the E and Bt horizon has hue of 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is sandy loam or loamy sand. The E part of the E and Bt horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 4 to 6. Depth to the first lamella ranges from 27 to 38 inches.

Crosier Series

The Crosier series consists of very deep, somewhat poorly drained, moderately slowly permeable soils on till plains and moraines. These soils formed in loamy glacial till. Slopes range from 1 to 4 percent.

Typical pedon of Crosier loam, 1 to 4 percent slopes, 1,190 feet west and 1,300 feet south of the northeast corner of sec. 36, T. 4 S., R. 7 W.

Ap—0 to 10 inches; dark brown (10YR 3/3) loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; common very fine and fine and few medium roots; about 5 percent gravel; neutral; abrupt smooth boundary.

Bt1—10 to 21 inches; brown (10YR 5/3) loam; common medium distinct dark yellowish brown (10YR 4/6) and common coarse faint distinct dark grayish brown (10YR 4/2) mottles; moderate medium and coarse subangular blocky structure; firm; common fine and few medium roots; common faint grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

Bt2—21 to 28 inches; grayish brown (10YR 5/2) loam; common medium prominent dark yellowish brown (10YR 4/6), common fine prominent yellowish brown (10YR 5/8), and many medium faint dark grayish brown (10YR 4/2) mottles; moderate coarse and very coarse subangular blocky structure; firm; few fine and medium roots; common faint dark grayish brown (10YR 4/2) clay films on vertical and horizontal faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bt3—28 to 36 inches; brown (10YR 5/3) loam; common medium prominent strong brown (7.5YR 5/8) and many coarse faint grayish brown (10YR 5/2) mottles; moderate medium and coarse subangular blocky structure; friable; few very fine and fine roots; common faint dark grayish brown (10YR 4/2) clay films on vertical and horizontal faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

BC—36 to 42 inches; yellowish brown (10YR 5/4) sandy loam; common medium prominent strong brown (7.5YR 5/8) and common fine distinct grayish brown (10YR 5/2) mottles; weak medium and coarse subangular blocky structure; friable; few very fine and fine roots; about 3 percent gravel; neutral; gradual wavy boundary.

C1—42 to 50 inches; brown (10YR 5/3) sandy loam; common fine and medium faint yellowish brown (10YR 5/4), common medium distinct yellowish brown (10YR 5/6), and common fine faint grayish brown (10YR 5/2) mottles; massive; friable; few very fine and fine roots; about 5 percent gravel; slightly effervescent; moderately alkaline; gradual wavy boundary.

C2—50 to 55 inches; brown (10YR 5/3) loam; many medium faint grayish brown (10YR 5/2), many medium distinct yellowish brown (10YR 5/6), and common medium distinct gray (10YR 5/1) mottles; massive; firm; about 5 percent gravel; slightly effervescent; moderately alkaline; gradual wavy boundary.

C3—55 to 60 inches; brown (10YR 5/3) sandy loam; many medium faint grayish brown (10YR 5/2) and many coarse distinct yellowish brown (10YR 5/6) mottles; massive; firm; about 5 percent gravel; slightly effervescent; moderately alkaline.

The thickness of the solum ranges from 25 to 45 inches. The content of gravel ranges from 2 to 10 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It is dominantly loam, but the range includes sandy loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 3

to 6, and chroma of 2 to 6. It is sandy clay loam, loam, or clay loam.

The C horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. It is sandy loam or loam.

Dowagiac Series

The Dowagiac series consists of very deep, well drained soils on outwash plains and terraces. These soils formed in loamy material over sandy material. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Dowagiac loam, 0 to 2 percent slopes, 1,240 feet east and 2,520 feet north of the southwest corner of sec. 1, T. 4 S., R. 5 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; common fine and medium and many very fine roots; about 5 percent gravel; neutral; abrupt smooth boundary.

Bt1—9 to 14 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine and medium subangular blocky structure; friable; common very fine and few fine roots; common faint dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; about 5 percent gravel; neutral; clear smooth boundary.

Bt2—14 to 21 inches; strong brown (7.5YR 4/6) clay loam; moderate fine and medium subangular blocky structure; firm; few fine and common very fine roots; common prominent dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bt3—21 to 25 inches; yellowish brown (10YR 5/6) sandy clay loam; moderate fine and medium subangular blocky structure; friable; few fine roots; many prominent dark brown (7.5YR 3/4) continuous clay films on vertical and horizontal faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bt4—25 to 34 inches; dark brown (7.5YR 3/4) sandy loam; weak medium and coarse subangular blocky structure; very friable; few fine roots; common faint dark brown (7.5YR 3/4) continuous clay bridges between sand grains; about 10 percent gravel; neutral; gradual wavy boundary.

2BC1—34 to 40 inches; strong brown (7.5YR 4/6) sand; single grain; loose; few fine roots; few strata of dark brown (7.5YR 3/4) loamy sand; about 5 percent gravel; neutral; abrupt wavy boundary.

2BC2—40 to 44 inches; dark yellowish brown (10YR 3/4) gravelly loamy sand; weak fine and medium subangular blocky structure; very friable; few fine roots; about 15 percent gravel; neutral; clear wavy boundary.

2C—44 to 60 inches; yellowish brown (10YR 5/6) very gravelly coarse sand; single grain; loose; about 40 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 40 to 50 inches. The depth to the sandy material ranges from 30 to 40 inches. The content of gravel ranges from 5 to 20 percent in the solum and from 15 to 50 percent in the 2C horizon.

The Ap horizon has hue of 10YR and value and chroma of 2 or 3. It is dominantly loam, but the range includes sandy loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 3 to 6. It is loam, clay loam, sandy clay loam, or sandy loam. The 2BC horizon has value of 3 or 4 and chroma of 3 to 6. It is sand, coarse sand, gravelly coarse sand, or gravelly loamy sand. Some pedons do not have a BC horizon.

The 2C horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It is sand or coarse sand and the gravelly or very gravelly analogs of these textures.

Edwards Series

The Edwards series consists of very deep, very poorly drained soils in depressions in old lakebeds on outwash plains and till plains. These soils formed in organic material 17 to 51 inches thick over marl. Permeability ranges from moderately slow to moderately rapid in the organic material. Slopes range from 0 to 2 percent.

Typical pedon of Edwards muck, 1,700 feet west and 175 feet north of the southeast corner of sec. 14, T. 3 S., R. 7 W.

Oa1—0 to 5 inches; muck, black (N 2/0) broken face and rubbed; about 6 percent fiber, less than 2 percent rubbed; moderate fine and medium subangular blocky structure; friable; common very fine and fine roots; neutral; clear wavy boundary.

Oa2—5 to 12 inches; muck, black (10YR 2/1) broken face and rubbed; about 12 percent fiber, about 4 percent rubbed; moderate very coarse subangular blocky structure parting to moderate very thick platy; friable; common fine and very fine roots; neutral; clear wavy boundary.

Oa3—12 to 17 inches; muck, black (N 2/0) broken face and black (10YR 2/1) rubbed; about 4 percent fiber, about 2 percent rubbed; moderate very coarse subangular blocky structure; friable; common very fine and fine roots; neutral; clear smooth boundary.

Oa4—17 to 21 inches; muck, very dark gray (10YR 3/1) broken face and black (10YR 2/1) rubbed; about 4 percent fiber, less than 2 percent rubbed; moderate coarse subangular blocky structure parting to moderate thick platy; friable; common very fine and fine roots; neutral; abrupt smooth boundary.

Cg1—21 to 27 inches; light gray (10YR 7/2) marl; common medium faint very pale brown (10YR 7/3) mottles; massive; friable; common very fine roots; about 15 percent shells; 2 percent organic mixing of material from the Oa4 horizon; violently effervescent; moderately alkaline; clear wavy boundary.

Cg2—27 to 32 inches; dark grayish brown (10YR 4/2) marl; massive; friable; few very fine roots; about 8 percent shells and 2 percent wood fragments; very dark grayish brown (10YR 3/2) organic stains; violently effervescent; moderately alkaline; clear wavy boundary.

Cg3—32 to 60 inches; light gray (10YR 7/2) marl; common coarse prominent pink (5YR 7/3) mottles; massive; friable; few very fine roots; about 7 percent shells and 2 percent wood fragments; very dark grayish brown (10YR 3/2) organic stains; violently effervescent; moderately alkaline.

The thickness of the organic material ranges from 17 to 51 inches.

The surface and subsurface tiers have hue of 10YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 2. They are typically muck, but the range includes thin layers of mucky peat.

The Cg horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 1 or 2. It is marl or marl that has thin strata of muck, sand, or loamy material. Some pedons have a thin layer of coprogenous earth above the marl horizon.

Eleva Series

The Eleva series consists of moderately deep, well drained, moderately permeable soils on till plains. These soils formed in loamy glacial drift over sandstone bedrock. Slopes range from 1 to 6 percent.

Typical pedon of Eleva sandy loam, 1 to 6 percent slopes, 390 feet east and 2,240 feet south of the northwest corner of sec. 23, T. 3 S., R. 2 W.

Ap—0 to 9 inches; brown (10YR 4/3) sandy loam, brown (10YR 5/3) dry; weak very fine granular structure; friable; strongly acid; abrupt smooth boundary.

E—9 to 16 inches; yellowish brown (10YR 5/4) sandy loam; moderate medium subangular blocky structure; friable; strongly acid; abrupt smooth boundary.

Bt1—16 to 23 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; many thin brown (7.5YR 4/4) clay films on faces of peds; strongly acid; gradual wavy boundary.

Bt2—23 to 29 inches; brown (7.5YR 4/4) sandy loam; moderate coarse subangular blocky structure; friable; strongly acid; clear wavy boundary.

2Cr—29 to 45 inches; dark yellowish brown (10YR 4/4), weathered sandstone that breaks into very channery loamy sand; common fine faint strong brown (7.5YR 5/6), light yellowish brown (10YR 6/4), and light gray (10YR 7/1) mottles; weak coarse subangular blocky structure; very friable; about 40 percent hard sandstone fragments; strongly acid; clear wavy boundary.

2R—45 inches; dark yellowish brown (10YR 4/4) sandstone.

The thickness of the solum and the depth to weathered sandstone bedrock range from 20 to 40 inches. The depth to unweathered sandstone bedrock ranges from 40 to 60 inches. The content of gravel, cobbles, and channers ranges from 0 to 15 percent in the solum. Reaction ranges from strongly acid to slightly acid throughout the profile.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3.

The E horizon has hue of 10YR, value of 4 or 5, and chroma of 4. Some pedons do not have an E horizon.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 5. It is dominantly sandy loam, but the range includes loam.

Some pedons have a BC or C horizon above the 2Cr horizon.

The colors of the sandstone bedrock vary widely.

Elmdale Series

The Elmdale series consists of very deep, moderately well drained, moderately permeable soils on till plains and moraines. These soils formed in loamy glacial till. Slopes range from 2 to 6 percent.

Typical pedon of Elmdale sandy loam, 2 to 6 percent slopes, 400 feet south and 1,500 feet west of the northeast corner of sec. 30, T. 4 S., R. 8 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) sandy loam, light brownish gray (10YR 6/2) dry; moderate fine subangular blocky structure parting to moderate medium granular; friable; common very fine and fine and few medium roots; about 3 percent gravel; strongly acid; abrupt smooth boundary.

Bt1—9 to 14 inches; yellowish brown (10YR 5/4) sandy loam; common fine prominent brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; friable; few very fine and fine and few medium roots; few faint dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds and few faint dark yellowish brown (10YR 4/4) clay bridges between sand grains; about 3 percent gravel; moderately acid; clear wavy boundary.

Bt2—14 to 21 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; friable; few very fine and fine and few medium roots; common distinct brown (7.5YR 4/4) clay films on vertical and horizontal faces of peds and few distinct brown (7.5YR 4/4) clay bridges between sand grains; about 5 percent gravel; moderately acid; gradual wavy boundary.

Bt3—21 to 26 inches; dark yellowish brown (10YR 4/4) sandy loam; many coarse distinct light brownish gray (10YR 6/2), common medium prominent yellowish red (5YR 4/6), and common distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; few very fine and fine roots; common faint dark yellowish brown (10YR 4/4) clay bridges between sand grains; about 5 percent gravel; moderately acid; gradual wavy boundary.

Bt4—26 to 33 inches; dark yellowish brown (10YR 4/4) sandy loam; common coarse prominent brown (7.5YR 4/4) and common medium distinct light brownish gray (10YR 6/2) mottles; moderate fine and medium subangular blocky structure; friable; common faint dark yellowish brown (10YR 4/4) clay bridges between sand grains; about 5 percent gravel; moderately acid; gradual wavy boundary.

Bt5—33 to 43 inches; brown (10YR 5/3) sandy loam; common fine prominent yellowish red (5YR 4/6), common fine and medium distinct strong brown (7.5YR 5/8), and common fine distinct light brownish gray (10YR 6/2) mottles; moderate fine and medium subangular blocky structure; friable; common faint dark yellowish brown (10YR 4/4) clay bridges between sand grains; about 5 percent gravel; strongly acid; gradual wavy boundary.

BC—43 to 75 inches; brown (10YR 5/3) sandy loam; many medium distinct light brownish gray (10YR 6/2), common medium and coarse prominent strong brown (7.5YR 4/6), and common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate fine and medium subangular blocky structure; friable; few prominent black (10YR 2/1) patchy iron-manganese stains; about 5 percent gravel; strongly acid.

The depth to carbonates and the thickness of the sandy loam till range from 40 to more than 80 inches. The content of gravel ranges from 1 to 10 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Some pedons have an E horizon.

The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam, fine sandy loam, or loam.

The BC horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. Some pedons have a C horizon within a depth of 80 inches.

Gilford Series

The Gilford series consists of very deep, poorly drained soils on outwash plains and lake plains. These soils formed in sandy and loamy outwash and lacustrine material over sandy and gravelly outwash material. Permeability is moderately rapid in the solum and very rapid in the substratum. Slopes range from 0 to 2 percent.

Typical pedon of Gilford fine sandy loam, gravelly substratum, 1,060 feet north and 900 feet east of the southwest corner of sec. 16, T. 4 S., R. 5 W.

Ap—0 to 11 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; moderate coarse granular structure parting to moderate medium granular; very friable; common medium and very fine roots; about 1 percent gravel; neutral; abrupt smooth boundary.

Bg1—11 to 16 inches; dark gray (5Y 4/1) sandy loam; few coarse faint olive gray (5Y 5/2) mottles; moderate medium subangular blocky structure parting to weak fine subangular blocky; friable; few very fine roots; root channels and gravel have coatings of Ap material and organic stains of dark gray (10YR 4/1); few prominent very dark gray (10YR 3/1) discontinuous coatings in root channels and pores; about 2 percent gravel; slightly acid; clear wavy boundary.

Bg2—16 to 20 inches; grayish brown (2.5Y 5/2) sandy loam; few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; friable; few very fine roots; few distinct dark gray (10YR 4/1) patchy organic coatings on vertical faces of peds and common prominent very dark gray (10YR 3/1) coatings in root channels and pores; about 3 percent gravel; moderately acid; clear irregular boundary.

Bg3—20 to 32 inches; dark gray (10YR 4/1) sandy loam; common medium prominent yellowish brown (10YR 5/6) and few fine prominent dark yellowish

brown (10YR 4/6) mottles; moderate medium subangular blocky structure; friable; few very fine roots; few distinct black (10YR 2/1) patchy organic coatings in root channels and pores; about 2 percent gravel; slightly acid; clear wavy boundary.

Bg4—32 to 35 inches; dark grayish brown (2.5Y 4/2) sandy loam; common fine prominent strong brown (7.5YR 4/6) and common medium prominent yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure parting to moderate medium subangular blocky; friable; few very fine roots; few distinct dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; about 3 percent gravel; slightly acid; clear broken boundary.

2BCg—35 to 38 inches; dark grayish brown (10YR 4/2) loamy sand; common coarse prominent strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; friable; few very fine roots; about 3 percent gravel; very strongly acid; clear wavy boundary.

2Cg—38 to 60 inches; dark gray (10YR 4/1) gravelly coarse sand; single grain; loose; about 20 percent gravel; slightly acid.

The thickness of the solum ranges from 30 to 40 inches. The content of gravel ranges from 0 to 3 percent in the solum and from 15 to 20 percent in the 2C horizon.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly fine sandy loam, but the range includes sand, mucky sand, sandy loam, and mucky sandy loam.

The Bg horizon has hue of 10YR to 5Y, value of 2 to 5, and chroma of 1 or 2. It is sandy loam or fine sandy loam.

The 2BCg horizon has colors similar to those of the Bg horizon. It has textures ranging from coarse sand to loamy sand.

The 2C horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 3. It is gravelly coarse sand, gravelly sand, or stratified sand and gravel.

Granby Series

The Granby series consists of very deep, very poorly drained, rapidly permeable soils on outwash plains and lake plains. These soils formed in sandy outwash or lacustrine material. Slopes range from 0 to 2 percent.

Typical pedon of Granby loamy sand, 1,840 feet west and 60 feet south of the northeast corner of sec. 13, T. 1 S., R. 4 W.

Ap—0 to 10 inches; black (N 2/0) loamy sand, very dark gray (10YR 3/1) dry; few fine prominent dark reddish brown (5YR 3/4) mottles; moderate medium granular structure; friable; few medium and common very fine and fine roots; neutral; abrupt smooth boundary.

Bg1—10 to 17 inches; light brownish gray (2.5Y 6/2) sand; common medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; neutral; gradual wavy boundary.

Bg2—17 to 33 inches; grayish brown (2.5Y 5/2) sand; few coarse prominent yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; very friable; slightly alkaline; gradual wavy boundary.

Bg3—33 to 40 inches; grayish brown (2.5Y 5/2) sand; weak medium subangular blocky structure; very friable; slightly alkaline; gradual wavy boundary.

Cg—40 to 60 inches; gray (5Y 5/1) fine sand; single grain; loose; slightly effervescent; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 13 inches. The thickness of the solum ranges from 20 to 45 inches.

The Ap horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. It is dominantly loamy sand, but the range includes mucky loamy sand and sand. Some pedons have an E horizon.

The Bg horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. It is sand or fine sand.

The Cg horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 or 2. It is dominantly fine sand or sand, but the range includes thin strata of loamy sand.

Hillsdale Series

The Hillsdale series consists of very deep, well drained, moderately permeable soils on moraines and till plains. These soils formed in loamy glacial till. Slopes range from 0 to 25 percent.

Typical pedon of Hillsdale sandy loam, 0 to 6 percent slopes, 200 feet north and 580 feet east of the southwest corner of sec. 1, T. 3 S., R. 5 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) sandy loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure parting to weak medium and coarse granular; friable; common fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Bt1—9 to 13 inches; dark yellowish brown (10YR 4/4) sandy loam; common fine distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; friable; few fine roots; common faint brown (10YR 4/3) clay films on vertical faces of

peds; pockets of dark brown (10YR 3/3) material from the Ap horizon along roots and root channels; about 5 percent gravel; slightly acid; clear wavy boundary.

Bt2—13 to 20 inches; yellowish brown (10YR 5/4) sandy loam; few fine distinct dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; friable; few fine roots; common faint brown (10YR 4/3) clay films on vertical faces of peds; few faint dark brown (10YR 3/3) clay bridges between sand grains; about 5 percent gravel; slightly acid; gradual wavy boundary.

Bt3—20 to 48 inches; yellowish brown (10YR 5/6) sandy loam; weak medium subangular blocky structure; friable; few prominent brown (10YR 4/3) clay films on vertical faces of peds; common distinct dark brown (10YR 3/3) clay bridges between sand grains; about 3 percent gravel; slightly acid; gradual wavy boundary.

BC—48 to 66 inches; dark yellowish brown (10YR 4/4) sandy loam; few fine distinct brownish yellow (10YR 6/8) and few fine prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable; about 3 percent gravel; slightly acid; clear irregular boundary.

C—66 to 80 inches; yellowish brown (10YR 5/4) sandy loam; massive; friable; about 3 percent gravel; slightly effervescent; slightly alkaline.

The thickness of the solum and the depth to carbonates range from 45 to 70 inches. The control section averages less than 18 percent clay. The content of gravel ranges from 2 to 10 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3, and chroma of 2 or 3. It is dominantly sandy loam, but the range includes loam. Some pedons have an E horizon.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is sandy loam or loam. Some pedons do not have a BC horizon.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is dominantly sandy loam but may have thin strata of loamy sand.

Hixton Series

The Hixton series consists of moderately deep, well drained, moderately permeable soils on outwash plains and terraces. These soils formed in loamy deposits and residuum over sandstone bedrock. Slopes range from 0 to 6 percent.

Typical pedon of Hixton loam, 0 to 6 percent slopes, 1,450 feet north and 100 feet east of the southwest corner of sec. 24, T. 2 S., R. 7 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure parting to moderate medium granular; friable; few medium and coarse and common fine roots; about 3 percent gravel; neutral; abrupt smooth boundary.

Bt1—9 to 20 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; friable; few fine roots; common distinct dark yellowish brown (10YR 3/4) clay bridges between sand grains; about 2 percent gravel; slightly acid; gradual wavy boundary.

Bt2—20 to 28 inches; brown (10YR 4/3) loam; moderate medium subangular blocky structure; friable; few very fine and fine roots; common distinct dark yellowish brown (10YR 3/4) clay bridges between sand grains; about 3 percent gravel; moderately acid; gradual wavy boundary.

Bt3—28 to 34 inches; dark yellowish brown (10YR 4/6) sandy loam; moderate medium subangular blocky structure; friable; few distinct dark yellowish brown (10YR 3/4) clay bridges between sand grains; about 3 percent gravel; slightly acid; abrupt smooth boundary.

2C—34 to 38 inches; yellowish brown (10YR 5/4) sand; single grain; loose; slightly acid; abrupt smooth boundary.

3R—38 to 60 inches; yellowish brown (10YR 5/4) sandstone bedrock that is partially weathered in the upper part; moderately acid.

The thickness of the solum generally ranges from 20 to 36 inches. The depth to bedrock ranges from 25 to 40 inches. The content of gravel and cobbles ranges from 2 to 10 percent in the solum and from 5 to 10 percent in the 2C horizon.

The Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. It is dominantly loam, but the range includes sandy loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 4, and chroma of 3 or 4. It is dominantly loam, but the range includes sandy loam and sandy clay loam.

The 2C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is sand or loamy sand.

The colors of the sandstone bedrock vary widely.

Houghton Series

The Houghton series consists of very deep, very poorly drained, moderately slowly permeable to moderately rapidly permeable soils in swales and depressions on till plains, outwash plains, and lake plains. These soils formed in deposits of herbaceous organic material more than 51 inches thick. Slopes range from 0 to 2 percent.

Typical pedon of Houghton muck, undrained, 120 feet west and 1,740 feet north of the southeast corner of sec. 16, T. 1 S., R. 5 W.

Oa1—0 to 7 inches; muck, black (N 2/0) broken face, black (5YR 2.5/1) rubbed; about 10 percent fiber, about 3 percent rubbed; moderate medium subangular blocky structure parting to moderate coarse granular; very friable; common medium and coarse and few fine roots; about 5 percent wood fragments; neutral; clear wavy boundary.

Oa2—7 to 17 inches; muck, black (N 2/0) broken face and rubbed; about 5 percent fiber, about 2 percent rubbed; moderate medium subangular blocky structure parting to moderate coarse granular; very friable; common fine and medium roots; about 10 percent wood fragments; slightly alkaline; gradual wavy boundary.

Oa3—17 to 48 inches; muck, black (5YR 2.5/1) broken face and rubbed; about 17 percent fiber, about 8 percent rubbed; weak very coarse granular structure; very friable; few fine roots; about 30 percent wood fragments; slightly alkaline; gradual wavy boundary.

Oa4—48 to 60 inches; muck, black (5YR 2.5/1) broken face, dark reddish brown (5YR 2/2) rubbed; about 12 percent fiber, about 8 percent rubbed; moderate medium granular structure; very friable; about 7 percent wood fragments; slightly alkaline.

The thickness of the organic material is more than 51 inches.

The surface tier has hue of 2.5YR to 7.5YR or is neutral in hue. It has value of 2 or 2.5 and chroma of 0 to 2. It is typically muck, but in some pedons it is mucky peat or is both muck and mucky peat.

The subsurface tiers have hue of 5YR to 10YR or are neutral in hue. They have value of 2 or 2.5 and chroma of 0 to 2. They are typically muck, but the range includes up to 10 inches of mucky peat.

Kalamazoo Series

The Kalamazoo series consists of very deep, well drained soils on outwash plains and terraces. These soils formed in loamy outwash material over sandy outwash material. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 18 percent.

Typical pedon of Kalamazoo loam, 2 to 6 percent slopes, 260 feet west and 2,610 feet south of the northeast corner of sec. 12, T. 2 S., R. 6 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; common very fine and fine roots; about 5 percent gravel; neutral; abrupt smooth boundary.

Bw—9 to 15 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; friable; common very fine and fine roots; about 5 percent gravel; neutral; clear wavy boundary.

Bt1—15 to 25 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; common very fine roots; common faint dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; about 5 percent gravel; slightly acid; clear smooth boundary.

Bt2—25 to 29 inches; brown (7.5YR 5/4) clay loam; moderate medium subangular blocky structure; firm; common very fine roots; common distinct dark yellowish brown (10YR 4/4) clay films on vertical faces of peds; about 5 percent gravel; moderately acid; clear wavy boundary.

2Bt3—29 to 35 inches; brown (7.5YR 4/4) sandy loam; weak medium and coarse subangular blocky structure; friable; few very fine roots; common medium distinct dark yellowish brown (10YR 4/4) clay bridges between sand grains; about 5 percent gravel; moderately acid; clear wavy boundary.

2BC—35 to 46 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; weak medium subangular blocky structure; very friable; about 16 percent gravel; slightly acid; abrupt smooth boundary.

2C1—46 to 54 inches; yellowish brown (10YR 5/6) sand; single grain; loose; thin strata of dark yellowish brown (10YR 3/4) loamy sand; about 5 percent gravel; slightly alkaline; abrupt smooth boundary.

2C2—54 to 60 inches; yellowish brown (10YR 5/6) sand; single grain; loose; about 10 percent gravel; slightly effervescent; moderately alkaline.

The thickness of the solum ranges from 40 to 55 inches. The depth to sand or gravelly sand ranges from 25 to 40 inches. The content of gravel and cobbles ranges from 2 to 20 percent in the upper part of the solum and from 0 to 20 percent in the lower part of the solum and in the 2C horizon.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is dominantly loam, but the range includes sandy loam.

The B horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 3 or 4. It is dominantly clay loam, loam, sandy loam, and sandy clay loam, but the range includes the gravelly analogs of these textures.

The 2BC horizon has hue of 7.5YR or 10YR, value of

4 or 5, and chroma of 3 to 6. It is gravelly loamy sand or loamy sand.

The 2C horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6. It is dominantly sand or coarse sand, but the range includes the gravelly analogs of these textures. Some pedons have thin strata of loamy sand.

Kibbie Series

The Kibbie series consists of very deep, somewhat poorly drained, moderately permeable soils on outwash plains, lake plains, and till plains. These soils formed in stratified loamy and silty glacial lacustrine material. Slopes range from 0 to 2 percent.

Typical pedon of Kibbie loam, 0 to 2 percent slopes, 1,250 feet south and 100 feet west of the northeast corner of sec. 33, T. 1 S., R. 4 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 5/3) dry; moderate fine and medium granular structure; friable; common very fine and fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Bt1—9 to 15 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine and common very fine roots; common faint brown (10YR 5/3) continuous clay films on vertical and horizontal faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

Bt2—15 to 18 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct dark yellowish brown (10YR 4/6) and common fine and medium prominent light brownish gray (2.5Y 6/2) mottles; moderate medium subangular blocky structure; firm; few very fine and fine roots; common faint brown (10YR 5/3) continuous clay films on vertical and horizontal faces of peds; about 2 percent gravel; slightly alkaline; abrupt wavy boundary.

Bt3—18 to 24 inches; yellowish brown (10YR 5/6) loam; common coarse faint dark yellowish brown (10YR 4/6) and common medium distinct light gray (10YR 7/2) mottles; weak fine and medium subangular blocky structure; friable; few very fine and fine roots; few distinct dark yellowish brown (10YR 4/4) clay films on vertical faces of peds; about 5 percent gravel; slightly alkaline; abrupt wavy boundary.

2BC1—24 to 30 inches; pale brown (10YR 6/3) silt loam; common coarse prominent yellowish brown (10YR 5/6) and common medium faint light gray (10YR 7/2) mottles; strong coarse subangular blocky structure; firm; few very fine roots; common distinct light gray (10YR 7/1) discontinuous carbonate coatings on vertical faces of peds; about 1 percent gravel; violently effervescent; moderately alkaline; clear wavy boundary.

2BC2—30 to 32 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and common prominent light brownish gray (2.5Y 6/2) mottles; strong coarse subangular blocky structure; firm; few very fine roots; common distinct light gray (10YR 7/1) discontinuous carbonate coatings on vertical faces of peds; about 1 percent gravel; violently effervescent; moderately alkaline; clear wavy boundary.

2C—32 to 60 inches; light yellowish brown (10YR 6/4) silt loam; common medium distinct yellowish brown (10YR 5/6) and common coarse prominent light brownish gray (2.5Y 6/2) mottles; massive; firm; about 1 percent gravel; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 24 to 38 inches.

The Ap horizon has hue of 10YR, value of 2 to 4, and chroma of 1 to 3. It is dominantly loam, but the range includes sandy loam.

The B and BC horizons have hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 3 to 6. They are loam, clay loam, silt loam, or silty clay loam.

The 2C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4. It is silt loam or stratified silt loam to fine sand.

Leoni Series

The Leoni series consists of very deep, well drained soils on outwash plains and terraces. These soils formed in gravelly loamy material over gravelly and sandy outwash material. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 12 percent.

Typical pedon of Leoni gravelly loam, 0 to 6 percent slopes, 2,300 feet south and 840 feet west of the northeast corner of sec. 13, T. 3 S., R. 6 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) gravelly loam, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure parting to moderate coarse granular; friable; common fine and medium roots; about 25 percent gravel; neutral; abrupt smooth boundary.

Bt1—9 to 19 inches; brown (7.5YR 4/4) very gravelly clay loam; moderate medium subangular blocky structure; firm; few fine roots; few faint brown (7.5YR 4/4) patchy clay films on vertical and horizontal faces of peds and common faint brown

(7.5YR 4/4) clay bridges between sand grains; about 50 percent gravel and 3 percent cobbles; neutral; gradual wavy boundary.

Bt2—19 to 26 inches; brown (7.5YR 4/4) very gravelly sandy clay loam; moderate medium subangular blocky structure; firm; common faint brown (7.5YR 4/4) clay bridges and few faint brown (7.5YR 4/4) patchy clay films on vertical and horizontal faces of peds; about 55 percent gravel and 3 percent cobbles; slightly acid; gradual wavy boundary.

Bt3—26 to 34 inches; strong brown (7.5YR 4/6) very gravelly clay loam; weak fine and medium subangular blocky structure; friable; common distinct dark brown (7.5YR 3/4) clay bridges on vertical and horizontal faces of peds; about 45 percent gravel and 3 percent cobbles; moderately acid; gradual wavy boundary.

BC—34 to 38 inches; strong brown (7.5YR 4/6) gravelly sandy loam; weak medium subangular blocky structure; friable; about 25 percent gravel and 3 percent cobbles; slightly acid; clear wavy boundary.

2C1—38 to 48 inches; yellowish brown (10YR 5/4) very gravelly coarse sand; single grain; loose; about 50 percent gravel; violently effervescent; slightly alkaline; clear wavy boundary.

2C2—48 to 60 inches; light yellowish brown (10YR 6/4) gravelly sand; single grain; loose; about 30 percent gravel; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 35 to 45 inches. The content of gravel and cobbles ranges from 15 to 35 percent in the Ap horizon and from 25 to 65 percent in the B and 2C horizons.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is dominantly gravelly loam, but the range includes gravelly sandy loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 4, and chroma of 4 to 6. It is dominantly very gravelly clay loam and very gravelly sandy clay loam, but the range includes the extremely gravelly and cobbly analogs of these textures.

The BC horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is gravelly sandy loam, gravelly loamy sand, or the very gravelly and extremely gravelly or cobbly analogs of these textures.

The 2C horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is the gravelly, cobbly, very gravelly, or extremely gravelly analogs of sand, coarse sand, or sandy loam, or it is stratified sand and gravel.

Martisco Series

The Martisco series consists of very deep, very poorly drained soils in swales and depressions in old lakebeds and streambeds on outwash plains, lake plains, and till plains. These soils formed in shallow herbaceous organic material less than 16 inches thick over marl. Permeability is moderate or moderately rapid in the upper part of the profile and slow in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Martisco muck, 400 feet north and 1,800 feet east of the southwest corner of sec. 28, T. 3 S., R. 7 W.

Oa1—0 to 6 inches; muck, black (N 2/0) broken face and rubbed; about 3 percent fiber, about 1 percent rubbed; weak fine and medium granular structure; very friable; common fine and very fine roots; slightly alkaline; abrupt smooth boundary.

Oa2—6 to 13 inches; muck, black (10YR 2/1) broken face and rubbed; about 3 percent fiber, about 2 percent rubbed; weak medium and coarse granular structure; friable; common fine and very fine roots; slightly alkaline; clear smooth boundary.

Cg1—13 to 21 inches; light gray (10YR 7/1) marl; common fine distinct grayish brown (10YR 5/2) and few fine prominent yellowish brown (10YR 5/8) mottles; massive; friable; common fine roots; black (10YR 2/1) organic stains; about 10 percent shell fragments and 1 percent gravel; violently effervescent; moderately alkaline; abrupt smooth boundary.

Cg2—21 to 37 inches; dark grayish brown (2.5Y 4/2) marl; common coarse prominent yellowish brown (10YR 5/6) mottles; massive; friable; few fine roots; about 8 percent shell fragments and 1 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

Cg3—37 to 48 inches; gray (10YR 5/1) marl; few fine prominent brownish yellow (10YR 6/6) mottles; massive; very friable; about 4 percent shell fragments and 1 percent gravel; violently effervescent; moderately alkaline; gradual smooth boundary.

Cg4—48 to 60 inches; gray (N 5/0) marl; massive; friable; about 2 percent shell fragments and 1 percent gravel; violently effervescent; moderately alkaline.

The thickness of the organic layers and the depth to marl range from 10 to 16 inches.

The surface and subsurface tiers have hue of 10YR or are neutral in hue. They have value of 2 and chroma of 0 or 1. They are dominantly muck, but in some pedons they are both muck and mucky peat.

The Cg horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 to 7 and chroma of 0 to 2. It is marl or marl that has thin strata of muck, sand, or loamy material. Some pedons have a thin layer of coprogenous earth above the marl horizon.

Matherton Series

The Matherton series consists of very deep, somewhat poorly drained soils on terraces and outwash plains. These soils formed in loamy over sandy and gravelly outwash material. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 3 percent.

Typical pedon of Matherton loam, 0 to 3 percent slopes, 30 feet north and 650 feet east of the southwest corner of sec. 11, T. 4 S., R. 5 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common very fine and fine roots; about 5 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—8 to 14 inches; dark yellowish brown (10YR 4/4) sandy clay loam; few fine distinct grayish brown (10YR 5/2), common fine distinct dark yellowish brown (10YR 4/6), and few fine prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; few very fine roots; material from the Ap horizon in worm channels and root channels; common faint dark yellowish brown (10YR 4/4) clay films on vertical faces of peds; about 5 percent gravel; moderately acid; clear wavy boundary.

Bt2—14 to 20 inches; yellowish brown (10YR 5/4) loam; common medium and coarse distinct grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; common faint brown (10YR 5/3) clay bridges between sand grains; about 10 percent gravel; slightly acid; clear wavy boundary.

2Btg—20 to 24 inches; grayish brown (10YR 5/2) gravelly clay loam; common medium prominent strong brown (7.5YR 5/8) and common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; few faint brown (10YR 4/3) clay films on vertical and horizontal faces of peds and many faint brown (10YR 4/3) clay bridges between sand grains; about 20 percent gravel; moderately acid; clear irregular boundary.

2Bt1—24 to 27 inches; brown (10YR 4/3) gravelly clay loam; common coarse prominent strong brown (7.5YR 5/6), common fine distinct yellowish brown (10YR 5/6), and common fine faint grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; friable; common distinct black (N 2/0) patchy organic coatings; common faint brown (10YR 5/3) clay films and common faint brown (10YR 5/3) continuous clay bridges between sand grains; about 25 percent gravel; slightly acid; clear smooth boundary.

2Bt2—27 to 36 inches; dark brown (10YR 3/3) gravelly clay loam; common medium distinct dark gray (10YR 4/1), common coarse distinct yellowish brown (10YR 5/6), and common fine prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; very few faint dark brown (10YR 3/3) clay films on vertical faces of peds; about 25 percent gravel; slightly acid; clear wavy boundary.

2Cg—36 to 60 inches; light brownish gray (10YR 6/2) very gravelly sand; common coarse distinct yellowish brown (10YR 5/6) mottles; single grain; loose; about 40 percent gravel; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 33 to 40 inches. The content of gravel ranges from 5 to 25 percent in the solum and from 15 to 60 percent in the 2C horizon.

The Ap horizon has hue of 10YR, value of 3, and chroma of 2 or 3.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. It is loam, sandy clay loam, clay loam, or the gravelly analogs of these textures.

The 2Cg horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 1 or 2. It is dominantly very gravelly sand, but the range includes sand and gravelly sand.

Morley Series

The Morley series consists of very deep, well drained and moderately well drained, slowly permeable soils on till plains and moraines. These soils formed in loamy glacial till. Slopes range from 2 to 18 percent.

Typical pedon of Morley loam, 2 to 6 percent slopes, 100 feet west and 2,500 feet south of the northeast corner of sec. 26, T. 1 S., R. 5 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) loam, light brownish gray (10YR 6/2) dry; strong very coarse granular structure parting to strong coarse granular; friable; common fine to coarse roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Bt1—8 to 10 inches; yellowish brown (10YR 5/4) clay loam; strong medium subangular blocky structure; firm; common very fine and fine roots; few faint yellowish brown (10YR 5/4) skeletans on vertical faces of peds; about 2 percent gravel; slightly acid; clear broken boundary.

Bt2—10 to 13 inches; dark yellowish brown (10YR 4/6) clay loam; few fine faint yellowish brown (10YR 5/6) mottles; strong medium and coarse subangular

blocky structure; very firm; common very fine and fine roots; common distinct brown (10YR 5/3) clay films on vertical and horizontal faces of peds; about 2 percent gravel; moderately acid; clear wavy boundary.

Bt3—13 to 20 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct dark yellowish brown (10YR 4/6) mottles; strong medium subangular blocky structure parting to strong very coarse subangular blocky; very firm; common very fine roots; common faint dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; about 3 percent gravel; moderately acid; clear wavy boundary.

Bt4—20 to 26 inches; yellowish brown (10YR 5/6) clay loam; strong medium and coarse subangular blocky structure; firm; many distinct dark brown (10YR 3/3) clay films on vertical and horizontal faces of peds; 20 percent of faces of peds covered with calcium carbonate; about 2 percent gravel; moderately acid; clear wavy boundary.

BC—26 to 34 inches; yellowish brown (10YR 5/4) clay loam; moderate medium and coarse subangular blocky structure; firm; about 2 percent gravel; violently effervescent; slightly alkaline; gradual wavy boundary.

C—34 to 60 inches; brown (10YR 5/3) clay loam; moderate medium and coarse subangular blocky structure; firm; about 2 percent gravel; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 21 to 40 inches. The content of gravel ranges from 2 to 5 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3.

The B and BC horizons have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. They are clay loam, silty clay loam, or clay.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is clay loam or silty clay loam.

Oshtemo Series

The Oshtemo series consists of very deep, well drained soils on outwash plains and terraces. These soils formed in loamy material and in the underlying sandy material. Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Slopes range from 0 to 40 percent.

Typical pedon of Oshtemo sandy loam, 0 to 6 percent slopes, 1,000 feet east and 100 feet north of the southwest corner of sec. 16, T. 3 S., R. 5 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) sandy loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; few very fine roots; about 3 percent gravel; moderately acid; abrupt smooth boundary.

Bt1—9 to 13 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure parting to moderate coarse granular; friable; few very fine and fine roots; common faint dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; about 3 percent gravel; slightly acid; clear smooth boundary.

Bt2—13 to 18 inches; dark yellowish brown (10YR 4/6) sandy loam; moderate fine and medium subangular blocky structure; friable; few very fine and fine roots; few prominent dark brown (7.5YR 3/4) clay films and common distinct dark yellowish brown (10YR 4/4) clay bridges on vertical and horizontal faces of peds; about 3 percent gravel; slightly acid; clear wavy boundary.

Bt3—18 to 33 inches; dark yellowish brown (10YR 4/6) sandy loam; moderate medium and coarse subangular blocky structure; friable; few fine roots; few faint distinct strong brown (7.5YR 4/6) clay bridges between sand grains; about 5 percent gravel; moderately acid; gradual wavy boundary.

Bt and E—33 to 47 inches; dark yellowish brown (10YR 4/6) sandy loam (Bt); weak medium and coarse subangular blocky structure; very friable; few distinct strong brown (7.5YR 4/6) clay films; about 30 percent yellowish brown (10YR 5/6) sand (E); single grain; loose; about 1 percent gravel; moderately acid; clear smooth boundary.

E and Bt—47 to 70 inches; brownish yellow (10YR 6/6) sand (E); single grain; loose; lamellae of dark yellowish brown (10YR 4/6) sandy loam (Bt); weak coarse granular structure; very friable; about 1 percent gravel; slightly acid; gradual wavy boundary.

C—70 to 80 inches; yellowish brown (10YR 5/6) sand; single grain; loose; about 1 percent gravel; neutral.

The thickness of the solum ranges from 40 to 75 inches. The content of gravel ranges from 2 to 25 percent throughout the profile.

The Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3.

The Bt horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 4 to 6. It is sandy loam, sandy clay loam, or the gravelly analogs of these textures. The Bt part of the Bt and E and E and Bt horizons has colors and textures similar to those of the Bt horizon. The E part of the Bt and E and E and Bt horizons has hue of 5YR to 10YR, value of 4 to 6, and chroma of 4 or 5. Some pedons do not have separate Bt and E and E

and Bt horizons. Some pedons have a separate BC horizon.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6. It is dominantly sand, but the range includes coarse sand, fine sand, or the gravelly analogs of these textures.

Palms Series

The Palms series consists of very deep, very poorly drained soils in swales and depressions on outwash plains, lake plains, and till plains. These soils formed in deposits of herbaceous organic material 16 to 51 inches thick over loamy material. Permeability is moderately slow to moderately rapid in the upper part of the profile and moderately slow or moderate in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Palms muck, 850 feet north and 2,140 feet east of the southwest corner of sec. 29, T. 2 S., R. 4 W.

Oa1—0 to 9 inches; muck, black (N 2/0) broken face and rubbed; about 2 percent fiber, less than 2 percent rubbed; moderate medium granular structure; very friable; common very fine and fine and few medium roots; neutral; clear wavy boundary.

Oa2—9 to 18 inches; muck, black (N 2/0), broken face and rubbed; about 4 percent fiber, less than 2 percent rubbed; moderate medium subangular blocky structure; firm; common medium and few fine roots; about 1 percent wood fragments; neutral; abrupt smooth boundary.

Cg1—18 to 25 inches; dark gray (5Y 4/1) loam; massive; friable; few medium roots; black (N 2/0) organic stains in peds; about 10 percent gravel; neutral; clear wavy boundary.

Cg2—25 to 28 inches; dark gray (5Y 4/1) loam; massive; firm; black (N 2/0) organic stains in peds; about 5 percent gravel; neutral; clear wavy boundary.

Cg3—28 to 35 inches; gray (10YR 5/1) clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; massive; firm; white (10YR 8/2) calcium pockets; about 10 percent gravel; neutral; clear wavy boundary.

Cg4—35 to 60 inches; dark grayish brown (2.5Y 4/2) sandy loam; common medium prominent greenish gray (5BG 5/1) and few fine prominent yellowish brown (10YR 5/4) mottles; massive; friable; common prominent greenish gray (5BG 5/1) patchy clay films on sand and gravel; about 10 percent gravel; slightly alkaline.

The thickness of the organic layers ranges from 16 to 51 inches.

The surface tier has hue of 10YR to 5YR or is neutral in hue. It has value of 2, 2.5, or 3 and chroma of 0 to 2. It is typically muck, but the range includes mucky peat.

The subsurface tier has hue of 5YR to 10YR or is neutral in hue. It has value of 2 or 2.5 and chroma of 0 to 2. It is typically muck, but the range includes thin layers of mucky peat.

The Cg horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 3 to 5 and chroma of 0 to 2. It has textures ranging from gravelly sandy loam to silty clay loam.

Pella Series

The Pella series consists of very deep, poorly drained, moderately permeable soils on outwash plains and lake plains. These soils formed in stratified silty and loamy outwash or lacustrine material. Slopes range from 0 to 2 percent.

Typical pedon of Pella silt loam, 1,320 feet south and 200 feet west of the northeast corner of sec. 33, T. 1 S., R. 4 W.

Ap—0 to 11 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) dry; strong medium subangular blocky structure; firm; common fine and medium roots; about 1 percent gravel; slightly alkaline; abrupt smooth boundary.

A—11 to 13 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; common medium prominent dark gray (5Y 4/1) mottles; strong coarse subangular blocky structure; firm; common fine and medium roots; about 1 percent gravel; slightly alkaline; abrupt wavy boundary.

Bg1—13 to 17 inches; olive gray (5Y 5/2) silty clay loam; few fine prominent yellow (10YR 7/8) mottles; strong coarse and very coarse subangular blocky structure; very firm; common very fine and fine roots; common very dark gray (10YR 3/1) organic coatings of material from the A horizon on faces of peds; about 1 percent gravel; slightly alkaline; clear wavy boundary.

Bg2—17 to 27 inches; olive gray (5Y 5/2) silty clay loam; common fine prominent yellow (10YR 7/6) mottles; strong coarse and very coarse subangular blocky structure; very firm; common very fine and fine roots; common very dark gray (10YR 3/1) organic coatings of material from the A horizon on faces of peds; about 1 percent gravel; slightly alkaline; clear wavy boundary.

Bg3—27 to 33 inches; olive gray (5Y 5/2) silt loam; few fine prominent dark yellowish brown (10YR 4/6) and

common medium prominent brownish yellow (10YR 6/6) mottles; moderate medium and coarse subangular blocky structure; very firm; few very fine and fine roots; strata of sandy loam less than ½ inch thick; gray (10YR 6/1) coatings in root channels; about 1 percent gravel; slightly alkaline; clear wavy boundary.

BCg—33 to 39 inches; light olive gray (5Y 6/2) silt loam; common medium prominent yellowish brown (10YR 5/6) and brown (7.5YR 4/4) mottles; moderate very coarse subangular blocky structure; firm; few very fine roots; gray (10YR 6/1) coatings in root channels; about 1 percent gravel; slightly alkaline; abrupt wavy boundary.

Cg—39 to 60 inches; gray (5Y 5/1) silt loam; few fine prominent strong brown (7.5YR 4/6) and common medium prominent dark yellowish brown (10YR 4/6) and brownish yellow (10YR 6/6) mottles; massive; firm; about 1 percent gravel; slightly effervescent; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 14 inches. The thickness of the solum ranges from 30 to 40 inches.

The Ap horizon has hue of 10YR to 5Y, value of 2 or 3, and chroma of 1 or 2. The A horizon has colors similar to those of the Ap horizon. It is silt loam or silty clay loam.

The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is silt loam, loam, or silty clay loam. Some pedons do not have a BC horizon.

The Cg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It ranges from silt loam to sandy loam and is stratified in many pedons.

Pewamo Series

The Pewamo series consists of very deep, poorly drained, moderately slowly permeable soils on till plains and moraines. These soils formed in loamy or clayey glacial till. Slopes range from 0 to 2 percent.

Typical pedon of Pewamo clay loam, 1,100 feet east and 2,440 feet south of the northwest corner of sec. 34, T. 1 S., R. 5 W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; common fine prominent strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure parting to moderate medium granular; friable; many fine roots; about 5 percent gravel; slightly acid; abrupt smooth boundary.

Btg1—10 to 17 inches; gray (10YR 5/1) clay; common medium and coarse prominent yellowish brown (10YR 5/8) mottles; moderate medium angular blocky structure; firm; many fine roots; many faint grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; about 5 percent gravel; slightly acid; gradual wavy boundary.

Btg2—17 to 24 inches; dark gray (10YR 4/1) clay loam; common medium and coarse prominent yellowish brown (10YR 5/6) mottles; strong coarse angular blocky structure; very firm; many faint grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; about 5 percent gravel; slightly alkaline; clear wavy boundary.

BCg—24 to 48 inches; gray (10YR 5/1) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; strong coarse angular blocky structure; grayish brown (10YR 5/2) clay films on vertical faces of peds; very firm; about 5 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

Cg—48 to 60 inches; gray (10YR 5/1) clay loam; prominent yellowish brown (10YR 5/6) mottles; massive; firm; about 5 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 30 to 55 inches. The content of gravel ranges from 2 to 5 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly clay loam, but the range includes loam and silty clay loam.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam, silty clay loam, or clay. Some pedons do not have a BC horizon.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam or silty clay loam.

Riddles Series

The Riddles series consists of very deep, well drained, moderately permeable soils on till plains and moraines. These soils formed in loamy glacial till. Slopes range from 0 to 30 percent.

Typical pedon of Riddles loam, 0 to 6 percent slopes, 200 feet east and 50 feet south of the northwest corner of sec. 7, T. 4 S., R. 5 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) loam, pale brown (10YR 6/3) dry; moderate medium and coarse granular structure; friable; common fine and few medium roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Bt1—9 to 17 inches; dark yellowish brown (10YR 4/6) clay loam; moderate medium subangular blocky structure; firm; few fine and medium roots; material from the Ap horizon in worm holes and root

channels; few distinct dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

Bt2—17 to 23 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; many faint dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bt3—23 to 31 inches; strong brown (7.5YR 4/6) loam; moderate medium subangular blocky structure; firm; common prominent dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bt4—31 to 39 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; common faint dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

BC—39 to 60 inches; dark yellowish brown (10YR 4/6) loam; moderate medium subangular blocky structure; friable; about 5 percent gravel; neutral.

The thickness of the solum ranges from 45 to 70 inches. The upper part of the argillic horizon contains 20 to 30 percent clay. The content of gravel ranges from 1 to 5 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Some pedons have an E horizon.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is clay loam, loam, or sandy loam.

The C horizon, if it occurs, has hue of 10YR, value of 4 or 5, and chroma of 4. It is loam or sandy loam.

Sebewa Series

The Sebewa series consists of very deep, poorly drained soils on outwash plains and terraces. These soils formed in loamy outwash material over sandy outwash material. Permeability is moderate in the upper part of the profile and rapid or very rapid in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Sebewa loam, 150 feet west and 1,070 feet south of the northeast corner of sec. 29, T. 2 S., R. 8 W.

Ap—0 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; many fine and common medium roots; about 1 percent gravel; neutral; abrupt smooth boundary.

Bg—12 to 18 inches; dark gray (10YR 4/1) clay loam; common fine prominent yellowish red (5YR 4/6) and common fine prominent yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; common fine and medium roots; about 2 percent gravel; moderately acid; clear wavy boundary.

Btg1—18 to 25 inches; dark gray (N 4/0) clay loam; common fine prominent yellowish red (5YR 4/6) mottles; moderate fine angular blocky structure; firm; few fine and medium roots; common prominent grayish brown (10YR 5/2) patchy clay bridges between sand grains; about 5 percent gravel; slightly acid; clear wavy boundary.

Btg2—25 to 32 inches; grayish brown (2.5Y 5/2) clay loam; common fine distinct light olive brown (2.5Y 5/4) and dark yellowish brown (10YR 4/6) mottles; moderate fine angular blocky structure; firm; about 5 percent gravel; slightly alkaline; clear wavy boundary.

Btg3—32 to 38 inches; grayish brown (10YR 5/2) loam; few fine prominent yellowish red (5YR 4/6) mottles; weak medium subangular blocky structure; friable; about 5 percent gravel; slightly alkaline; abrupt smooth boundary.

2Cg1—38 to 45 inches; gray (10YR 5/1) sand; few medium prominent yellowish brown (10YR 5/8) and light olive brown (2.5Y 5/4) mottles; single grain; loose; about 10 percent gravel; slightly effervescent; slightly alkaline; abrupt wavy boundary.

2Cg2—45 to 60 inches; grayish brown (10YR 5/2) gravelly sand; common medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; about 20 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 30 to 40 inches. The depth to sand and gravel ranges from 20 to 40 inches. The content of gravel ranges from 1 to 5 percent in the Ap and Bt horizons and from 10 to 35 percent in the 2C horizon.

The Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is dominantly loam, but the range includes sandy loam.

The Btg horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 2. It is sandy clay loam, loam, or clay loam. Some pedons have a BC horizon.

The 2Cg horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 to 4. It is sand, coarse sand, or the gravelly or very gravelly analogs of these textures.

Sleeth Series

The Sleeth series consists of very deep, somewhat poorly drained soils on outwash plains and terraces. These soils formed in loamy material over loamy to sandy material. Permeability is moderate in the solum and rapid in the substratum. Slopes are 0 to 2 percent.

Typical pedon of Sleeth loam, 0 to 2 percent slopes, 200 feet east and 2,250 feet south of the northwest corner of sec. 32, T. 2 S., R. 8 W.

Ap—0 to 9 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; few fine roots; many very fine and fine vesicular pores; about 3 percent gravel; slightly acid; abrupt smooth boundary.

Bt—9 to 15 inches; yellowish brown (10YR 5/4) loam; common medium prominent strong brown (7.5YR 5/6) and many medium distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; common fine and medium tubular pores; tubular pores and root channels lined with material from the Ap horizon; few distinct light brownish gray (10YR 6/2) clay films on vertical and horizontal faces of peds; about 3 percent gravel; moderately acid; gradual smooth boundary.

Btg1—15 to 34 inches; light brownish gray (2.5Y 6/2) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium angular and subangular blocky structure; firm; few fine roots; common medium tubular pores; tubular pores and root channels lined with material from the Ap horizon; few distinct light brownish gray (10YR 6/2) clay films on vertical and horizontal faces of peds; about 5 percent gravel; moderately acid; gradual wavy boundary.

Btg2—34 to 41 inches; light brownish gray (2.5Y 6/2) loam; common fine prominent dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable; few distinct light brownish gray (10YR 6/2) clay films on vertical and horizontal faces of peds; about 5 percent gravel; moderately acid; clear wavy boundary.

BCg1—41 to 45 inches; light brownish gray (5YR 6/2) loam; common fine prominent brownish yellow (10YR 6/8) mottles; weak medium subangular blocky structure; friable; about 5 percent gravel; moderately acid; gradual wavy boundary.

BCg2—45 to 54 inches; gray (10YR 6/1) sandy loam; common medium prominent reddish yellow (7.5YR 7/8) and strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable; about 5 percent gravel; neutral; gradual wavy boundary.

BCg3—54 to 58 inches; gray (10YR 6/1) sandy loam; common fine prominent brownish yellow (10YR 6/8) mottles; weak medium subangular blocky structure; very friable; about 5 percent gravel; slightly alkaline; gradual wavy boundary.

2C—58 to 70 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 2 percent gravel; slightly alkaline.

The thickness of the solum ranges from 40 to 60 inches. The content of gravel ranges from 2 to 10 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3.

The Bt horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4. It is loam or sandy clay loam.

The BC horizon has colors similar to those of the Bt horizon. It is loam or sandy loam.

The 2C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 to 4. It is sand, loamy sand, or coarse sand.

Spinks Series

The Spinks series consists of very deep, well drained, moderately rapidly permeable soils on lake plains, outwash plains, and moraines. These soils formed in sandy and loamy glaciofluvial material. Slopes range from 0 to 40 percent.

Typical pedon of Spinks loamy sand, 0 to 6 percent slopes, 480 feet west and 1,680 feet south of the northeast corner of sec. 10, T. 3 S., R. 6 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) loamy sand, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; very friable; common fine and medium roots; neutral; abrupt smooth boundary.

E1—9 to 18 inches; dark yellowish brown (10YR 4/6) loamy sand; weak medium subangular blocky structure; very friable; few fine and medium roots; neutral; clear wavy boundary.

E2—18 to 30 inches; yellowish brown (10YR 5/6) sand; single grain; loose; few fine roots; neutral; clear wavy boundary.

E and Bt1—30 to 41 inches; yellowish brown (10YR 5/6) sand (E); single grain; loose; lamellae of strong brown (7.5YR 4/6) loamy sand (Bt) ⅛ to ½ inch thick; weak medium subangular blocky structure; very friable; few fine roots; common distinct strong brown (7.5YR 4/6) clay bridges between sand grains; neutral; clear wavy boundary.

E and Bt2—41 to 70 inches; yellowish brown (10YR 5/6) sand (E); single grain; loose; lamellae of brown

(7.5YR 4/4) sandy loam and dark yellowish brown (10YR 4/4) loamy sand (Bt) ¼ to 1 inch thick; weak medium subangular blocky structure; very friable; few fine roots; common prominent brown (7.5YR 4/4) clay bridges between sand grains; neutral.

The thickness of the solum ranges from 40 to more than 70 inches. The content of gravel ranges from 0 to 5 percent throughout the profile.

Pedons in undisturbed areas have an A horizon. This horizon is 1 to 4 inches thick.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. The E horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 8. It is sand, loamy sand, or loamy fine sand. The E part of the E and Bt horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6.

The Bt part of the E and Bt horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 4 to 6. Depth to the first lamella ranges from 15 to 27 inches. The lamellae are sandy loam or loamy sand and have a combined thickness of about 7 inches.

Some pedons have a C horizon within a depth of 80 inches.

Teasdale Series

The Teasdale series consists of very deep, somewhat poorly drained, moderately permeable soils on till plains and moraines. These soils formed in loamy glacial till. Slopes range from 1 to 4 percent.

Typical pedon of Teasdale sandy loam, 1 to 4 percent slopes, 1,460 feet west and 55 feet north of the southeast corner of sec. 14, T. 4 S., R. 4 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; very friable; common fine and few medium roots; about 3 percent gravel; neutral; abrupt smooth boundary.

B/E—9 to 13 inches; yellowish brown (10YR 5/4) sandy loam, light brownish gray (10YR 6/2) dry (B); common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium granular structure; friable; brown (10YR 5/3) sandy loam (E); the E part occurs as interfingerings 1/16 to ⅛ inch thick and ¼ to ½ inch long into the B material; very friable; few fine and common medium roots; about 3 percent gravel; neutral; clear broken boundary.

Bt1—13 to 16 inches; yellowish brown (10YR 5/4) sandy loam; common fine distinct grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; friable; common fine and few medium roots; common faint yellowish brown (10YR 5/4) clay bridges between sand grains; about 3 percent gravel; neutral; clear wavy boundary.

Bt2—16 to 24 inches; brown (10YR 5/3) sandy loam; common medium distinct gray (10YR 5/1) and yellowish brown (10YR 5/6) and common medium prominent yellowish brown (10YR 5/8) mottles; weak medium and coarse subangular blocky structure; friable; few medium and fine roots; common faint yellowish brown (10YR 5/4) clay bridges between sand grains; about 5 percent gravel; neutral; clear wavy boundary.

Bt3—24 to 34 inches; yellowish brown (10YR 5/4) sandy loam; common coarse distinct light gray (10YR 7/2), common medium distinct gray (10YR 5/1), and common medium distinct yellowish brown (10YR 5/8) mottles; weak medium and coarse subangular blocky structure; friable; few fine roots; common distinct grayish brown (10YR 5/2) clay films on vertical faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bt4—34 to 48 inches; brown (10YR 5/3) sandy loam; common medium distinct yellowish brown (10YR 5/6) and common coarse faint grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; friable; common faint grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; about 5 percent gravel; neutral; gradual irregular boundary.

BC—48 to 51 inches; yellowish brown (10YR 5/4) sandy loam; common medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; friable; about 5 percent gravel; neutral; gradual irregular boundary.

C—51 to 60 inches; brown (10YR 5/3) sandy loam; common medium faint grayish brown (10YR 5/2) mottles; massive; friable; about 5 percent gravel; slightly effervescent; slightly alkaline.

The thickness of the solum ranges from 40 to 65 inches. The content of gravel ranges from 2 to 10 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is dominantly sandy loam, but the range includes loam.

The B part of the B/E horizon has colors and textures similar to those of the Bt horizon. The E part of the B/E horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. Some pedons have a separate E horizon.

The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is sandy loam or fine sandy loam.

The C horizon has hue of 10YR, value of 5, and chroma of 3.

Formation of the Soils

This section describes the factors of soil formation and relates them to the soils in the survey area. It also describes the major processes of soil formation.

Factors of Soil Formation

Soil forms through the interaction of five major factors—the physical, chemical, and mineral composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or topography; and the length of time that the processes of soil formation have acted on the parent material (Jenny, 1941).

Climate and plant and animal life are the active factors of soil formation. They slowly change the parent material into a natural body of soil that has genetically related layers, called horizons. The effects of climate and plant and animal life are conditioned by relief. The nature of the parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the transformation of the parent material into a soil. Generally, a long time is required for the formation of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made about the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil formation are unknown.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. The parent material of the soils in Calhoun County was deposited by glaciers or by meltwater from the glaciers. Much of this material was subsequently reworked by water and wind. The glaciers covered the county about 12,000 years ago. Parent material determines the chemical and mineralogical composition of the soil. Although the parent material is of common glacial origin, its properties vary greatly, sometimes within a small area, depending on how the material was deposited. The dominant parent materials in Calhoun County were deposited as glacial till, outwash material, alluvium, and organic material.

Glacial till was deposited directly by glaciers with a minimum of water action. It is a mixture of particles of different sizes. The small pebbles in glacial till have sharp corners, indicating that they have not been worn by water. The glacial till in Calhoun County generally is calcareous clay loam, loam, and sandy loam. Morley, Riddles, and Hillsdale soils formed in glacial till.

Outwash material was deposited by running water from melting glaciers. The size of the particles depends on the speed of the water that carried them. As the water slowed down, the coarser particles were deposited first. The finer particles, such as very fine sand, silt, and clay, were carried by slowly moving water. Outwash deposits generally occur as layers of particles of similar size, such as sand, coarse sand, and gravel. Kalamazoo, Oshtemo, and Boyer soils formed in outwash material.

Alluvium was recently deposited by floodwater along streams. It varies in texture, depending on the speed of the water from which it was deposited. Cohoctah soils formed in alluvium.

Organic material occurs as deposits of plant remains. After the glaciers withdrew from the survey area, water was left standing in depressions on outwash plains, flood plains, and till plains. Grasses and sedges growing around the edges of these lakes died, and this residue fell to the bottom. Because the areas were wet, the plant remains did not decompose but accumulated around the edge of the lake. Later, water-tolerant trees grew in these areas. After these trees died, their residue became part of the organic accumulation. Eventually, the lakes were filled with organic material and developed into areas of muck. Houghton, Palms, and Adrian soils formed in organic material.

Plant and Animal Life

Green plants have been the principal organisms influencing the soils in Calhoun County. Bacteria, fungi,

and earthworms also have been important. The chief contribution of plant and animal life is the addition of organic matter and nitrogen to the soil. The kind of organic matter on and in the soil depends on the kinds of native plants that grew on the soil. The remains of these plants accumulated on the surface, decayed, and eventually became organic matter. The roots of plants provided channels for the downward movement of water through the soil and added organic matter as they decayed. Bacteria in the soil helped to break down the organic matter into plant nutrients.

The native vegetation in Calhoun County was a mixture of coniferous and deciduous trees. Differences in natural soil drainage and changes in parent material have affected the composition of forest species.

In general, the well drained upland soils, such as Morley, Hillsdale, and Kalamazoo soils, were covered with northern red oak, American basswood, sugar maple, and yellow-poplar. The somewhat poorly drained Blount, Teasdale, and Matherton soils were covered with northern red oak, white ash, red maple, American basswood, pin oak, and white oak. The poorly drained Pewamo, Barry, and Sebewa soils were covered with red maple, American basswood, silver maple, white ash, swamp white oak, and eastern cottonwood. The very poorly drained Houghton, Palms, and Adrian soils were covered with silver maple, red maple, green ash, tamarack, and northern whitecedar.

Climate

Climate determines the kind of plant and animal life on and in the soil and the amount of water available for the weathering of minerals and the transporting of soil material. Through its influence on soil temperature, climate also determines the rate of chemical reaction in the soil.

The climate in Calhoun County is cool and humid. It is presumed to be similar to that under which the soils formed. The soils in the county differ from soils that formed in a dry, warm climate or from those that formed in a moist, hot climate. The climate is uniform throughout the county, but its effects are modified locally by the proximity to large lakes. Only minor differences in the soils in the county are the result of climatic differences.

Relief

Relief, or topography, has markedly affected the formation of soils in Calhoun County through its influence on natural drainage, runoff, erosion, plant cover, and soil temperature. In most parts of the county, the areas at the highest elevations are more likely to be glacial till soils. The soils at the adjacent lower elevations are commonly outwash soils. Exceptions are in the central and northwestern parts of the county. In this county, slopes range from 0 to 40 percent. Natural drainage classes range from excessively drained on hilltops and terraces to very poorly drained in depressions.

Relief influences the formation of soils by affecting runoff and drainage. Drainage, in turn, through its influence on aeration of the soil, determines the color of the soil. Runoff is most rapid on the steeper slopes, but water can be ponded temporarily in low areas. Water and air move freely through well drained soils but slowly through very poorly drained soils. In soils that are well aerated, the iron and aluminum compounds that give most soils their color are brightly colored and are oxidized.

Poorly aerated soils are dull gray and mottled. Kalamazoo soils are examples of well drained, well aerated soils. Sebewa soils are examples of poorly drained, poorly aerated soils. Both of these soils formed in similar kinds of parent material.

Time

Generally, a long time is needed for the development of distinct soil horizons. Differences in the length of time that the parent material has been in place are commonly reflected in the degree of profile development. Some soils form rapidly; others form slowly.

The soils in Calhoun County range from young to mature. The glacial deposits in which many of the soils formed have been exposed to the soil-forming factors long enough for the development of distinct horizons. Some soils that formed in recent alluvial sediment have not been in place long enough for the development of distinct horizons. Cohoctah soils, which formed in alluvial material, are young soils. Morley soils are older, as evidenced by the leaching of lime from the soil.

Processes of Soil Formation

Several processes were involved in the development of horizons in the soils of Calhoun County. These were the accumulation of organic matter, the leaching of lime (calcium carbonate) and other bases, the reduction and transfer of iron, and the formation and translocation of clay minerals. More than one of these processes have helped to differentiate horizons in most of the soils.

As organic matter accumulated at the surface, an A horizon formed. If the soil is plowed, the A horizon is mixed into a plow layer, or Ap horizon. The surface layer of the soils in Calhoun County ranges from high to low in content of organic matter. The content is high, for

example, in Barry soils and low in Spinks soils.

The leaching of carbonates and other bases has occurred in most of the soils. The leaching of bases usually precedes the translocation of silicate clay minerals. Many of the soils are moderately leached or strongly leached. Riddles soils, for example, are leached to a depth of 45 to 70 inches. Differences in the depth of leaching are the result of differences in the time during which soils have been forming and differences in parent material.

Gleying, or the reduction and transfer of iron, is evident in somewhat poorly drained to very poorly drained soils. Pewamo soils are examples. Gray colors in the subsoil indicate the reduction and loss of iron.

The translocation of clay minerals contributes to horizon development. An eluviated, or leached, E horizon is lower in content of clay and typically is lighter in color than an illuviated B horizon. The B horizon typically has an accumulation of clay (clay films) in pores and on the faces of peds. Soils in which clay has been translocated were probably leached of carbonates and soluble salts to a considerable extent before the translocation of clay took place. Oshtemo soils are examples of soils in which clay (in the form of clay films) has accumulated in the B horizon.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles 2 millimeters to 38 centimeters (15 inches) long.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form

a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another

within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured soil. Sandy clay, silty clay, or clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:
O horizon.—An organic layer of fresh and decaying plant residue.
A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.
E horizon.—The mineral horizon in which the main

feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to

pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, classes for simple slopes are as follows:

Nearly level	0 to 2 percent
Nearly level or very gently sloping	0 to 4 percent
Nearly level to gently sloping	0 to 6 percent
Moderately sloping	6 to 12 percent
Strongly sloping	12 to 18 percent
Strongly sloping to steep	12 to 30 percent
Moderately steep or steep	18 to 40 percent

Classes for complex slopes are as follows:

Nearly level	0 to 2 percent
Nearly level or gently undulating	0 to 4 percent
Nearly level to undulating	0 to 6 percent
Gently rolling	6 to 12 percent
Rolling	12 to 18 percent
Rolling to very hilly	12 to 30 percent
Hilly or steep	18 to 40 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters

in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-80 at Battle Creek, Michigan)

Month	Temperature						Precipitation				
				2 years in 10 will have--		Average		2 years in 10 will have--		Average	
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	number of growing degree days*	Average	Less than--	More than--	number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	29.7	15.1	22.4	55	-11	0	1.86	0.91	2.67	4	12.8
February----	33.0	16.5	24.8	56	-11	0	1.59	.79	2.28	4	8.7
March-------	43.2	25.2	34.2	74	2	12	2.49	1.60	3.29	6	7.3
April-------	58.0	36.4	47.2	82	17	89	3.44	2.29	4.49	7	2.4
May---------	69.9	46.5	58.2	89	28	281	3.15	2.07	4.14	6	.0
June--------	79.2	56.3	67.7	95	38	532	3.86	2.49	5.11	7	.0
July--------	82.9	60.5	71.7	96	46	671	3.46	2.24	4.57	6	.0
August------	81.1	58.8	70.0	95	42	618	3.28	1.56	4.76	6	.0
September---	73.8	51.6	62.7	93	32	386	2.79	1.47	4.12	5	.0
October-----	61.9	41.1	51.5	84	21	140	2.83	1.30	4.15	6	.1
November----	46.8	31.2	39.0	72	9	23	2.72	1.76	3.59	6	6.1
December----	34.6	20.8	27.7	60	-5	1	2.48	1.13	3.64	6	11.1
Yearly:											
Average---	57.8	38.3	48.1	---	---	---	---	---	---	---	---
Extreme---	---	---	---	98	-13	---	---	---	---	---	---
Total-----	---	---	---	---	---	2,753	33.95	28.95	38.76	69	48.5

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-80 at Battle Creek, Michigan)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 23	May 9	May 19
2 years in 10 later than--	Apr. 19	May 4	May 14
5 years in 10 later than--	Apr. 11	Apr. 23	May 5
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 16	Oct. 6	Sept. 20
2 years in 10 earlier than--	Oct. 22	Oct. 11	Sept. 26
5 years in 10 earlier than--	Nov. 2	Oct. 22	Oct. 7

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-80 at Battle Creek, Michigan)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	182	158	136
8 years in 10	190	166	142
5 years in 10	204	180	154
2 years in 10	219	195	166
1 year in 10	226	203	173

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
2	Houghton muck, undrained	38,652	8.3
4	Adrian muck	7,150	1.6
5	Palms muck	6,655	1.4
7	Houghton muck, drained	1,784	0.4
8	Edwards muck	1,575	0.3
9	Martisco muck	1,249	0.3
12B	Coloma loamy sand, 0 to 6 percent slopes	5,945	1.3
12C	Coloma loamy sand, 6 to 12 percent slopes	3,170	0.7
12D	Coloma loamy sand, 12 to 18 percent slopes	1,722	0.4
12E	Coloma loamy sand, 18 to 40 percent slopes	1,069	0.2
13B	Spinks loamy sand, 0 to 6 percent slopes	9,557	2.1
13C	Spinks loamy sand, 6 to 12 percent slopes	8,198	1.8
13D	Spinks loamy sand, 12 to 18 percent slopes	4,413	1.0
13E	Spinks loamy sand, 18 to 40 percent slopes	1,891	0.4
14B	Bronson sandy loam, 0 to 6 percent slopes	8,378	1.8
15B	Eleva sandy loam, 1 to 6 percent slopes	22	*
16B	Oshtemo sandy loam, 0 to 6 percent slopes	50,921	11.0
16C	Oshtemo sandy loam, 6 to 12 percent slopes	21,603	4.7
16D	Oshtemo sandy loam, 12 to 18 percent slopes	7,180	1.6
16E	Oshtemo sandy loam, 18 to 40 percent slopes	2,958	0.6
17B	Boyer sandy loam, 0 to 6 percent slopes	8,981	2.0
17C	Boyer sandy loam, 6 to 12 percent slopes	7,981	1.7
17D	Boyer sandy loam, 12 to 18 percent slopes	5,172	1.1
17E	Boyer sandy loam, 18 to 40 percent slopes	1,532	0.3
21B	Leoni gravelly loam, 0 to 6 percent slopes	2,675	0.6
21C	Leoni gravelly loam, 6 to 12 percent slopes	929	0.2
22A	Dowagiac loam, 0 to 2 percent slopes	1,689	0.4
23B	Hixton loam, 0 to 6 percent slopes	879	0.2
25A	Kalamazoo loam, 0 to 2 percent slopes	13,235	2.9
25B	Kalamazoo loam, 2 to 6 percent slopes	42,180	9.1
25C	Kalamazoo loam, 6 to 12 percent slopes	8,937	1.9
25D	Kalamazoo loam, 12 to 18 percent slopes	2,805	0.6
28B	Elmdale sandy loam, 2 to 6 percent slopes	1,727	0.4
29B	Hillsdale sandy loam, 0 to 6 percent slopes	33,381	7.3
29C	Hillsdale sandy loam, 6 to 12 percent slopes	14,639	3.2
29D	Hillsdale sandy loam, 12 to 18 percent slopes	2,182	0.5
29E	Hillsdale sandy loam, 18 to 25 percent slopes	835	0.2
33B	Riddles loam, 0 to 6 percent slopes	6,065	1.3
33C	Riddles loam, 6 to 12 percent slopes	2,387	0.5
33E	Riddles loam, 12 to 30 percent slopes	562	0.1
38B	Morley loam, moderately wet, 2 to 6 percent slopes	876	0.2
39B	Morley loam, 2 to 6 percent slopes	6,296	1.4
39C	Morley loam, 6 to 12 percent slopes	3,011	0.7
39D	Morley loam, 12 to 18 percent slopes	605	0.1
43B	Brady sandy loam, 1 to 4 percent slopes	9,134	2.0
44A	Matherton loam, 0 to 3 percent slopes	9,875	2.1
45A	Sleeth loam, 0 to 2 percent slopes	4,307	0.9
46B	Crosier loam, 1 to 4 percent slopes	1,738	0.4
47B	Teasdale sandy loam, 1 to 4 percent slopes	3,352	0.7
53A	Kibbie loam, 0 to 2 percent slopes	533	0.1
58B	Blount loam, 1 to 4 percent slopes	5,721	1.2
61	Algansee fine sand, occasionally flooded	970	0.2
62	Granby loamy sand	1,359	0.3
63	Gilford fine sandy loam, gravelly substratum	3,989	0.9
64	Cohoctah loam, gravelly substratum, frequently flooded	2,602	0.6
65	Sebewa loam	24,352	5.3
72	Barry loam	2,205	0.5
73	Pella silt loam	1,263	0.3
78	Pewamo clay loam	4,028	0.9
82	Udipsamments and Udorthents, nearly level to steep	5,418	1.2
83	Pits, sand and gravel	673	0.1
84	Histosols and Aquents, ponded	5,500	1.2

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
85	Histosols and Fluvaquents, frequently flooded	1,453	0.3
87	Hapludalfs-Udipsamments-Histosols complex, nearly level to steep	927	0.2
90B	Coloma-Boyer loamy sands, 0 to 6 percent slopes	181	*
90C	Coloma-Boyer loamy sands, 6 to 12 percent slopes	210	*
90D	Coloma-Boyer loamy sands, 12 to 18 percent slopes	254	0.1
95B	Urban land-Kalamazoo complex, 0 to 6 percent slopes	2,240	0.5
95C	Urban land-Kalamazoo complex, 6 to 12 percent slopes	233	0.1
96B	Urban land-Oshtemo complex, 0 to 6 percent slopes	6,857	1.5
96C	Urban land-Oshtemo complex, 6 to 12 percent slopes	928	0.2
96D	Urban land-Oshtemo complex, 12 to 18 percent slopes	271	0.1
99	Urban land	2,132	0.5
113B	Urban land-Coloma complex, 0 to 6 percent slopes	1,697	0.4
113C	Urban land-Coloma complex, 6 to 12 percent slopes	436	0.1
	Water areas less than 40 acres in size	1,285	0.3
	Total	459,776	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
14B	Bronson sandy loam, 0 to 6 percent slopes
15B	Eleva sandy loam, 1 to 6 percent slopes
16B	Oshtemo sandy loam, 0 to 6 percent slopes
17B	Boyer sandy loam, 0 to 6 percent slopes
21B	Leoni gravelly loam, 0 to 6 percent slopes
22A	Dowagiac loam, 0 to 2 percent slopes
23B	Hixton loam, 0 to 6 percent slopes
25A	Kalamazoo loam, 0 to 2 percent slopes
25B	Kalamazoo loam, 2 to 6 percent slopes
28B	Elmdale sandy loam, 2 to 6 percent slopes
29B	Hillsdale sandy loam, 0 to 6 percent slopes
33B	Riddles loam, 0 to 6 percent slopes
38B	Morley loam, moderately wet, 2 to 6 percent slopes
39B	Morley loam, 2 to 6 percent slopes
43B	Brady sandy loam, 1 to 4 percent slopes
44A	Matherton loam, 0 to 3 percent slopes (where drained)
45A	Sleeth loam, 0 to 2 percent slopes (where drained)
46B	Crosier loam, 1 to 4 percent slopes (where drained)
47B	Teasdale sandy loam, 1 to 4 percent slopes (where drained)
53A	Kibbie loam, 0 to 2 percent slopes (where drained)
58B	Blount loam, 1 to 4 percent slopes (where drained)
63	Gilford fine sandy loam, gravelly substratum (where drained)
64	Cohoctah loam, gravelly substratum, frequently flooded (where drained and either protected from flooding or not frequently flooded during the growing season)
65	Sebewa loam (where drained)
72	Barry loam (where drained)
73	Pella silt loam (where drained)
78	Pewamo clay loam (where drained)

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS

(Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn		Corn, silage		Alfalfa hay		Soybeans	Oats	Winter wheat
		N	I	N	I	N	I	N	N	N
		Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Bu
2---------- Houghton	Vw	---	---	---	---	---	---	---	---	---
4---------- Adrian	Vw	---	---	---	---	---	---	---	---	---
5---------- Palms	Vw	---	---	---	---	---	---	---	---	---
7---------- Houghton	IIIw	130	---	20	---	---	---	35	---	---
8---------- Edwards	Vw	---	---	---	---	---	---	---	---	---
9---------- Martisco	Vw	---	---	---	---	---	---	---	---	---
12B---------- Coloma	IVs	---	---	---	---	---	---	---	---	---
12C, 12D--------- Coloma	VIs	---	---	---	---	---	---	---	---	---
12E---------- Coloma	VIIs	---	---	---	---	---	---	---	---	---
13B---------- Spinks	IIIs	---	---	---	---	---	---	27	---	30
13C---------- Spinks	IIIe	---	---	---	---	---	---	23	---	30
13D---------- Spinks	IVe	---	---	---	---	---	---	---	50	24
13E---------- Spinks	VIIe	---	---	---	---	---	---	---	---	---
14B---------- Bronson	IIe	95	170	16	27	4.0	9.0	27	75	35
15B---------- Eleva	IIIs	85	---	14	---	3.5	---	32	75	---
16B---------- Oshtemo	IIIs	100	150	16	25	4.0	8.0	30	80	45
16C---------- Oshtemo	IIIe	90	145	15	24	3.5	7.0	26	75	40
16D---------- Oshtemo	IVe	---	---	---	---	3.0	---	---	---	---
16E---------- Oshtemo	VIIe	---	---	---	---	---	---	---	---	---

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn		Corn, silage		Alfalfa hay		Soybeans	Oats	Winter wheat
		N	I	N	I	N	I	N	N	N
		Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Bu
17B---------- Boyer	IIIs	80	---	14	---	3.8	---	30	60	35
17C---------- Boyer	IIIe	75	---	12	---	3.4	---	26	55	32
17D---------- Boyer	IVe	---	---	---	---	---	---	---	---	---
17E---------- Boyer	VIIe	---	---	---	---	---	---	---	---	---
21B---------- Leoni	IIIs	110	160	18	27	4.2	---	35	80	55
21C---------- Leoni	IIIe	95	145	17	25	3.7	---	30	80	40
22A---------- Dowagiac	IIs	90	---	16	---	3.5	---	30	80	40
23B---------- Hixton	IIe	105	---	18	---	---	---	28	80	---
25A---------- Kalamazoo	IIs	105	160	18	27	4.0	8.0	30	80	50
25B---------- Kalamazoo	IIe	100	150	16	25	4.0	8.0	30	80	50
25C---------- Kalamazoo	IIIe	90	145	15	24	3.8	7.5	27	75	45
25D---------- Kalamazoo	IVe	---	---	---	---	3.5	---	---	---	---
28B---------- Elmdale	IIe	100	150	17	27	4.0	8.0	27	80	50
29B---------- Hillsdale	IIe	100	150	17	27	4.0	8.0	35	80	50
29C---------- Hillsdale	IIIe	90	145	15	24	4.0	8.0	32	75	45
29D---------- Hillsdale	IVe	---	---	---	---	---	---	---	---	---
29E---------- Hillsdale	VIe	---	---	---	---	---	---	---	---	---
33B---------- Riddles	IIe	115	---	20	---	---	---	38	---	50
33C---------- Riddles	IIIe	105	---	19	---	---	---	37	---	47
33E---------- Riddles	VIe	---	---	---	---	---	---	---	---	---
38B, 39B--------- Morley	IIe	105	---	---	---	4.5	---	35	80	50

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn		Corn, silage		Alfalfa hay		Soybeans	Oats	Winter wheat
		N	I	N	I	N	I	N	N	N
		Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Bu
39C---------- Morley	IIIe	100	---	---	---	4.3	---	34	62	46
39D---------- Morley	IVe	---	---	---	---	---	---	---	---	---
43B---------- Brady	IIe	110	---	18	---	4.5	---	31	90	47
44A---------- Matherton	IIw	110	---	18	---	4.5	---	36	90	45
45A---------- Sleeth	IIw	120	---	---	---	---	---	42	---	48
46B---------- Crosier	IIe	120	---	---	---	---	---	42	---	54
47B---------- Teasdale	IIw	115	---	19	---	4.5	---	33	90	50
53A---------- Kibbie	IIw	130	---	20	---	5.0	---	40	105	65
58B---------- Blount	IIe	105	---	---	---	---	---	35	63	47
61---------- Algansee	IIIw	---	---	---	---	---	---	---	65	---
62---------- Granby	Vw	90	---	15	---	---	---	---	---	---
63---------- Gilford	IIIw	100	---	17	---	---	---	32	75	45
64---------- Cohoctah	Vw	---	---	---	---	---	---	---	---	---
65---------- Sebewa	IIw	115	---	19	---	4.8	---	36	95	55
72---------- Barry	IIw	120	---	19	---	4.8	---	---	100	55
73---------- Pella	IIw	140	---	---	---	---	---	48	78	56
78---------- Pewamo	IIw	130	---	20	---	6.0	---	42	100	60
82. Udipsamments and Udorthents										
83. Pits										
84. Histosols and Aquents										

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn		Corn, silage		Alfalfa hay		Soybeans	Oats	Winter wheat
		N	I	N	I	N	I	N	N	N
		Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Bu
85. Histosols and Fluvaquents										
87. Hapludalfs-Udipsamments-Histosols										
90B---------- Coloma-Boyer	IVs	60	---	10	---	---	---	23	51	---
90C, 90D--------- Coloma-Boyer	VIs	---	---	---	---	---	---	---	---	---
95B, 95C. Urban land-Kalamazoo										
96B, 96C, 96D. Urban land-Oshtemo										
99. Urban land										
113B, 113C. Urban land-Coloma										

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

(Miscellaneous areas are excluded. Absence of an entry indicates no acreage)

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	---	---	---	---
II	181,214	116,375	49,915	14,924
III	146,584	67,685	6,743	72,156
IV	28,483	22,357	---	6,126
V	59,242	---	59,242	---
VI	6,753	1,397	---	5,356
VII	7,450	6,381	---	1,069
VIII	---	---	---	---

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Volume*	
2---------- Houghton	2W	Severe	Severe	Severe	Severe	Silver maple--------	82	36	---
						Red maple----------	56	36	
						White ash----------	56	44	
						Quaking aspen-------	60	64	
						Tamarack-----------	52	45	
						Green ash----------	---	---	
						Northern whitecedar-	37	55	
4---------- Adrian	2W	Severe	Severe	Severe	Severe	Silver maple--------	78	32	---
						Red maple----------	53	34	
						White ash----------	69	64	
						Quaking aspen-------	60	64	
						Tamarack-----------	45	35	
						Green ash----------	69	64	
5---------- Palms	2W	Severe	Severe	Severe	Severe	Red maple----------	55	35	Northern whitecedar, tamarack.
						Silver maple--------	80	34	
						White ash----------	---	---	
						Quaking aspen-------	---	---	
						Northern whitecedar-	---	---	
						Tamarack-----------	61	61	
						Black ash----------	---	---	
7---------- Houghton	2W	Severe	Severe	Severe	Severe	Silver maple--------	82	36	---
						Red maple----------	56	36	
						White ash----------	56	44	
						Quaking aspen-------	60	64	
						Tamarack-----------	52	45	
						Green ash----------	---	---	
						Northern whitecedar-	37	55	
8---------- Edwards	2W	Severe	Severe	Severe	Severe	Red maple----------	56	36	---
						White ash----------	---	---	
						Green ash----------	---	---	
						Tamarack-----------	---	---	
						Swamp white oak-----	---	---	
						Silver maple--------	---	---	
9---------- Martisco	2W	Severe	Severe	Severe	Severe	Red maple----------	55	35	---
12B, 12C, 12D--- Coloma	2A	Slight	Slight	Slight	Slight	Northern pin oak----	49	33	Red pine, eastern white pine, jack pine.
						Jack pine----------	---	---	
						Eastern white pine--	---	---	
						Black oak----------	---	---	
12E---------- Coloma	2R	Moderate	Moderate	Slight	Slight	Northern pin oak----	49	32	Red pine, eastern white pine, jack pine.
						Jack pine----------	---	---	
						Eastern white pine--	---	---	
						Black oak----------	---	---	
13B, 13C, 13D--- Spinks	4A	Slight	Slight	Slight	Moderate	Northern red oak----	66	60	Red pine, eastern white pine, imperial Carolina poplar.
						White oak----------	---	---	
						Black oak----------	---	---	
						Black cherry--------	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Volume*	
13E--Spinks	4R	Moderate	Slight	Slight	Moderate	Northern red oak	66	60	Red pine, eastern white pine, imperial Carolina poplar.
						White oak	---	---	
						Black oak	---	---	
						Black cherry	---	---	
14B--Bronson	4A	Slight	Slight	Slight	Moderate	Northern red oak	66	60	Eastern white pine, red pine, black walnut.
						White oak	66	60	
						Sugar maple	61	38	
						American beech	---	---	
						American basswood	---	---	
						Shagbark hickory	---	---	
						Black walnut	---	---	
15B--Eleva	2D	Slight	Slight	Moderate	Moderate	Black oak	45	30	Jack pine, red pine.
						Northern pin oak	---	---	
						Northern red oak	---	---	
16B, 16C, 16D--Oshtemo	4A	Slight	Slight	Slight	Moderate	Northern red oak	66	60	Eastern white pine, red pine, white spruce.
						White oak	---	---	
						American basswood	66	60	
						Sugar maple	61	38	
16E--Oshtemo	4R	Moderate	Slight	Slight	Moderate	Northern red oak	66	60	Eastern white pine, red pine, white spruce.
						White oak	---	---	
						American basswood	66	60	
						Sugar maple	61	38	
17B, 17C, 17D--Boyer	4A	Slight	Slight	Slight	Moderate	Northern red oak	66	60	Northern red oak, white oak, eastern white pine, red pine.
						White oak	---	---	
						American basswood	---	---	
						Sugar maple	---	---	
						Black oak	---	---	
17E--Boyer	4R	Moderate	Slight	Slight	Moderate	Northern red oak	66	60	Northern red oak, white oak, eastern white pine, red pine.
						White oak	---	---	
						American basswood	---	---	
						Sugar maple	---	---	
						Black oak	---	---	
21B, 21C--Leoni	4A	Slight	Slight	Slight	Moderate	Northern red oak	65	59	Red pine, eastern white pine.
						White oak	---	---	
						American basswood	---	---	
						Sugar maple	---	---	
						White ash	---	---	
						Black walnut	---	---	
						Black cherry	---	---	
22A--Dowagiac	4A	Slight	Slight	Slight	Moderate	Northern red oak	65	59	Black walnut, yellow-poplar, northern red oak, eastern white pine, red pine, white spruce.
						White oak	---	---	
						White ash	61	53	
						Black walnut	---	---	
						Black cherry	---	---	
						Yellow-poplar	---	---	
						Sugar maple	61	38	
						American basswood	61	53	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Volume*	
23B---------- Hixton	4A	Slight	Slight	Slight	Moderate	Northern red oak----	65	59	Northern whitecedar, red pine, white spruce.
						White oak----------	---	---	
						Black oak----------	---	---	
25A, 25B, 25C, 25D---------- Kalamazoo	4A	Slight	Slight	Slight	Moderate	Northern red oak----	65	59	Black walnut, yellow-poplar, eastern white pine, white spruce, Norway spruce, red pine, imperial Carolina poplar.
						White ash----------	65	59	
						Black walnut--------	---	---	
						Yellow-poplar-------	---	---	
						White oak----------	---	---	
						Black cherry--------	---	---	
						American basswood---	65	59	
						Sugar maple---------	61	38	
28B---------- Elmdale	5A	Slight	Slight	Slight	Moderate	Northern red oak----	65	59	Black walnut, yellow-poplar, red pine, eastern white pine.
						White oak----------	---	---	
						Black walnut--------	---	---	
						Black cherry--------	---	---	
						Yellow-poplar-------	---	---	
						Sugar maple---------	60	38	
						American basswood---	---	---	
						White ash----------	---	---	
29B, 29C, 29D--- Hillsdale	4A	Slight	Slight	Slight	Moderate	Northern red oak----	66	60	Black walnut, eastern white pine, white spruce, red pine, yellow-poplar, imperial Carolina poplar.
						White ash----------	---	---	
						Sugar maple---------	---	---	
						Black cherry--------	---	---	
						American basswood---	---	---	
						Yellow-poplar-------	---	---	
29E---------- Hillsdale	4R	Moderate	Slight	Slight	Moderate	Northern red oak----	66	60	Black walnut, eastern white pine, white spruce, red pine, yellow-poplar, imperial Carolina poplar.
						White ash----------	---	---	
						Sugar maple---------	---	---	
						Black cherry--------	---	---	
						American basswood---	---	---	
						Yellow-poplar-------	---	---	
33B, 33C-------- Riddles	5A	Slight	Slight	Slight	Moderate	Northern red oak----	75	73	Black walnut, eastern white pine, red pine, white spruce.
						Red maple----------	75	47	
						White ash----------	75	73	
						Green ash----------	75	73	
						Black walnut--------	---	---	
						Yellow-poplar-------	---	---	
33E---------- Riddles	5R	Moderate	Slight	Slight	Moderate	Northern red oak----	75	73	Black walnut, eastern white pine, red pine, white spruce.
						Red maple----------	75	47	
						White ash----------	75	73	
						Green ash----------	75	73	
						Black walnut--------	---	---	
						Yellow-poplar-------	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Volume*	
38B---------- Morley	5A	Slight	Slight	Slight	Moderate	White oak----------	70	66	White oak, black walnut, green ash, eastern white pine, Norway spruce, red pine, white spruce.
						Northern red oak----	70	66	
						Black walnut--------	---	---	
						Shagbark hickory----	---	---	
39B, 39C, 39D--- Morley	5A	Slight	Slight	Slight	Moderate	White oak----------	70	66	White oak, black walnut, green ash, eastern white pine, Norway spruce, red pine, white spruce.
						Northern red oak----	70	66	
						Black walnut--------	---	---	
						Shagbark hickory----	---	---	
43B---------- Brady	3W	Moderate	Slight	Slight	Moderate	Red maple----------	61	38	Eastern white pine, white spruce.
						White ash----------	---	---	
						Silver maple--------	---	---	
						Bitternut hickory---	---	---	
						Swamp white oak-----	---	---	
						American basswood---	61	53	
44A---------- Matherton	4W	Severe	Slight	Slight	Moderate	Northern red oak----	62	54	White spruce, Norway spruce, eastern white pine.
						Swamp white oak-----	---	---	
						White oak----------	---	---	
						White ash----------	---	---	
						American basswood---	---	---	
						Red maple----------	---	---	
45A---------- Sleeth	4W	Severe	Slight	Slight	Moderate	Northern red oak----	66	60	---
						White oak----------	---	---	
						American basswood---	---	---	
						White ash----------	---	---	
46B---------- Crosier	4W	Moderate	Slight	Slight	Moderate	Northern red oak----	66	60	White spruce, eastern white pine.
						White oak----------	---	---	
						American basswood---	---	---	
						White ash----------	---	---	
47B---------- Teasdale	4W	Moderate	Slight	Slight	Severe	Northern red oak----	66	60	Northern red oak, white spruce, eastern white pine.
						Red maple----------	66	41	
						White ash----------	66	60	
						Eastern cottonwood--	101	130	
						American basswood---	---	---	
						Pin oak------------	---	---	
53A---------- Kibbie	4W	Severe	Slight	Slight	Severe	Northern red oak----	66	60	Imperial Carolina poplar, eastern white pine, Norway spruce.
						Red maple----------	---	---	
						White ash----------	---	---	
						American basswood---	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Volume*	
58B---------- Blount	3C	Severe	Slight	Slight	Severe	Northern red oak----	57	46	Eastern white pine, northern whitecedar, white spruce, Norway spruce, yellow-poplar.
						White oak----------	57	46	
						White ash----------	57	46	
						Sugar maple---------	54	34	
61---------- Algansee	4W	Severe	Slight	Slight	Severe	Silver maple--------	78	32	White spruce, eastern white pine.
						Swamp white oak-----	---	---	
						White ash----------	---	---	
						Red maple----------	56	42	
						American sycamore---	---	---	
						Green ash----------	---	---	
62---------- Granby	2W	Severe	Severe	Severe	Severe	Silver maple--------	82	36	Eastern white pine, white spruce, Austrian pine, northern whitecedar.
						Red maple----------	68	42	
						American basswood---	---	---	
						White ash----------	---	---	
						Eastern cottonwood--	---	---	
63---------- Gilford	2W	Severe	Severe	Severe	Severe	Red maple----------	56	36	Eastern white pine, white spruce.
						Silver maple--------	---	---	
						American basswood---	---	---	
						Bur oak------------	---	---	
						White ash----------	---	---	
						Swamp white oak-----	---	---	
64---------- Cohoctah	2W	Severe	Severe	Severe	Severe	Silver maple--------	80	34	Eastern white pine, white spruce, northern whitecedar.
						Red maple----------	56	36	
						Eastern cottonwood--	---	---	
						White ash----------	---	---	
						Swamp white oak-----	---	---	
						American sycamore---	---	---	
65---------- Sebewa	3W	Severe	Severe	Severe	Severe	Red maple----------	69	42	White ash, white spruce, eastern white pine.
						White ash----------	69	64	
						American basswood---	---	---	
						Swamp white oak-----	---	---	
						Northern red oak----	---	---	
72---------- Barry	2W	Severe	Severe	Severe	Severe	Silver maple--------	74	29	Eastern white pine, white spruce.
						Red maple----------	56	36	
						White ash----------	---	---	
						Eastern cottonwood--	74	77	
						Swamp white oak-----	---	---	
						American sycamore---	---	---	
						Bitternut hickory---	---	---	
						Pin oak------------	---	---	
73---------- Pella	3W	Severe	Moderate	Moderate	Severe	Northern whitecedar-	33	21	Northern whitecedar, white spruce, tamarack, black spruce, green ash.
						American elm--------	---	---	
						White ash----------	---	---	
						Silver maple--------	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Volume*	
78---------- Pewamo	3W	Severe	Severe	Severe	Severe	Red maple----------	66	41	White spruce, eastern white pine.
						American basswood---	66	60	
						Silver maple--------	---	---	
						White ash----------	---	---	
						Black ash----------	---	---	
						Eastern cottonwood--	---	---	
90B, 90C, 90D:									
Coloma---------	2A	Slight	Slight	Slight	Slight	Northern pin oak----	49	33	Red pine, eastern white pine, jack pine.
						Jack pine----------	---	---	
						Eastern white pine--	---	---	
						Black oak----------	---	---	
Boyer----------	4A	Slight	Slight	Slight	Moderate	Northern red oak----	66	60	Northern red oak, white oak, eastern white pine, red pine.
						White oak----------	---	---	
						American basswood---	---	---	
						Sugar maple---------	---	---	
						Black oak----------	---	---	
95B, 95C: Urban land.									
Kalamazoo------	4A	Slight	Slight	Slight	Moderate	Northern red oak----	65	59	Black walnut, yellow-poplar, eastern white pine, white spruce, Norway spruce, red pine, imperial Carolina poplar.
						White ash----------	65	59	
						Black walnut--------	65	---	
						Yellow-poplar-------	---	---	
						White oak----------	---	---	
						Black cherry--------	---	---	
						American basswood---	65	59	
						Sugar maple---------	61	38	
96B, 96C, 96D: Urban land.									
Oshtemo--------	4A	Slight	Slight	Slight	Moderate	Northern red oak----	66	60	Eastern white pine, red pine, white spruce.
						White oak----------	---	---	
						American basswood---	66	60	
						Sugar maple---------	61	38	
113B, 113C: Urban land.									
Coloma---------	2A	Slight	Slight	Slight	Slight	Northern pin oak----	49	33	Red pine, eastern white pine, jack pine.
						Jack pine----------	---	---	
						Eastern white pine--	---	---	
						Black oak----------	---	---	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil or that the soil has never been cleared and windbreaks are not needed)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
4---------- Adrian	Indigo silky dogwood, common ninebark, American cranberrybush, nannyberry viburnum.	Northern whitecedar, tamarack.	Green ash, silver maple, black willow.	---
5---------- Palms	Indigo silky dogwood, common ninebark, nannyberry viburnum, American cranberrybush.	Northern whitecedar, tamarack.	Green ash, silver maple, black willow.	---
7---------- Houghton	Indigo silky dogwood, lilac, Amur privet, common ninebark, nannyberry viburnum.	Northern whitecedar, tamarack.	Green ash, silver maple, black willow.	Imperial Carolina poplar.
8---------- Edwards	Amur privet, nannyberry viburnum, American cranberrybush, indigo silky dogwood, common ninebark, lilac, Amur maple.	White spruce, Siberian crabapple, northern whitecedar.	Green ash----------	Imperial Carolina poplar.
12B, 12C, 12D----- Coloma	Eastern redcedar, Siberian peashrub, lilac, gray dogwood, smooth sumac, Canada buffaloberry.	Eastern white pine, red pine, jack pine.	---	---
13B, 13C, 13D----- Spinks	American cranberrybush, lilac, Siberian peashrub, Amur honeysuckle.	White spruce, eastern redcedar.	Eastern white pine, red pine, green ash, Norway spruce.	Imperial Carolina poplar.
14B---------- Bronson	Indigo silky dogwood, nannyberry viburnum, lilac, common ninebark.	White spruce, midwest Manchurian crabapple.	Eastern white pine, red pine, Norway spruce, green ash.	Imperial Carolina poplar.
15B---------- Eleva	Manyflower cotoneaster, Siberian peashrub, gray dogwood, lilac, Amur maple, eastern redcedar.	Norway spruce---------	Eastern white pine, red pine, jack pine.	---
16B, 16C, 16D----- Oshtemo	Roselow sargent crabapple, lilac, Siberian peashrub, indigo silky dogwood, American cranberrybush, nannyberry viburnum.	Green ash, eastern redcedar.	Eastern white pine, red pine, Norway spruce.	Imperial Carolina poplar.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
17B, 17C, 17D----- Boyer	Amur maple, Siberian peashrub, lilac, Roselow sargent crabapple, midwest Manchurian crabapple.	Red pine, Austrian pine, green ash, eastern redcedar.	Eastern white pine----	---
21B, 21C---------- Leoni	Siberian peashrub, Amur maple, lilac, midwest Manchurian crabapple, nannyberry viburnum, Roselow sargent crabapple.	Red pine, Austrian pine, green ash, eastern redcedar.	Eastern white pine----	---
22A--------------- Dowagiac	Lilac, Amur privet, Amur maple, midwest Manchurian crabapple, autumn-olive, Siberian peashrub, Roselow sargent crabapple.	Eastern redcedar, red pine, Austrian pine, green ash.	Eastern white pine----	---
23B--------------- Hixton	Gray dogwood, Amur maple, lilac, indigo silky dogwood, American cranberrybush.	Norway spruce---------	Eastern white pine, red pine, jack pine.	---
25A, 25B, 25C, 25D---------- Kalamazoo	Lilac, Siberian peashrub, autumn-olive.	Red pine, green ash, eastern redcedar, Austrian pine.	Eastern white pine----	---
28B--------------- Elmdale	Indigo silky dogwood, nannyberry viburnum, lilac, common ninebark, European privet, American cranberrybush.	White spruce, northern whitecedar.	Green ash, red pine, eastern white pine, Norway spruce.	---
29B, 29C, 29D----- Hillsdale	Autumn-olive, lilac, Roselow sargent crabapple, Siberian peashrub.	White spruce, midwest Manchurian crabapple, Austrian pine.	Eastern white pine, red pine, Norway spruce.	Imperial Carolina poplar.
33B, 33C---------- Riddles	Indigo silky dogwood, Siberian peashrub, lilac, Amur maple.	Northern whitecedar, Black Hills spruce, Siberian crabapple.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
38B--------------- Morley	Eastern redcedar, lilac, Siberian peashrub, northern whitecedar.	Hackberry, Russian-olive, white spruce.	Eastern white pine, red pine, white ash, green ash, red maple.	---
39B, 39C, 39D----- Morley	Eastern redcedar, lilac, Siberian peashrub, northern whitecedar.	Red pine, hackberry, Russian-olive, white spruce.	Eastern white pine, red maple, green ash, white ash.	---

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
43B---------- Brady	Indigo silky dogwood, lilac, nannyberry viburnum, American cranberrybush.	White spruce, northern whitecedar, blue spruce, Amur maple.	Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
44A---------- Matherton	Nannyberry viburnum, American cranberrybush.	Northern whitecedar, white spruce, midwest Manchurian crabapple, Amur maple.	Eastern white pine, Norway spruce.	Imperial Carolina poplar.
45A---------- Sleeth	Redosier dogwood, common ninebark, American cranberrybush, silky dogwood, arrowwood.	White spruce, eastern white pine, northern whitecedar, Austrian pine, Siberian crabapple.	Norway spruce, red maple.	---
46B---------- Crosier	Redosier dogwood, common ninebark, American cranberrybush, indigo silky dogwood, arrowwood.	White spruce, eastern white pine, northern whitecedar, Austrian pine, Siberian crabapple.	Norway spruce, red maple.	---
47B---------- Teasdale	American cranberrybush, Amur privet, lilac, indigo silky dogwood, nannyberry viburnum, Roselow sargent crabapple.	White spruce, northern whitecedar, midwest Manchurian crabapple.	Eastern white pine, green ash, Norway spruce.	---
53A---------- Kibbie	Common ninebark, indigo silky dogwood, nannyberry viburnum, lilac, American cranberrybush.	Northern whitecedar, white spruce, midwest Manchurian crabapple.	Eastern white pine, green ash, Norway spruce.	---
58B---------- Blount	American cranberrybush, Amur privet, white spruce, late lilac, northern whitecedar.	---	White ash, red pine, eastern white pine, Norway spruce, red maple, silver maple.	Green ash.
61---------- Algansee	Indigo silky dogwood, lilac, American cranberrybush.	Northern whitecedar, midwest Manchurian crabapple, Amur maple, white spruce.	Green ash, eastern white pine, Norway spruce, red maple.	Imperial Carolina poplar.
62---------- Granby	Eastern white pine, indigo silky dogwood, Manchurian crabapple.	Northern whitecedar, imperial Carolina poplar, green ash.	Norway spruce, white spruce, lilac.	Amur privet, American cranberrybush, nannyberry viburnum.
63---------- Gilford	Indigo silky dogwood, American cranberrybush, Amur privet, lilac, nannyberry viburnum.	Northern whitecedar, white spruce, midwest Manchurian crabapple.	Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
64---------- Cohoctah	Amur privet, American cranberrybush, lilac, nannyberry viburnum, indigo silky dogwood.	Northern whitecedar, midwest Manchurian crabapple, white spruce.	Green ash, Norway spruce, eastern white pine.	Imperial Carolina poplar.
65---------- Sebewa	Indigo silky dogwood, Amur privet, American cranberrybush, lilac, nannyberry viburnum.	White spruce, northern whitecedar.	Eastern white pine, Norway spruce, green ash.	Imperial Carolina poplar.
72---------- Barry	Indigo silky dogwood, American cranberrybush, lilac, Amur privet.	White spruce, midwest Manchurian crabapple, northern whitecedar.	Norway spruce, green ash, white ash, red maple.	Imperial Carolina poplar.
73---------- Pella	Indigo silky dogwood, redosier dogwood, common ninebark, nannyberry viburnum, American cranberrybush, northern whitecedar.	Balsam fir, white spruce.	Green ash, white ash, red maple, silver maple.	---
78---------- Pewamo	Amur maple, American cranberrybush, lilac, northern whitecedar, indigo silky dogwood, Amur privet, common ninebark.	Norway spruce, Siberian crabapple, eastern white pine, white spruce.	Green ash----------	---
90B, 90C, 90D:				
Coloma----------	Eastern redcedar, Siberian peashrub, lilac, American cranberrybush, indigo silky dogwood, gray dogwood, Amur maple.	Eastern white pine, red pine, jack pine.	---	---
Boyer----------	Amur maple, Siberian peashrub, lilac, Roselow sargent crabapple, midwest Manchurian crabapple.	Red pine, Austrian pine, green ash, eastern redcedar.	Eastern white pine----	---
95B, 95C:				
Urban land.				
Kalamazoo--------	Lilac, Siberian peashrub, autumn-olive.	Red pine, green ash, eastern redcedar, Austrian pine.	Eastern white pine----	---
96B, 96C, 96D:				
Urban land.				
Oshtemo----------	Roselow sargent crabapple, lilac, Siberian peashrub, indigo silky dogwood, American cranberrybush, nannyberry viburnum.	Green ash, eastern redcedar.	Eastern white pine, red pine, Norway spruce.	Imperial Carolina poplar.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
113B, 113C: Urban land.				
Coloma	Eastern redcedar, Siberian peashrub, lilac, American cranberrybush, indigo silky dogwood, gray dogwood, Amur maple.	Eastern white pine, red pine, jack pine.	---	---

TABLE 10.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
2--- Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
4--- Adrian	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
5--- Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
7--- Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
8--- Edwards	Severe: ponding, percs slowly, excess humus.	Severe: ponding, excess humus, percs slowly.	Severe: excess humus, ponding, percs slowly.	Severe: ponding, excess humus.
9--- Martisco	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
12B--- Coloma	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.
12C--- Coloma	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
12D--- Coloma	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.
12E--- Coloma	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
13B--- Spinks	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
13C--- Spinks	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
13D--- Spinks	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.
13E--- Spinks	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
14B--- Bronson	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
15B---------- Eleva	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
16B---------- Oshtemo	Slight----------	Slight----------	Moderate: slope, small stones.	Slight.
16C---------- Oshtemo	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
16D---------- Oshtemo	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
16E---------- Oshtemo	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
17B---------- Boyer	Slight----------	Slight----------	Moderate: slope, small stones.	Slight.
17C---------- Boyer	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
17D---------- Boyer	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
17E---------- Boyer	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
21B---------- Leoni	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
21C---------- Leoni	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
22A---------- Dowagiac	Slight----------	Slight----------	Slight----------	Slight.
23B---------- Hixton	Slight----------	Slight----------	Moderate: slope, depth to rock.	Slight.
25A, 25B---------- Kalamazoo	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
25C---------- Kalamazoo	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
25D---------- Kalamazoo	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.
28B---------- Elmdale	Moderate: wetness.	Moderate: wetness.	Moderate: slope, small stones.	Slight.
29B---------- Hillsdale	Slight----------	Slight----------	Moderate: slope, small stones.	Slight.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
29C---------- Hillsdale	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
29D, 29E---------- Hillsdale	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
33B---------- Riddles	Slight----------	Slight----------	Moderate: slope, small stones.	Slight.
33C---------- Riddles	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
33E---------- Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
38B, 39B---------- Morley	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.
39C---------- Morley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
39D---------- Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
43B---------- Brady	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
44A---------- Matherton	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
45A---------- Sleeth	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
46B---------- Crosier	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
47B---------- Teasdale	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
53A---------- Kibbie	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
58B---------- Blount	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
61---------- Algansee	Severe: flooding, wetness, too sandy.	Severe: too sandy.	Severe: too sandy, wetness.	Severe: too sandy.
62---------- Granby	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
63---------- Gilford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
64--- Cohoctah	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.
65--- Sebewa	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
72--- Barry	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
73--- Pella	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
78--- Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
82: Udipsamments---	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Udorthents---	Variable---	Variable---	Variable---	Variable.
83. Pits				
84: Histosols---	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Aquents---	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
85: Histosols---	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Fluvaquents---	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.
87: Hapludalfs. Udipsamments. Histosols.				
90B: Coloma---	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.
Boyer---	Slight---	Slight---	Moderate: slope, small stones.	Slight.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
90C:				
Coloma	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
Boyer	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
90D:				
Coloma	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.
Boyer	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
95B:				
Urban land	Variable	Variable	Variable	Variable.
Kalamazoo	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
95C:				
Urban land	Variable	Variable	Variable	Variable.
Kalamazoo	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
96B:				
Urban land	Variable	Variable	Variable	Variable.
Oshtemo	Slight	Slight	Moderate: slope, small stones.	Slight.
96C:				
Urban land	Variable	Variable	Variable	Variable.
Oshtemo	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
96D:				
Urban land	Variable	Variable	Variable	Variable.
Oshtemo	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
99--- Urban land	Variable	Variable	Variable	Variable.
113B:				
Urban land	Variable	Variable	Variable	Variable.
Coloma	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
113C:				
Urban land	Variable	Variable	Variable	Variable.
Coloma	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.

TABLE 11.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
2---- Houghton	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
4---- Adrian	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
5---- Palms	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
7---- Houghton	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
8---- Edwards	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
9---- Martisco	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
12B---- Coloma	Fair	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
12C, 12D---- Coloma	Poor	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
12E---- Coloma	Very poor.	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
13B---- Spinks	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
13C, 13D---- Spinks	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
13E---- Spinks	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
14B---- Bronson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
15B---- Eleva	Good	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
16B---- Oshtemo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
16C---- Oshtemo	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
16D---- Oshtemo	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
16E---- Oshtemo	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
17B---- Boyer	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
17C---------- Boyer	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
17D---------- Boyer	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
17E---------- Boyer	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
21B---------- Leoni	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
21C---------- Leoni	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
22A---------- Dowagiac	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
23B---------- Hixton	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
25A, 25B---------- Kalamazoo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
25C, 25D---------- Kalamazoo	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
28B---------- Elmdale	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Poor.
29B---------- Hillsdale	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
29C---------- Hillsdale	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
29D, 29E---------- Hillsdale	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
33B---------- Riddles	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
33C---------- Riddles	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
33E---------- Riddles	Very poor.	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
38B, 39B---------- Morley	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
39C---------- Morley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
39D---------- Morley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
43B---------- Brady	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
44A---------- Matherton	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
45A---------- Sleeth	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
46B---------- Crosier	Fair	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
47B---------- Teasdale	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
53A---------- Kibbie	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
58B---------- Blount	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
61---------- Algansee	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
62---------- Granby	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
63---------- Gilford	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
64---------- Cohoctah	Very poor.	Fair	Fair	Good	Good	Good	Good	Fair	Good	Good.
65---------- Sebewa	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
72---------- Barry	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
73---------- Pella	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
78---------- Pewamo	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
82: Udipsamments.										
Udorthents.										
83. Pits										
84: Histosols.										
Aquents.										
85: Histosols.										
Fluvaquents.										
87: Hapludalfs.										

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
87: Udipsamments. Histosols.										
90B: Coloma	Fair	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
Boyer	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
90C, 90D: Coloma	Poor	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
Boyer	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
95B: Urban land.										
Kalamazoo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
95C: Urban land.										
Kalamazoo	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
96B: Urban land.										
Oshtemo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
96C: Urban land.										
Oshtemo	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
96D: Urban land.										
Oshtemo	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
99. Urban land										
113B: Urban land.										
Coloma	Fair	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
113C: Urban land.										

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
113C: Coloma----------	Poor	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.

TABLE 12.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2---------- Houghton	Severe: ponding, excess humus.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: excess humus, ponding.
4---------- Adrian	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
5---------- Palms	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
7---------- Houghton	Severe: ponding, excess humus.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: excess humus, ponding.
8---------- Edwards	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
9---------- Martisco	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
12B---------- Coloma	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: large stones, droughty.
12C---------- Coloma	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
12D, 12E---------- Coloma	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
13B---------- Spinks	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
13C---------- Spinks	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
13D, 13E---------- Spinks	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
14B---------- Bronson	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
15B---------- Eleva	Severe: cutbanks cave.	Slight---------	Moderate: depth to rock.	Slight---------	Moderate: frost action.	Moderate: small stones, droughty.
16B---------- Oshtemo	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
16C---------- Oshtemo	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
16D, 16E---------- Oshtemo	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
17B---------- Boyer	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Moderate: droughty.
17C---------- Boyer	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
17D, 17E---------- Boyer	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
21B---------- Leoni	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Moderate: small stones, large stones.
21C---------- Leoni	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: small stones, large stones, slope.
22A---------- Dowagiac	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Slight.
23B---------- Hixton	Severe: cutbanks cave.	Slight---------	Moderate: depth to rock.	Slight---------	Moderate: frost action.	Moderate: depth to rock.
25A---------- Kalamazoo	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Moderate: small stones.
25B---------- Kalamazoo	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Moderate: small stones.
25C---------- Kalamazoo	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: small stones, slope.
25D---------- Kalamazoo	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
28B---------- Elmdale	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Moderate: wetness, frost action.	Moderate: large stones.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
29B---------- Hillsdale	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
29C---------- Hillsdale	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
29D, 29E---------- Hillsdale	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
33B---------- Riddles	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Slight.
33C---------- Riddles	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
33E---------- Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
38B---------- Morley	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
39B---------- Morley	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
39C---------- Morley	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
39D---------- Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
43B---------- Brady	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
44A---------- Matherton	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
45A---------- Sleeth	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
46B---------- Crosier	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
47B---------- Teasdale	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
53A---------- Kibbie	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
58B---------- Blount	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
61---------- Algansee	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, droughty, flooding.
62---------- Granby	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
63---------- Gilford	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
64---------- Cohoctah	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: ponding, flooding.
65---------- Sebewa	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
72---------- Barry	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
73---------- Pella	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
78---------- Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
82: Udipsamments-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Udorthents-------	Variable-------	Variable-------	Variable-------	Variable-------	Variable-------	Variable.
83. Pits						
84: Histosols--------	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Aquents----------	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
85:						
Histosols	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Fluvaquents	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding, flooding.
87:						
Hapludalfs.						
Udipsamments.						
Histosols.						
90B:						
Coloma	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: large stones, droughty.
Boyer	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Moderate: droughty.
90C:						
Coloma	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
Boyer	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
90D:						
Coloma	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Boyer	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
95B:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Kalamazoo	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Moderate: small stones.
95C:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Kalamazoo	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: small stones, slope.
96B:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
96B:						
Oshtemo	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
96C:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Oshtemo	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
96D:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Oshtemo	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
99---- Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
113B:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Coloma	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: large stones, droughty.
113C:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Coloma	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.

TABLE 13.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2--- Houghton	Severe: subsides, ponding, percs slowly.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
4--- Adrian	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
5--- Palms	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
7--- Houghton	Severe: subsides, ponding, percs slowly.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
8--- Edwards	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
9--- Martisco	Severe: ponding, percs slowly.	Severe: seepage, excess humus.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, excess humus.
12B--- Coloma	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
12C--- Coloma	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
12D, 12E--- Coloma	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
13B--- Spinks	Slight---	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
13C--- Spinks	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
13D, 13E--- Spinks	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
14B---------- Bronson	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: thin layer.
15B---------- Eleva	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.
16B---------- Oshtemo	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
16C---------- Oshtemo	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage.
16D, 16E---------- Oshtemo	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, slope.
17B---------- Boyer	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
17C---------- Boyer	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
17D, 17E---------- Boyer	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
21B---------- Leoni	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: small stones.
21C---------- Leoni	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: small stones.
22A---------- Dowagiac	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
23B---------- Hixton	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.
25A, 25B---------- Kalamazoo	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
25C---------- Kalamazoo	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
25D---------- Kalamazoo	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope, thin layer.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
28B---------- Elmdale	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too sandy, wetness.
29B---------- Hillsdale	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
29C---------- Hillsdale	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
29D, 29E---------- Hillsdale	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
33B---------- Riddles	Moderate: percs slowly.	Moderate: seepage, slope.	Slight----------	Slight----------	Fair: small stones.
33C---------- Riddles	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
33E---------- Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
38B---------- Morley	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
39B---------- Morley	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
39C---------- Morley	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
39D---------- Morley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
43B---------- Brady	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness, thin layer.
44A---------- Matherton	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
45A---------- Sleeth	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.
46B---------- Crosier	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
47B---------- Teasdale	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
53A---------- Kibbie	Severe: wetness.	Severe: wetness.	Severe: wetness, too sandy.	Severe: wetness.	Poor: too sandy, wetness.
58B---------- Blount	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
61---------- Algansee	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
62---------- Granby	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
63---------- Gilford	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
64---------- Cohoctah	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, thin layer.
65---------- Sebewa	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
72---------- Barry	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding.
73---------- Pella	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
78---------- Pewamo	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
82:					
Udipsamments-------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Udorthents---------	Variable---------	Variable---------	Variable---------	Variable---------	Variable.
83. Pits					
84:					
Histosols----------	Severe: ponding.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, excess humus.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
84:					
Aquents	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
85:					
Histosols	Severe: ponding.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, excess humus.
Fluvaquents	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
87:					
Hapludalfs.					
Udipsamments.					
Histosols.					
90B:					
Coloma	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Boyer	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
90C:					
Coloma	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Boyer	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
90D:					
Coloma	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Boyer	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
95B:					
Urban land	Variable	Variable	Variable	Variable	Variable.
Kalamazoo	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
95C:					
Urban land	Variable	Variable	Variable	Variable	Variable.
Kalamazoo	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: thin layer.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
96B:					
Urban land	Variable	Variable	Variable	Variable	Variable.
Oshtemo	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
96C:					
Urban land	Variable	Variable	Variable	Variable	Variable.
Oshtemo	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage.
96D:					
Urban land	Variable	Variable	Variable	Variable	Variable.
Oshtemo	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, slope.
99--- Urban land	Variable	Variable	Variable	Variable	Variable.
113B:					
Urban land	Variable	Variable	Variable	Variable	Variable.
Coloma	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
113C:					
Urban land	Variable	Variable	Variable	Variable	Variable.
Coloma	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

TABLE 14.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
2---------- Houghton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
4---------- Adrian	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: excess humus, wetness.
5---------- Palms	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
7---------- Houghton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
8---------- Edwards	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
9---------- Martisco	Poor: thin layer, wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
12B, 12C---------- Coloma	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy, small stones.
12D---------- Coloma	Fair: slope.	Probable----------	Improbable: too sandy.	Poor: too sandy, small stones, slope.
12E---------- Coloma	Poor: slope.	Probable----------	Improbable: too sandy.	Poor: too sandy, small stones, slope.
13B---------- Spinks	Good----------	Probable----------	Improbable: too sandy.	Fair: too sandy.
13C---------- Spinks	Good----------	Probable----------	Improbable: too sandy.	Fair: slope, too sandy.
13D---------- Spinks	Fair: slope.	Probable----------	Improbable: too sandy.	Poor: slope.
13E---------- Spinks	Poor: slope.	Probable----------	Improbable: too sandy.	Poor: slope.
14B---------- Bronson	Fair: wetness.	Probable----------	Improbable*: too sandy.	Poor: small stones, area reclaim.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
15B---------- Eleva	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
16B, 16C---------- Oshtemo	Good----------	Probable----------	Improbable*: too sandy.	Poor: small stones.
16D---------- Oshtemo	Fair: slope.	Probable----------	Improbable*: too sandy.	Poor: small stones, slope.
16E---------- Oshtemo	Poor: slope.	Probable----------	Improbable*: too sandy.	Poor: small stones, slope.
17B, 17C---------- Boyer	Good----------	Probable----------	Improbable*: too sandy.	Poor: small stones, area reclaim.
17D---------- Boyer	Fair: slope.	Probable----------	Improbable*: too sandy.	Poor: small stones, area reclaim, slope.
17E---------- Boyer	Poor: slope.	Probable----------	Improbable*: too sandy.	Poor: small stones, area reclaim, slope.
21B, 21C---------- Leoni	Good----------	Probable----------	Probable----------	Poor: small stones, area reclaim.
22A---------- Dowagiac	Good----------	Probable----------	Probable----------	Poor: small stones, area reclaim.
23B---------- Hixton	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey.
25A, 25B, 25C--------- Kalamazoo	Good----------	Probable----------	Improbable*: too sandy.	Poor: small stones, area reclaim.
25D---------- Kalamazoo	Fair: slope.	Probable----------	Improbable*: too sandy.	Poor: small stones, area reclaim, slope.
28B---------- Elmdale	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
29B, 29C---------- Hillsdale	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
29D, 29E---------- Hillsdale	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
33B, 33C---------- Riddles	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
33E---------- Riddles	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
38B, 39B, 39C---------- Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
39D---------- Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
43B---------- Brady	Fair: wetness.	Probable----------	Improbable*: too sandy.	Poor: small stones.
44A---------- Matherton	Fair: wetness.	Probable----------	Probable----------	Poor: small stones, area reclaim.
45A---------- Sleeth	Fair: wetness.	Probable----------	Improbable: too sandy.	Fair: too clayey, small stones.
46B---------- Crosier	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
47B---------- Teasdale	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
53A---------- Kibbie	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
58B---------- Blount	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
61---------- Algansee	Fair: wetness.	Probable----------	Improbable: too sandy.	Poor: too sandy.
62---------- Granby	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: too sandy, wetness.
63---------- Gilford	Poor: wetness.	Probable----------	Improbable*: too sandy.	Poor: area reclaim, wetness.
64---------- Cohoctah	Poor: wetness.	Probable----------	Probable----------	Poor: area reclaim, wetness.
65---------- Sebewa	Poor: wetness.	Probable----------	Probable----------	Poor: small stones, area reclaim, wetness.
72---------- Barry	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
73--- Pella	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
78--- Pewamo	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, wetness.
82:				
Udipsamments---	Good---	Probable---	Improbable: too sandy.	Poor: too sandy.
Udorthents---	Variable---	Variable---	Variable---	Variable.
83. Pits				
84:				
Histosols---	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Aquents---	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
85:				
Histosols---	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Fluvaquents---	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
87: Hapludalfs. Udipsamments. Histosols.				
90B, 90C:				
Coloma---	Good---	Probable---	Improbable: too sandy.	Poor: too sandy, small stones.
Boyer---	Good---	Probable---	Improbable*: too sandy.	Poor: small stones, area reclaim.
90D:				
Coloma---	Fair: slope.	Probable---	Improbable: too sandy.	Poor: too sandy, small stones, slope.
Boyer---	Fair: slope.	Probable---	Improbable*: too sandy.	Poor: small stones, area reclaim, slope.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
95B, 95C:				
Urban land	Variable	Variable	Variable	Variable.
Kalamazoo	Good	Probable	Improbable*: too sandy.	Poor: small stones, area reclaim.
96B, 96C:				
Urban land	Variable	Variable	Variable	Variable.
Oshtemo	Good	Probable	Probable	Poor: small stones.
96D:				
Urban land	Variable	Variable	Variable	Variable.
Oshtemo	Fair: slope.	Probable	Improbable: too sandy.	Poor: small stones, slope.
99 Urban land	Variable	Variable	Variable	Variable.
113B, 113C:				
Urban land	Variable	Variable	Variable	Variable.
Coloma	Good	Probable	Improbable: too sandy.	Poor: too sandy, small stones.

* Some of the deeper layers (below a depth of 5 feet) may be probable sources.

TABLE 15.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
2----- Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Frost action, subsides, ponding.	Ponding, soil blowing.	Wetness.
4----- Adrian	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing, rooting depth.	Wetness, rooting depth.
5----- Palms	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness, erodes easily, rooting depth.
7----- Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Frost action, subsides, ponding.	Ponding, soil blowing.	Wetness.
8----- Edwards	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, percs slowly, subsides.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
9----- Martisco	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, percs slowly.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
12B----- Coloma	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
12C, 12D, 12E----- Coloma	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
13B----- Spinks	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
13C, 13D, 13E----- Spinks	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
14B----- Bronson	Severe: seepage.	Severe: thin layer, wetness.	Severe: cutbanks cave.	Frost action, slope, cutbanks cave.	Slope, wetness.	Favorable.
15B----- Eleva	Severe: seepage.	Slight---------	Severe: no water.	Deep to water	Slope, droughty.	Droughty, depth to rock.
16B----- Oshtemo	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Favorable.
16C, 16D, 16E----- Oshtemo	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
17B---------- Boyer	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Droughty.
17C, 17D, 17E----- Boyer	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, droughty.
21B---------- Leoni	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, droughty.	Droughty.
21C---------- Leoni	Severe: seepage, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, droughty.	Slope, droughty.
22A---------- Dowagiac	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Favorable------	Favorable.
23B---------- Hixton	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, depth to rock.	Depth to rock.
25A---------- Kalamazoo	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Favorable------	Favorable.
25B---------- Kalamazoo	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Slope----------	Favorable.
25C, 25D---------- Kalamazoo	Severe: seepage, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope----------	Slope.
28B---------- Elmdale	Moderate: seepage, slope.	Severe: piping.	Severe: cutbanks cave.	Slope, cutbanks cave.	Slope, wetness, soil blowing.	Favorable.
29B---------- Hillsdale	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Rooting depth.
29C, 29D, 29E----- Hillsdale	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Slope, rooting depth.
33B---------- Riddles	Moderate: seepage, slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Slope----------	Favorable.
33C, 33E---------- Riddles	Severe: slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Slope----------	Slope.
38B---------- Morley	Moderate: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, percs slowly.	Erodes easily, rooting depth.
39B---------- Morley	Moderate: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, percs slowly, erodes easily.	Erodes easily, percs slowly.
39C, 39D---------- Morley	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, percs slowly, erodes easily.	Slope, erodes easily, percs slowly.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
43B---------- Brady	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action---	Wetness--------	Wetness.
44A---------- Matherton	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness--------	Wetness.
45A---------- Sleeth	Severe: seepage.	Severe: wetness.	Severe: cutbanks cave.	Frost action---	Wetness--------	Wetness.
46B---------- Crosier	Slight---------	Severe: thin layer, wetness.	Severe: slow refill.	Frost action---	Wetness--------	Wetness.
47B---------- Teasdale	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action---	Wetness, soil blowing.	Wetness, rooting depth.
53A---------- Kibbie	Moderate: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness--------	Wetness, erodes easily.
58B---------- Blount	Slight---------	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, erodes easily, rooting depth.
61---------- Algansee	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty.	Wetness, droughty.
62---------- Granby	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty.
63---------- Gilford	Severe: seepage.	Severe: seepage, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, soil blowing, rooting depth.	Wetness, rooting depth.
64---------- Cohoctah	Severe: seepage.	Severe: piping, ponding.	Severe: cutbanks cave.	Ponding, flooding, frost action.	Ponding, flooding.	Wetness.
65---------- Sebewa	Severe: seepage.	Severe: seepage, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, rooting depth.	Wetness, rooting depth.
72---------- Barry	Severe: seepage.	Severe: thin layer, ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding--------	Wetness.
73---------- Pella	Moderate: seepage.	Severe: piping, ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding--------	Wetness.
78---------- Pewamo	Slight---------	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Wetness, erodes easily.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
82:						
Udipsamments	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
Udorthents	Variable	Variable	Variable	Variable	Variable	Variable.
83.						
Pits						
84:						
Histosols	Slight	Severe: excess humus, ponding.	Slight	Ponding, frost action.	Ponding, soil blowing.	Wetness.
Aquents	Slight	Severe: ponding.	Slight	Ponding, frost action.	Ponding	Wetness.
85:						
Histosols	Slight	Severe: excess humus, ponding.	Slight	Ponding, frost action.	Ponding, soil blowing.	Wetness.
Fluvaquents	Slight	Severe: ponding.	Slight	Ponding, flooding.	Ponding, flooding.	Wetness.
87:						
Hapludalfs.						
Udipsamments.						
Histosols.						
90B:						
Coloma	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Boyer	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
90C, 90D:						
Coloma	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
Boyer	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
95B:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Kalamazoo	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Slope	Favorable.
95C:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Kalamazoo	Severe: seepage, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope	Slope.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
96B:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Oshtemo	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Favorable.
96C, 96D:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Oshtemo	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope.
99--- Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
113B:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Coloma	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
113C:						
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Coloma	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.

TABLE 16.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
2----------	0-7	Muck----------	PT	A-8	0	---	---	---	---	---	---
Houghton	7-60	Muck----------	PT	A-8	0	---	---	---	---	---	---
4----------	0-25	Muck----------	PT	A-8	---	---	---	---	---	---	---
Adrian	25-60	Sand, fine sand, gravelly loamy sand.	SP, SM	A-2, A-3, A-1	0	80-100	60-100	30-80	0-35	---	NP
5----------	0-9	Muck----------	PT	A-8	0	---	---	---	---	---	---
Palms	9-18	Muck----------	PT	A-8	0	---	---	---	---	---	---
	18-60	Clay loam, silty clay loam, gravelly sandy loam.	CL-ML, CL, SC, SC-SM	A-4, A-6, A-7, A-2	0	85-100	60-100	35-95	15-90	20-45	5-20
7----------	0-7	Muck----------	PT	A-8	0	---	---	---	---	---	---
Houghton	7-60	Muck----------	PT	A-8	0	---	---	---	---	---	---
8----------	0-21	Muck----------	PT	A-8	0	---	---	---	---	---	---
Edwards	21-60	Marl----------	---	---	0	---	---	---	---	---	---
9----------	0-13	Muck----------	PT	A-8	0	---	---	---	---	---	---
Martisco	13-60	Marl----------	---	---	0	---	---	---	---	---	---
12B, 12C----------	0-8	Loamy sand-------	SM	A-2, A-4	0-7	75-100	75-100	50-80	15-30	---	NP
Coloma	8-30	Sand----------	SP, SM, SP-SM	A-2, A-3	0-7	75-100	75-100	40-75	2-15	---	NP
	30-80	Stratified sand to sandy loam.	SP, SM, SP-SM	A-2, A-3, A-4	0-7	75-100	75-100	40-85	2-40	---	NP
12D----------	0-6	Loamy sand-------	SM	A-2, A-4	0-7	75-100	75-100	50-90	15-30	---	NP
Coloma	6-25	Sand----------	SP, SM, SP-SM	A-2, A-3	0-7	75-100	75-100	40-75	2-15	---	NP
	25-80	Stratified sand to sandy loam.	SP, SM, SP-SM	A-2, A-3, A-4	0-7	75-100	75-100	40-85	2-40	---	NP
12E----------	0-3	Loamy sand-------	SM	A-2, A-4	0-7	75-100	75-100	50-90	15-30	---	NP
Coloma	3-30	Sand----------	SP, SM, SP-SM	A-2, A-3	0-7	75-100	75-100	50-75	2-15	---	NP
	30-80	Stratified sand to sandy loam.	SP, SM, SP-SM	A-2, A-3, A-4	0-7	75-100	75-100	40-85	2-40	---	NP
13B, 13C----------	0-9	Loamy sand-------	SM, SC-SM, SP-SM	A-2-4, A-1-b	0	95-100	75-100	35-80	10-30	<25	NP-7
Spinks	9-30	Loamy sand, sand, loamy fine sand.	SM, SP-SM, SC-SM	A-2-4, A-3, A-1-b	0	95-100	75-100	35-90	5-35	<25	NP-7
	30-70	Sand, loamy sand, sandy loam.	SM, SP-SM, SC-SM	A-2-4, A-1-b	0	95-100	75-100	40-85	10-35	<25	NP-7
13D----------	0-8	Loamy sand-------	SM, SC-SM, SP-SM	A-2-4, A-1-b	0	95-100	75-100	35-80	10-30	<25	NP-7
Spinks	8-30	Loamy sand, sand, loamy fine sand.	SM, SP-SM, SC-SM	A-2-4, A-3, A-1-b	0	95-100	75-100	35-90	5-35	<25	NP-7
	30-70	Sand, loamy sand, sandy loam.	SM, SP-SM, SC-SM	A-2-4, A-1-b	0	95-100	75-100	40-85	10-35	<25	NP-7

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
13E---------- Spinks	0-6	Loamy sand-------	SM, SC-SM, SP-SM	A-2-4, A-1-b	0	95-100	75-100	35-90	10-30	<25	NP-7
	6-30	Loamy sand, sand, loamy fine sand.	SM, SP-SM, SC-SM	A-2-4, A-3, A-1-b	0	95-100	75-100	35-90	5-35	<25	NP-7
	30-70	Sand, loamy fine sand.	SM, SP-SM, SC-SM	A-2-4, A-1-b	0	95-100	75-100	40-90	10-35	<25	NP-7
14B---------- Bronson	0-8	Sandy loam-------	SM, SC-SM	A-2, A-4	0-5	95-100	90-100	55-70	25-40	<25	NP-7
	8-14	Sandy loam-------	SC-SM, SM	A-2, A-4	0-5	95-100	90-100	55-70	25-40	<25	NP-7
	14-44	Sandy loam, sandy clay loam.	SC, SC-SM	A-2, A-4, A-6, A-1	0-5	80-95	75-90	45-85	20-50	20-30	4-11
	44-47	Loamy sand, gravelly loamy sand.	SM, SP-SM	A-2, A-1	0-5	80-95	60-90	30-70	10-25	<20	NP-4
	47-60	Sand, gravelly coarse sand.	SP, SP-SM	A-1, A-2, A-3	0-10	80-100	50-100	30-70	0-10	---	NP
15B---------- Eleva	0-9	Sandy loam-------	SM, SC-SM, ML, CL-ML	A-4, A-2-4, A-1-b	0	75-100	70-100	40-90	20-55	<25	NP-7
	9-29	Sandy loam, loam	CL, SC, ML, SM	A-4, A-2-4, A-1-b	0-2	75-100	70-100	40-95	20-75	<30	3-9
	29	Weathered bedrock	---	---	---	---	---	---	---	---	---
16B, 16C---------- Oshtemo	0-9	Sandy loam-------	SM, SC-SM, ML, CL-ML	A-2, A-4	0	95-100	85-95	50-85	25-55	<20	NP-4
	9-47	Sandy loam, sandy clay loam, gravelly sandy loam.	SC, SC-SM	A-2, A-4, A-1	0	80-100	55-95	35-85	15-50	20-30	4-10
	47-70	Sandy loam, gravelly sandy loam, sand.	SM, SP-SM	A-2, A-1	0	80-95	55-95	35-70	5-35	---	NP
	70-80	Sand, gravelly sand, fine sand.	SP-SM, SP	A-1, A-2, A-3	0-5	70-100	50-90	20-60	0-10	---	NP
16D, 16E---------- Oshtemo	0-8	Sandy loam-------	SM, SC-SM, ML, CL-ML	A-2, A-4	0	95-100	85-95	50-85	25-55	<20	NP-4
	8-33	Sandy loam, sandy clay loam, gravelly sandy loam.	SC, SC-SM	A-2, A-4, A-1	0	80-100	55-95	35-85	15-50	20-30	4-10
	33-47	Loamy sand, sandy loam, gravelly sandy loam, sand.	SM, SP-SM	A-2, A-1	0	80-95	55-95	35-70	5-35	---	NP
	47-70	Sand, gravelly sand, fine sand.	SP-SM, SP	A-1, A-2, A-3	0-5	70-100	50-90	20-60	0-10	---	NP
17B---------- Boyer	0-10	Sandy loam-------	SM, SC-SM	A-2, A-4, A-1	0-5	90-100	75-95	45-85	20-50	<25	NP-7
	10-14	Loamy sand-------	SM, SC-SM	A-2, A-4, A-1-b	0-5	85-100	60-95	30-75	10-30	<20	NP-4
	14-37	Sandy loam, gravelly sandy loam, loamy sand.	SC, SC-SM	A-2, A-4, A-1-b	0-5	80-100	60-95	35-75	15-50	20-30	5-10
	37-60	Sand, coarse sand, gravelly sand.	SP, SP-SM	A-1, A-2, A-3	0-10	70-100	50-100	30-70	0-10	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
17C---------- Boyer	0-9	Sandy loam-------	SM, SC-SM	A-2, A-4, A-1	0-5	90-100	75-95	45-85	20-50	<25	NP-7
	9-15	Loamy sand-------	SM, SC-SM	A-2, A-4, A-1-b	0-5	85-100	60-95	30-75	10-30	<20	NP-4
	15-35	Sandy loam, gravelly sandy loam, loamy sand.	SC, SC-SM	A-2, A-4, A-1-b	0-5	80-100	60-95	35-75	15-50	20-30	5-10
	35-60	Sand, coarse sand, gravelly sand.	SP, SP-SM	A-1, A-2, A-3	0-10	70-100	50-100	30-70	0-10	---	NP
17D, 17E---------- Boyer	0-4	Sandy loam-------	SM, SC-SM	A-2, A-4, A-1	0-5	90-100	75-95	45-85	20-50	<25	NP-7
	4-17	Loamy sand-------	SM, SC-SM	A-2, A-4, A-1-b	0-5	85-100	60-95	30-75	10-30	<20	NP-4
	17-35	Sandy loam, gravelly sandy loam, loamy sand.	SC, SC-SM	A-2, A-4, A-1-b	0-5	80-100	60-95	35-75	15-50	20-30	5-10
	35-60	Sand, coarse sand, gravelly sand.	SP, SP-SM	A-1, A-2, A-3	0-10	70-100	50-100	30-70	0-10	---	NP
21B---------- Leoni	0-9	Gravelly loam----	SM, SC, ML, CL	A-2-4, A-4, A-6	5-10	70-90	50-75	30-70	25-65	20-35	3-15
	9-34	Very gravelly clay loam, very gravelly sandy clay loam, extremely gravelly clay loam.	SC	A-2-4, A-4, A-6	5-10	70-85	25-50	20-40	15-40	25-45	9-22
	34-38	Gravelly sandy loam, extremely gravelly sandy loam, very gravelly loamy sand.	SP-SM, SM, SC, SC-SM	A-2-4, A-4, A-1-a	5-10	70-85	25-50	20-40	10-40	<30	NP-10
	38-60	Very gravelly coarse sand, gravelly sand, cobbly sandy loam.	SP-SM, SM, SC, SC-SM	A-2-4, A-4, A-1	5-40	65-85	25-75	10-60	5-40	<30	NP-10

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
21C---------- Leoni	0-8	Gravelly loam----	SM, SC, ML, CL	A-2-4, A-4, A-6	5-10	70-90	50-75	30-70	25-65	20-35	3-15
	8-34	Very gravelly clay loam, very gravelly sandy clay loam, extremely gravelly clay loam.	SC	A-2-4, A-4, A-6	5-10	70-85	25-50	20-40	15-40	25-45	9-22
	34-38	Gravelly sandy loam, extremely gravelly sandy loam, very gravelly loamy sand.	SP-SM, SM, SC, SC-SM	A-2-4, A-4, A-1-a	5-10	70-85	25-50	20-40	10-40	<30	NP-10
	38-60	Very gravelly coarse sand, gravelly sand, cobbly sandy loam.	SP-SM, SM, SC, SC-SM	A-2-4, A-4, A-1	5-40	65-85	25-50	10-40	5-40	<30	NP-10
22A---------- Dowagiac	0-9	Loam----------	ML, CL-ML, CL	A-4	0	95-100	95-100	80-100	60-90	<30	2-10
	9-25	Clay loam, sandy loam, loam.	CL, SC	A-6, A-4	0	95-100	70-95	65-90	40-75	25-40	9-20
	25-34	Sandy loam-------	SM, SC-SM, SC	A-2-4, A-1-b	0	80-100	60-85	40-60	15-30	<25	2-9
	34-60	Sand, gravelly loamy sand, very gravelly sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	50-90	25-90	10-55	0-10	---	NP
23B---------- Hixton	0-9	Loam----------	CL, CL-ML	A-4	0	100	85-95	75-90	60-75	20-30	5-10
	9-34	Loam, sandy loam, sandy clay loam.	CL, SC	A-4, A-6, A-2	0	85-100	85-95	55-95	25-75	25-35	9-15
	34-38	Sand, loamy sand	SM, SP-SM, SP	A-1, A-3, A-2	0	85-95	75-90	45-80	4-30	---	NP
	38-60	Weathered bedrock, unweathered bedrock.	---	---	0	---	---	---	---	---	---
25A, 25B---------- Kalamazoo	0-9	Loam----------	ML, CL-ML, CL	A-4, A-6	0-5	95-100	70-95	65-90	50-70	<35	NP-15
	9-35	Clay loam, sandy clay loam, gravelly sandy loam.	SC, CL	A-4, A-6, A-7, A-2	0-5	80-100	70-95	40-95	24-80	25-45	7-25
	35-46	Loamy sand, gravelly loamy sand.	SM, SP-SM, SC-SM, SP	A-2-4, A-1-b, A-3	0-5	80-100	25-95	10-70	0-30	<25	NP-7
	46-60	Stratified sand, gravelly sand, coarse sand.	SP, SP-SM	A-1, A-3, A-2	0-5	60-100	50-95	20-70	0-10	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
25C---------- Kalamazoo	0-8	Loam----------	ML, CL-ML, CL	A-4, A-6	0-5	95-100	70-95	65-90	50-70	<35	NP-15
	8-35	Clay loam, sandy clay loam, gravelly sandy loam.	SC, CL	A-4, A-6, A-7, A-2	0-5	80-100	70-95	40-95	24-80	25-45	7-25
	35-48	Loamy sand, gravelly loamy sand.	SM, SP-SM, SC-SM, SP	A-2-4, A-1-b, A-3	0-5	80-100	25-95	10-70	0-30	<25	NP-7
	48-60	Stratified sand, gravelly sand, coarse sand.	SP, SP-SM	A-1, A-3, A-2	0-5	60-100	50-95	20-70	0-10	---	NP
25D---------- Kalamazoo	0-7	Loam----------	ML, CL-ML, CL	A-4, A-6	0-5	95-100	70-95	65-90	50-70	<35	NP-15
	7-32	Clay loam, sandy clay loam, gravelly sandy loam.	SC, CL	A-4, A-6, A-7, A-2	0-5	80-100	70-95	40-95	24-80	25-45	7-25
	32-46	Loamy sand, gravelly loamy sand.	SM, SP-SM, SC-SM, SP	A-2-4, A-1-b, A-3	0-5	80-100	25-95	10-70	0-30	<25	NP-7
	46-60	Stratified sand, gravelly sand, coarse sand.	SP, SP-SM	A-1, A-3, A-2	0-5	60-100	50-95	20-70	0-10	---	NP
28B---------- Elmdale	0-9	Sandy loam-------	SM, SC-SM	A-2-4, A-4, A-1-b	0-10	90-100	85-98	45-70	15-40	<25	2-7
	9-43	Sandy loam, fine sandy loam, loam.	SM, CL, SC, ML	A-2, A-4, A-6	0-10	90-100	85-98	55-95	25-70	14-30	2-18
	43-75	Sandy loam-------	SM, SC-SM, SC	A-2-4, A-4	0-5	95-100	95-98	50-70	20-40	<25	NP-8
29B---------- Hillsdale	0-9	Sandy loam-------	SM, SC	A-2-4, A-4, A-1-b	0-5	90-100	75-95	45-70	20-50	<25	2-10
	9-48	Sandy loam, loam	SC-SM, SC, CL-ML, CL	A-2-4, A-4	0-5	90-100	75-95	55-85	30-70	20-30	4-10
	48-66	Sandy loam-------	SM, SC-SM, SC, SP-SM	A-2-4, A-1-b	0-5	90-100	75-95	40-70	20-50	<25	2-10
	66-80	Sandy loam, loamy sand.	SM, SC-SM, SC, SP-SM	A-2-4, A-4, A-1-b	0-5	90-100	75-95	40-75	20-50	<25	2-10
29C, 29D---------- Hillsdale	0-8	Sandy loam-------	SM, SC	A-2-4, A-4, A-1-b	0-5	90-100	75-95	45-70	20-50	<25	2-10
	8-40	Sandy loam, loam	SC-SM, SC, CL-ML, CL	A-2-4, A-4	0-5	90-100	75-95	55-85	30-70	20-30	4-10
	40-66	Sandy loam-------	SM, SC-SM, SC, SP-SM	A-2-4, A-1-b	0-5	90-100	75-95	40-70	20-50	<25	2-10
	66-80	Sandy loam, loamy sand.	SM, SC-SM, SC, SP-SM	A-2-4, A-4, A-1-b	0-5	90-100	75-95	40-75	20-50	<25	2-10

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
29E---------- Hillsdale	0-7	Sandy loam-------	SM, SC, ML, CL	A-2-4, A-4, A-1-b	0-5	90-100	75-95	45-70	20-50	<25	2-10
	7-39	Sandy loam, loam	SC-SM, SC, CL-ML, CL	A-2-4, A-4	0-5	90-100	75-95	55-85	30-70	20-30	4-10
	39-65	Sandy loam-------	SM, SC-SM, SC, SP-SM	A-2-4, A-1-b	0-5	90-100	75-95	40-70	20-50	<25	2-10
	65-80	Sandy loam, loamy sand.	SM, SC-SM, SC, SP-SM	A-2-4, A-4, A-1-b	0-5	90-100	75-95	40-75	20-50	<25	2-10
33B, 33C, 33E---- Riddles	0-9	Loam----------	CL, ML, CL-ML	A-4	0-3	90-100	75-95	60-90	45-75	<25	NP-8
	9-23	Clay loam, loam, sandy loam.	CL, SC	A-6	0-3	90-100	75-95	45-90	45-80	25-40	10-20
	23-60	Loam, sandy loam	CL-ML, CL, SC-SM, SC	A-4, A-6	0-3	90-100	75-95	45-90	25-75	25-35	5-15
38B---------- Morley	0-9	Loam----------	CL, CL-ML	A-6, A-4	0-5	95-100	90-95	85-95	75-85	25-40	5-15
	9-26	Silty clay loam, clay loam, clay.	CL, CH	A-7	0-10	95-100	90-95	85-95	80-90	40-60	15-35
	26-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-95	85-95	80-90	30-50	15-30
39B, 39C---------- Morley	0-8	Loam----------	CL, CL-ML	A-6, A-4	0-5	95-100	90-95	85-95	75-85	25-40	5-15
	8-34	Silty clay loam, clay loam, clay.	CL, CH	A-6, A-7	0-10	95-100	90-95	85-95	80-90	30-60	15-35
	34-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-95	85-95	80-90	30-50	15-30
39D---------- Morley	0-6	Loam----------	CL, CL-ML	A-6, A-4	0-5	95-100	90-95	85-95	75-85	25-40	5-15
	6-20	Silty clay loam, clay loam, clay.	CL, CH	A-6, A-7	0-10	95-100	90-95	85-95	80-90	30-60	15-35
	20-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-95	85-95	80-90	30-50	15-30
43B---------- Brady	0-9	Sandy loam-------	SM, SC-SM	A-2, A-4, A-1	0-5	95-100	75-100	45-85	20-50	<25	NP-7
	9-33	Sandy loam-------	SM, SC	A-2, A-4, A-6, A-1	0-5	85-100	60-100	35-90	20-50	15-35	NP-15
	33-38	Loamy sand-------	SM, SC, SP-SM, SC-SM	A-2, A-4, A-1	0-5	95-100	75-100	35-70	10-30	<30	NP-10
	38-60	Sand----------	SP, SP-SM	A-1, A-3, A-2-4	0-5	85-100	75-100	40-70	0-10	---	NP
44A---------- Matherton	0-8	Loam----------	CL, CL-ML	A-4, A-6	0-5	90-100	60-90	50-90	50-75	20-30	4-11
	8-36	Sandy clay loam, gravelly clay loam, loam.	SC, CL	A-6, A-2, A-7	0-5	85-95	60-90	50-90	30-75	30-45	10-25
	36-60	Gravelly sand, sand, very gravelly sand.	GP, SP, SM, GM	A-1, A-3, A-2-4	0-10	40-100	25-75	20-55	0-15	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
45A----------	0-9	Loam----------	CL-ML, CL	A-4, A-6	0	90-100	85-95	70-90	50-75	20-30	6-11
Sleeth	9-45	Loam, sandy clay loam.	CL, ML	A-6	0	90-100	85-95	75-95	50-80	30-40	11-25
	45-58	Loam, sandy loam	CL, CL-ML, SC, SC-SM	A-2-4, A-4, A-6	0	90-100	85-95	55-75	30-70	20-35	4-15
	58-70	Sand, loamy sand, coarse sand.	SM, SP-SM	A-2-4, A-3, A-1	0	90-100	85-95	40-70	10-15	---	NP
46B----------	0-10	Loam----------	CL	A-4, A-6	0	100	95-100	85-95	60-80	22-33	8-15
Crosier	10-36	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	90-95	85-95	75-90	60-70	33-47	15-26
	36-60	Loam, sandy loam	CL, ML	A-4, A-6	0-3	85-90	80-90	70-85	50-60	25-35	2-12
47B----------	0-9	Sandy loam-------	SM, SC	A-2-4, A-4	0-5	90-100	85-95	50-75	25-50	<25	2-8
Teasdale	9-51	Sandy loam, fine sandy loam.	CL, SC, CL-ML, SC-SM	A-2-6, A-6, A-2-4, A-4	0-15	85-100	70-95	40-80	25-65	20-30	5-15
	51-60	Sandy loam-------	SM, SC-SM, SC	A-2-4, A-4, A-1-b	0-15	85-100	70-95	35-75	15-50	<25	NP-8
53A----------	0-9	Loam----------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-95	<35	NP-15
Kibbie	9-32	Silt loam, silty clay loam, sandy loam.	CL, SC	A-4, A-6, A-7	0	90-100	85-100	80-100	35-90	25-45	9-25
	32-60	Stratified silt loam to fine sand.	ML, SM, SC, CL	A-4, A-2	0	100	95-100	70-95	30-80	<30	NP-10
58B----------	0-8	Loam----------	CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	8-20
Blount	8-21	Silty clay loam, clay, clay loam.	CH, CL	A-7, A-6	0-5	95-100	90-100	80-90	75-85	35-60	15-35
	21-48	Silty clay loam, clay loam.	CL, CH, ML, MH	A-6, A-7	0-5	95-100	90-100	80-90	70-90	35-55	10-30
	48-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	90-100	90-100	80-100	70-90	30-45	10-25
61----------	0-9	Fine sand--------	SM, SP-SM	A-3, A-2-4	0	100	100	50-70	5-15	---	NP
Algansee	9-60	Stratified sand, fine sand, coarse sand.	SM, SP-SM	A-3, A-2-4	0	100	100	50-80	5-35	---	NP
62----------	0-10	Loamy sand-------	SM	A-2	0	100	100	50-80	15-35	---	NP
Granby	10-40	Sand, fine sand	SP-SM, SM	A-3, A-2, A-1	0	100	95-100	45-80	5-35	---	NP
	40-60	Sand, fine sand, loamy sand.	SP-SM, SM	A-3, A-2, A-1	0	100	95-100	45-80	5-35	---	NP
63----------	0-11	Fine sandy loam	SM, SC, SC-SM	A-4	0	95-100	90-100	65-80	35-45	15-25	2-10
Gilford	11-35	Sandy loam, fine sandy loam.	SM, SC, SC-SM	A-2-4	0	90-100	90-100	55-70	25-35	20-30	NP-8
	35-38	Coarse sand, sand, loamy sand.	SM, SP, SP-SM	A-3, A-1-b, A-2-4	0	90-100	85-100	18-60	3-18	---	NP
	38-60	Gravelly coarse sand, very gravelly coarse sand, sand.	SP, SP-SM, GP, GP-GM	A-1	0-15	40-85	35-70	20-50	3-10	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
64---------- Cohoctah	0-11	Loam----------	ML, CL, CL-ML	A-4	0	100	100	65-95	50-75	<30	NP-10
	11-32	Loam, sandy loam	ML, SM, CL, SC	A-4, A-2	0	95-100	85-100	50-95	30-70	20-30	NP-10
	32-60	Sand, gravelly sand.	SP-SM, SP	A-1, A-3, A-2-4	0-10	70-100	50-100	30-70	0-10	---	NP
65---------- Sebewa	0-12	Loam----------	CL, CL-ML	A-4, A-6	0	95-100	75-98	65-95	50-75	20-35	4-15
	12-38	Sandy clay loam, loam, clay loam.	SC, CL	A-6, A-7, A-2	0	95-100	60-90	50-90	25-75	25-45	10-25
	38-60	Gravelly sand, very gravelly coarse sand, coarse sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-5	40-95	25-85	20-60	0-10	---	NP
72---------- Barry	0-14	Loam----------	ML, CL, CL-ML	A-4	0-3	90-100	75-100	70-100	55-75	20-30	NP-10
	14-46	Loam, sandy loam	SC, CL	A-6, A-2-6	0-3	90-100	75-100	45-95	20-75	25-35	10-15
	46-60	Sandy loam, loam	SM, SC, ML, CL	A-4, A-2-4, A-1-b	0-3	90-100	75-100	45-95	20-75	<30	NP-10
73---------- Pella	0-11	Silt loam--------	CL	A-6, A-7	0	100	95-100	90-100	85-95	30-45	10-20
	11-27	Silty clay loam, loam, silt loam.	CL	A-6, A-7	0	100	95-100	90-100	85-95	30-50	15-30
	27-60	Stratified sandy loam to silty clay loam.	SC-SM, SC, CL, CL-ML	A-2, A-4, A-6	0-5	90-100	80-100	50-100	30-85	20-35	7-20
78---------- Pewamo	0-10	Clay loam--------	CL	A-6, A-7	0-5	90-100	75-100	70-95	60-80	35-50	15-25
	10-24	Clay loam, clay, silty clay loam.	CL, CH	A-7	0-5	95-100	75-100	75-100	75-95	40-55	20-35
	24-60	Clay loam, silty clay loam.	CL	A-7	0-5	95-100	75-100	75-100	70-90	40-50	15-25
82:											
Udipsamments----	0-60	Sand, loamy sand	SP, SP-SM, SM	A-1, A-2, A-3	0	85-100	75-100	30-75	0-25	---	NP
Udorthents------	0-60	Loam----------	---	---	---	---	---	---	---	---	NP-15
	60-80	Variable---------	---	---	---	---	---	---	---	---	---
83. Pits											
84:											
Histosols-------	0-51	Muck----------	PT	A-8	0	---	---	---	---	---	NP
	51-60	Variable---------	---	---	---	---	---	---	---	---	---
Aquents---------	0-60	Variable---------	---	---	---	---	---	---	---	---	---
85:											
Histosols-------	0-51	Muck----------	PT	A-8	0	---	---	---	---	---	NP
	51-60	Variable---------	---	---	---	---	---	---	---	---	---
Fluvaquents-----	0-60	Variable---------	---	---	---	---	---	---	---	---	---

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
87:											
Hapludalfs------	0-60	Variable---------	---	---	---	---	---	---	---	---	---
Udipsamments----	0-60	Sand, loamy sand	SP, SP-SM, SM	A-1, A-2, A-3	0	85-100	75-100	30-75	0-25	---	NP
Histosols-------	0-51	Muck-------------	PT	A-8	0	---	---	---	---	---	NP
	51-60	Variable---------	---	---	---	---	---	---	---	---	---
90B:											
Coloma----------	0-8	Loamy sand-------	SM	A-2, A-4	0-7	75-100	75-100	50-80	15-30	---	NP
	8-30	Sand-------------	SP, SM, SP-SM	A-2, A-3	0-7	75-100	75-100	40-75	2-15	---	NP
	30-80	Stratified sand to sandy loam.	SP, SM, SP-SM	A-2, A-3, A-4	0-7	75-100	75-100	40-80	2-40	---	NP
Boyer-----------	0-10	Loamy sand-------	SM, SP-SM	A-2, A-1	0-5	95-100	75-95	30-80	10-35	<20	NP-4
	10-14	Loamy sand-------	SM, SC-SM	A-2, A-4, A-1-b	0-5	85-100	60-95	30-80	10-35	<20	NP-4
	14-37	Sandy loam, gravelly sandy loam.	SC, SC-SM	A-2, A-4, A-1-b	0-5	80-100	60-95	35-75	15-50	20-30	5-10
	37-60	Sand, coarse sand, gravelly sand.	SP, SP-SM	A-1, A-2, A-3	0-10	70-100	50-100	30-70	0-10	---	NP
90C:											
Coloma----------	0-8	Loamy sand-------	SM	A-2, A-4	0-7	75-100	75-100	50-80	15-30	---	NP
	8-30	Sand-------------	SP, SM, SP-SM	A-2, A-3	0-7	75-100	75-100	40-75	2-15	---	NP
	30-80	Stratified sand to sandy loam.	SP, SM, SP-SM	A-2, A-3, A-4	0-7	75-100	75-100	40-80	2-40	---	NP
Boyer-----------	0-9	Loamy sand-------	SM, SP-SM	A-2, A-1	0-5	95-100	75-95	30-80	10-35	<20	NP-4
	9-15	Loamy sand-------	SM, SC-SM	A-2, A-4, A-1-b	0-5	85-100	60-95	30-80	10-35	<20	NP-4
	15-35	Sandy loam, gravelly sandy loam.	SC, SC-SM	A-2, A-4, A-1-b	0-5	80-100	60-95	35-75	15-50	20-30	5-10
	35-60	Sand, coarse sand, gravelly sand.	SP, SP-SM	A-1, A-2, A-3	0-10	70-100	50-100	30-70	0-10	---	NP
90D:											
Coloma----------	0-6	Loamy sand-------	SM	A-2, A-4	0-7	95-100	75-100	50-80	15-30	---	NP
	6-25	Sand-------------	SP, SM, SP-SM	A-2, A-3	0-7	95-100	75-100	40-75	2-15	---	NP
	25-80	Stratified sand to sandy loam.	SP, SM, SP-SM	A-2, A-3, A-4	0-7	95-100	75-100	40-80	2-40	---	NP
Boyer-----------	0-4	Loamy sand-------	SM, SP-SM	A-2, A-1	0-5	95-100	75-95	30-80	10-35	<20	NP-4
	4-17	Loamy sand-------	SM, SC-SM	A-2, A-4, A-1-b	0-5	85-100	60-95	30-80	10-35	<20	NP-4
	17-35	Sandy loam, loam, gravelly sandy loam.	SC, SC-SM	A-2, A-4, A-1-b	0-5	80-100	60-95	35-75	15-50	20-30	5-10
	35-60	Sand, coarse sand, gravelly sand.	SP, SP-SM	A-1, A-2, A-3	0-10	70-100	50-100	30-70	0-10	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
95B:											
Urban land------	0-60	Variable---------	---	---	---	---	---	---	---	---	---
Kalamazoo-------	0-9	Loam-------------	ML, CL-ML, CL	A-4, A-6	0-5	95-100	70-100	65-90	50-70	<35	NP-15
	9-35	Clay loam, sandy clay loam, gravelly sandy loam.	SC, CL	A-4, A-6, A-7, A-2	0-5	80-100	70-95	40-95	24-80	25-45	7-25
	35-46	Loamy sand, gravelly loamy sand.	SM, SP-SM, SC-SM, SP	A-2-4, A-1-b, A-3	0-5	80-100	25-95	10-70	0-30	<25	NP-7
	46-60	Stratified sand, gravelly sand, coarse sand.	SP, SP-SM	A-1, A-3, A-2	0-5	60-100	50-95	20-70	0-10	---	NP
95C:											
Urban land------	0-60	Variable---------	---	---	---	---	---	---	---	---	---
Kalamazoo-------	0-8	Loam-------------	ML, CL-ML, CL	A-4, A-6	0-5	95-100	70-100	65-90	50-70	<35	NP-15
	8-35	Clay loam, sandy clay loam, gravelly sandy loam.	SC, CL	A-4, A-6, A-7, A-2	0-5	80-100	70-95	40-95	24-80	25-45	7-25
	35-48	Loamy sand, gravelly loamy sand.	SM, SP-SM, SC-SM, SP	A-2-4, A-1-b, A-3	0-5	80-100	25-95	10-70	0-30	<25	NP-7
	48-60	Stratified sand, gravelly sand, coarse sand.	SP, SP-SM	A-1, A-3, A-2	0-5	60-100	50-95	20-70	0-10	---	NP
96B, 96C:											
Urban land------	0-60	Variable---------	---	---	---	---	---	---	---	---	---
Oshtemo---------	0-9	Sandy loam-------	SM, SC-SM, ML, CL-ML	A-2, A-4	0	95-100	85-95	50-85	25-55	<20	NP-4
	9-33	Sandy loam, sandy clay loam, gravelly sandy loam.	SC, SC-SM	A-2, A-4, A-1	0	80-100	55-95	35-85	15-50	20-30	4-10
	33-70	Loamy sand, sandy loam, gravelly sandy loam, sand.	SM, SP-SM	A-2, A-1	0	80-95	55-95	35-70	5-35	---	NP
	70-80	Sand, gravelly sand, fine sand.	SP-SM, SP	A-1, A-2, A-3	0-5	70-100	50-90	20-60	0-10	---	NP
96D:											
Urban land------	0-60	Variable---------	---	---	---	---	---	---	---	---	---
Oshtemo---------	0-8	Sandy loam-------	SM, SC-SM, ML, CL-ML	A-2, A-4	0	95-100	85-95	50-85	25-55	<20	NP-4
	8-32	Sandy loam, sandy clay loam, gravelly sandy loam.	SC, SC-SM	A-2, A-4, A-1	0	80-100	55-95	35-85	15-50	20-30	4-10
	32-69	Sandy loam, gravelly sandy loam, sand.	SM, SP-SM	A-2, A-1	0	80-95	55-95	35-70	5-35	---	NP
	69-80	Sand, gravelly sand, fine sand.	SP-SM, SP	A-1, A-2, A-3	0-5	70-100	50-90	20-60	0-10	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
99---------- Urban land	0-60	Variable---------	---	---	---	---	---	---	---	---	---
113B, 113C: Urban land------	0-60	Variable---------	---	---	---	---	---	---	---	---	---
Coloma----------	0-8	Loamy sand-------	SM	A-2, A-4	0-7	75-100	75-100	50-80	15-30	---	NP
	8-30	Sand-------------	SP, SM, SP-SM	A-2, A-3	0-7	75-100	75-100	40-75	2-15	---	NP
	30-80	Stratified sand to sandy loam.	SP, SM, SP-SM	A-2, A-3, A-4	0-7	75-100	75-100	40-85	2-40	---	NP

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
2----------	0-7	---	0.20-0.35	0.2-6.0	0.35-0.45	5.1-7.8	----------	----	5	2	>70
Houghton	7-60	---	0.15-0.25	0.2-6.0	0.35-0.45	5.1-7.8	----------	----			
4----------	0-25	---	0.30-0.55	0.2-6.0	0.35-0.45	5.1-7.3	----------	----	4	2	55-75
Adrian	25-60	2-10	1.40-1.75	6.0-20	0.03-0.08	5.6-8.4	Low----------	0.15			
5----------	0-9	---	0.30-0.40	0.2-6.0	0.35-0.45	5.1-7.8	----------	----	5	2	>75
Palms	9-18	---	0.15-0.30	0.2-6.0	0.35-0.45	5.1-7.8	----------	----			
	18-60	7-35	1.45-1.75	0.2-2.0	0.14-0.22	6.1-8.4	Low----------	0.37			
7----------	0-7	---	0.20-0.35	0.2-6.0	0.35-0.45	5.1-7.8	----------	----	5	2	>70
Houghton	7-60	---	0.15-0.25	0.2-6.0	0.35-0.45	5.1-7.8	----------	----			
8----------	0-21	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	----------	----	4	2	55-75
Edwards	21-60	3-6	---	0.01-0.06	---	7.4-8.4	----------	----			
9----------	0-13	---	0.25-0.45	0.6-6.0	0.35-0.45	6.1-8.4	----------	----	---	2	25-75
Martisco	13-60	---	---	0.06-0.2	---	7.9-8.4	Low----------	----			
12B, 12C---------	0-8	2-10	1.35-1.65	6.0-20	0.08-0.12	4.5-7.3	Low----------	0.17	5	2	.5-2
Coloma	8-30	0-10	1.35-1.65	6.0-20	0.05-0.12	5.1-7.3	Low----------	0.15			
	30-80	2-12	1.50-1.65	6.0-20	0.03-0.08	5.1-7.3	Low----------	0.15			
12D----------	0-6	2-10	1.35-1.65	6.0-20	0.08-0.12	4.5-7.3	Low----------	0.17	5	2	.5-2
Coloma	6-25	0-10	1.35-1.65	6.0-20	0.05-0.12	5.1-7.3	Low----------	0.15			
	25-80	2-12	1.50-1.65	6.0-20	0.03-0.08	5.1-7.3	Low----------	0.15			
12E----------	0-3	2-10	1.35-1.65	6.0-20	0.08-0.12	4.5-7.3	Low----------	0.17	5	2	.5-2
Coloma	3-30	0-10	1.35-1.65	6.0-20	0.05-0.12	5.1-7.3	Low----------	0.15			
	30-80	2-12	1.50-1.65	6.0-20	0.03-0.08	5.1-7.3	Low----------	0.15			
13B, 13C---------	0-9	2-15	1.40-1.70	6.0-20	0.08-0.10	5.1-7.3	Low----------	0.15	5	2	.5-3
Spinks	9-30	0-15	1.40-1.70	2.0-20	0.05-0.10	5.6-7.3	Low----------	0.15			
	30-70	3-15	1.40-1.70	2.0-6.0	0.04-0.08	5.6-7.8	Low----------	0.15			
13D----------	0-8	2-15	1.40-1.70	6.0-20	0.08-0.10	5.1-7.3	Low----------	0.15	5	2	.5-3
Spinks	8-30	0-15	1.40-1.70	2.0-20	0.05-0.10	5.6-7.3	Low----------	0.15			
	30-70	3-15	1.40-1.70	2.0-6.0	0.04-0.08	5.6-7.8	Low----------	0.15			
13E----------	0-6	2-15	1.40-1.70	6.0-20	0.08-0.10	5.1-7.3	Low----------	0.15	5	2	.5-3
Spinks	6-30	0-15	1.40-1.70	2.0-20	0.05-0.10	5.6-7.3	Low----------	0.15			
	30-70	3-15	1.40-1.70	2.0-6.0	0.04-0.08	5.6-7.8	Low----------	0.15			
14B----------	0-8	2-15	1.30-1.60	2.0-6.0	0.13-0.15	5.1-7.3	Low----------	0.24	4	3	1-3
Bronson	8-14	2-15	1.35-1.60	2.0-6.0	0.12-0.14	5.1-7.3	Low----------	0.24			
	14-44	10-20	1.35-1.60	2.0-6.0	0.12-0.18	5.1-7.3	Low----------	0.24			
	44-47	0-10	1.35-1.60	6.0-20	0.06-0.08	7.4-8.4	Low----------	0.17			
	47-60	0-5	1.50-1.65	6.0-20	0.02-0.04	7.4-8.4	Low----------	0.10			
15B----------	0-9	5-15	1.40-1.60	2.0-6.0	0.10-0.18	3.6-7.3	Low----------	0.24	4	3	1-3
Eleva	9-29	10-18	1.50-1.60	0.6-2.0	0.09-0.19	3.6-6.5	Low----------	0.24			
	29	---	---	0.2-2.0	---	---	----------	----			
16B, 16C---------	0-9	2-12	1.35-1.60	2.0-6.0	0.10-0.15	5.1-7.3	Low----------	0.24	5	3	.5-3
Oshtemo	9-47	10-18	1.30-1.60	2.0-6.0	0.12-0.19	5.1-6.5	Low----------	0.24			
	47-70	5-15	1.30-1.60	2.0-6.0	0.06-0.10	5.1-7.3	Low----------	0.17			
	70-80	0-15	1.30-1.50	>20	0.02-0.04	7.4-8.4	Low----------	0.10			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
16D, 16E----------	0-8	2-12	1.35-1.60	2.0-6.0	0.10-0.15	5.1-7.3	Low----------	0.24	5	3	.5-3
Oshtemo	8-33	10-18	1.30-1.60	2.0-6.0	0.12-0.19	5.1-6.5	Low----------	0.24			
	33-47	5-15	1.30-1.60	2.0-6.0	0.06-0.10	5.1-7.3	Low----------	0.17			
	47-70	0-15	1.30-1.50	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
17B----------	0-10	5-15	1.30-1.60	2.0-6.0	0.11-0.15	5.6-7.3	Low----------	0.24	4	3	1-3
Boyer	10-14	2-15	1.30-1.60	2.0-6.0	0.08-0.16	5.6-7.3	Low----------	0.17			
	14-37	10-18	1.35-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low----------	0.24			
	37-60	0-10	1.40-1.55	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
17C----------	0-9	5-15	1.30-1.60	2.0-6.0	0.11-0.15	5.6-7.3	Low----------	0.24	4	3	1-3
Boyer	9-15	2-15	1.30-1.60	2.0-6.0	0.08-0.16	5.6-7.3	Low----------	0.17			
	15-35	10-18	1.35-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low----------	0.24			
	35-60	0-10	1.40-1.55	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
17D, 17E----------	0-4	5-15	1.30-1.60	2.0-6.0	0.11-0.15	5.6-7.3	Low----------	0.24	4	3	1-3
Boyer	4-17	2-15	1.30-1.60	2.0-6.0	0.08-0.16	5.6-7.3	Low----------	0.17			
	17-35	10-18	1.35-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low----------	0.24			
	35-60	0-10	1.40-1.55	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
21B----------	0-9	8-25	1.30-1.55	0.6-2.0	0.13-0.19	5.6-7.3	Low----------	0.24	5	5	1-3
Leoni	9-34	18-35	1.40-1.70	0.6-2.0	0.08-0.13	5.1-7.3	Low----------	0.24			
	34-38	2-18	1.40-1.70	2.0-6.0	0.07-0.09	5.6-7.8	Low----------	0.17			
	38-60	0-18	1.40-1.65	6.0-20	0.02-0.07	7.4-8.4	Low----------	0.10			
21C----------	0-8	8-25	1.30-1.55	0.6-2.0	0.13-0.19	5.6-7.3	Low----------	0.24	5	5	1-3
Leoni	8-34	18-35	1.40-1.70	0.6-2.0	0.08-0.13	5.1-7.3	Low----------	0.24			
	34-38	2-18	1.40-1.70	2.0-6.0	0.07-0.09	5.6-7.8	Low----------	0.17			
	38-60	0-18	1.40-1.65	6.0-20	0.02-0.07	7.4-8.4	Low----------	0.10			
22A----------	0-9	7-20	1.30-1.60	0.6-2.0	0.16-0.18	5.6-6.5	Low----------	0.28	4	5	2-4
Dowagiac	9-25	27-35	1.35-1.70	0.6-2.0	0.13-0.14	5.1-6.5	Moderate-----	0.28			
	25-34	5-20	1.35-1.70	2.0-6.0	0.14-0.15	5.1-6.5	Low----------	0.28			
	34-60	0-10	1.55-1.65	6.0-20	0.01-0.04	5.6-8.4	Low----------	0.15			
23B----------	0-9	12-16	1.35-1.55	0.6-2.0	0.20-0.22	5.1-6.5	Low----------	0.32	4	5	1-2
Hixton	9-34	18-27	1.55-1.65	0.6-2.0	0.12-0.19	5.1-6.5	Low----------	0.32			
	34-38	2-6	1.55-1.70	6.0-20	0.05-0.10	5.1-6.5	Low----------	0.15			
	38-60	---	---	0.2-2.0	---	---	----------	----			
25A, 25B----------	0-9	8-25	1.30-1.65	0.6-2.0	0.16-0.22	5.1-7.3	Low----------	0.32	4	5	1-3
Kalamazoo	9-35	18-35	1.35-1.70	0.6-2.0	0.10-0.18	5.1-7.3	Moderate-----	0.32			
	35-46	2-15	1.50-1.65	6.0-20	0.02-0.08	5.1-7.8	Low----------	0.15			
	46-60	0-10	1.50-1.65	6.0-20	0.01-0.03	7.4-8.4	Low----------	0.10			
25C----------	0-8	8-25	1.30-1.65	0.6-2.0	0.16-0.22	5.1-7.3	Low----------	0.32	4	5	1-3
Kalamazoo	8-35	18-35	1.35-1.70	0.6-2.0	0.10-0.18	5.1-7.3	Moderate-----	0.32			
	35-48	2-15	1.50-1.65	6.0-20	0.02-0.08	5.1-7.8	Low----------	0.15			
	48-60	0-10	1.50-1.65	6.0-20	0.01-0.03	7.4-8.4	Low----------	0.10			
25D----------	0-7	8-25	1.30-1.65	0.6-2.0	0.16-0.22	5.1-7.3	Low----------	0.32	4	5	1-3
Kalamazoo	7-32	18-35	1.35-1.70	0.6-2.0	0.10-0.18	5.1-7.3	Moderate-----	0.32			
	32-46	2-15	1.50-1.65	6.0-20	0.02-0.08	5.1-7.8	Low----------	0.15			
	46-60	0-10	1.50-1.65	6.0-20	0.01-0.03	7.4-8.4	Low----------	0.10			
28B----------	0-9	2-15	1.10-1.65	2.0-6.0	0.12-0.15	5.1-7.3	Low----------	0.24	5	3	1-3
Elmdale	9-43	10-18	1.20-1.70	0.6-2.0	0.11-0.17	4.5-7.3	Low----------	0.24			
	43-75	2-15	1.80-2.00	0.6-2.0	0.10-0.13	6.6-8.4	Low----------	0.24			
29B----------	0-9	2-15	1.30-1.60	2.0-6.0	0.13-0.18	5.1-7.3	Low----------	0.24	5	3	1-3
Hillsdale	9-48	10-18	1.40-1.70	0.6-2.0	0.12-0.18	4.5-6.5	Low----------	0.24			
	48-66	5-15	1.60-1.75	0.6-6.0	0.08-0.13	5.1-6.5	Low----------	0.24			
	66-80	5-15	1.60-1.80	0.6-6.0	0.08-0.13	7.9-8.4	Low----------	0.24			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
29C, 29D----------	0-8	2-15	1.30-1.60	2.0-6.0	0.13-0.18	5.1-7.3	Low----------	0.24	5	3	1-3
Hillsdale	8-40	10-18	1.40-1.70	0.6-2.0	0.12-0.18	4.5-6.5	Low----------	0.24			
	40-66	5-15	1.60-1.75	0.6-6.0	0.08-0.13	5.1-6.5	Low----------	0.24			
	66-80	5-15	1.60-1.80	0.6-6.0	0.08-0.13	7.9-8.4	Low----------	0.24			
29E----------	0-7	2-15	1.30-1.60	2.0-6.0	0.13-0.18	5.1-7.3	Low----------	0.24	5	3	1-3
Hillsdale	7-39	10-18	1.40-1.70	0.6-2.0	0.12-0.18	4.5-6.5	Low----------	0.24			
	39-65	5-15	1.60-1.75	0.6-6.0	0.08-0.13	5.1-6.5	Low----------	0.24			
	65-80	5-15	1.60-1.80	0.6-6.0	0.08-0.13	7.9-8.4	Low----------	0.24			
33B, 33C, 33E----	0-9	8-16	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.32	5-4	5	.5-2
Riddles	9-23	18-30	1.40-1.60	0.6-2.0	0.12-0.18	4.5-7.3	Moderate-----	0.32			
	23-60	15-22	1.40-1.60	0.6-2.0	0.11-0.19	6.6-7.8	Low----------	0.32			
38B----------	0-9	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.37	4	6	2-3
Morley	9-26	35-50	1.55-1.70	0.06-0.2	0.11-0.15	5.6-7.8	Moderate-----	0.32			
	26-60	27-40	1.60-1.80	0.06-0.2	0.07-0.12	6.1-8.4	Moderate-----	0.43			
39B, 39C----------	0-8	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-6.5	Low----------	0.37	4	6	1-3
Morley	8-34	35-50	1.55-1.70	0.06-0.2	0.11-0.15	6.1-8.4	Moderate-----	0.43			
	34-60	27-40	1.60-1.80	0.06-0.2	0.07-0.12	6.1-8.4	Moderate-----	0.43			
39D----------	0-6	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-6.5	Low----------	0.37	4	6	1-3
Morley	6-20	35-50	1.55-1.70	0.06-0.2	0.11-0.15	6.1-8.4	Moderate-----	0.43			
	20-60	27-40	1.60-1.80	0.06-0.2	0.07-0.12	6.1-8.4	Moderate-----	0.43			
43B----------	0-9	2-15	1.35-1.55	2.0-6.0	0.12-0.16	5.1-7.3	Low----------	0.20	5	3	2-4
Brady	9-33	5-22	1.35-1.55	2.0-6.0	0.12-0.17	5.1-6.5	Low----------	0.24			
	33-38	5-20	1.35-1.50	2.0-6.0	0.08-0.13	5.1-7.3	Low----------	0.20			
	38-60	0-10	1.40-1.50	>20	0.02-0.04	6.6-8.4	Low----------	0.10			
44A----------	0-8	10-20	1.30-1.65	2.0-6.0	0.13-0.22	5.1-7.3	Low----------	0.28	4	5	2-4
Matherton	8-36	20-35	1.40-1.70	0.6-2.0	0.12-0.18	5.1-7.3	Moderate-----	0.24			
	36-60	0-10	1.50-1.65	6.0-20	0.02-0.04	7.4-8.4	Low----------	0.10			
45A----------	0-9	12-20	1.35-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.32	5	5	1-3
Sleeth	9-45	22-35	1.45-1.60	0.6-2.0	0.15-0.19	5.6-6.5	Moderate-----	0.32			
	45-58	10-27	1.45-1.60	0.6-2.0	0.13-0.18	5.6-6.5	Low----------	0.32			
	58-70	5-10	1.50-1.65	6.0-20	0.05-0.09	7.4-8.4	Low----------	0.15			
46B----------	0-10	7-18	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.32	5	5	1-3
Crosier	10-36	20-33	1.40-1.60	0.2-0.6	0.15-0.19	5.1-7.3	Moderate-----	0.32			
	36-60	10-20	1.40-1.60	0.2-0.6	0.10-0.19	6.1-8.4	Low----------	0.32			
47B----------	0-9	5-15	1.25-1.75	2.0-6.0	0.12-0.15	5.1-6.5	Low----------	0.24	5	3	2-3
Teasdale	9-51	10-18	1.55-1.75	0.6-2.0	0.11-0.17	4.5-7.3	Low----------	0.24			
	51-60	5-15	1.60-1.85	2.0-6.0	0.08-0.15	6.6-8.4	Low----------	0.24			
53A----------	0-9	5-25	1.40-1.65	0.6-2.0	0.16-0.24	5.6-7.3	Low----------	0.28	5	5	2-3
Kibbie	9-32	18-35	1.40-1.65	0.6-2.0	0.17-0.22	5.6-7.3	Low----------	0.43			
	32-60	2-18	1.40-1.70	0.6-2.0	0.12-0.22	7.4-8.4	Low----------	0.43			
58B----------	0-8	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.43	3	6	2-3
Blount	8-21	35-50	1.40-1.70	0.06-0.2	0.12-0.19	4.5-6.5	Moderate-----	0.43			
	21-48	27-38	1.50-1.70	0.06-0.2	0.12-0.19	6.1-8.4	Moderate-----	0.43			
	48-60	27-38	1.60-1.85	0.06-0.2	0.07-0.10	7.4-8.4	Moderate-----	0.43			
61----------	0-9	0-10	1.35-1.50	6.0-20	0.05-0.07	4.5-7.8	Low----------	0.15	5	1	1-4
Algansee	9-60	0-15	1.40-1.65	6.0-20	0.05-0.10	4.5-8.4	Low----------	0.17			
62----------	0-10	2-14	1.20-1.60	6.0-20	0.10-0.12	5.6-7.3	Low----------	0.17	5	2	4-10
Granby	10-40	0-14	1.45-1.60	6.0-20	0.05-0.12	5.6-7.8	Low----------	0.17			
	40-60	0-10	1.45-1.60	6.0-20	0.05-0.09	6.6-8.4	Low----------	0.17			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
63----------	0-11	10-20	1.50-1.70	2.0-6.0	0.16-0.18	5.1-7.3	Low----------	0.20	4	3	2-4
Gilford	11-35	8-17	1.60-1.80	2.0-6.0	0.10-0.14	5.1-7.3	Low----------	0.20			
	35-38	3-12	1.70-1.90	6.0-20	0.05-0.08	6.1-7.3	Low----------	0.15			
	38-60	1-5	1.70-1.90	>20	0.02-0.04	6.1-7.8	Low----------	0.10			
64----------	0-11	10-18	1.20-1.60	2.0-6.0	0.20-0.22	6.1-7.8	Low----------	0.28	4	5	3-6
Cohoctah	11-32	5-18	1.45-1.65	2.0-6.0	0.12-0.20	6.1-8.4	Low----------	0.28			
	32-60	5-10	1.40-1.55	>20	0.02-0.07	7.9-8.4	Low----------	0.10			
65----------	0-12	10-25	1.10-1.60	0.6-2.0	0.18-0.25	6.1-7.8	Low----------	0.24	4	5	2-12
Sebewa	12-38	18-35	1.40-1.70	0.6-2.0	0.15-0.19	6.1-7.8	Moderate-----	0.32			
	38-60	0-3	1.55-1.75	>6.0	0.02-0.04	7.4-8.4	Low----------	0.10			
72----------	0-14	8-18	1.60-1.70	0.6-2.0	0.20-0.22	6.1-7.8	Low----------	0.28	5	5	4-7
Barry	14-46	18-25	1.60-1.70	0.6-2.0	0.14-0.19	6.1-7.8	Low----------	0.28			
	46-60	5-18	1.70-1.80	2.0-6.0	0.10-0.17	7.4-8.4	Low----------	0.28			
73----------	0-11	18-27	1.15-1.35	0.6-2.0	0.22-0.24	6.1-7.8	Moderate-----	0.28	5	6	5-6
Pella	11-27	27-35	1.20-1.45	0.6-2.0	0.21-0.24	6.6-7.8	Moderate-----	0.28			
	27-60	15-30	1.40-1.70	0.6-2.0	0.10-0.22	7.4-8.4	Low----------	0.28			
78----------	0-10	27-40	1.35-1.55	0.6-2.0	0.16-0.19	6.1-7.3	Moderate-----	0.24	5	6	3-12
Pewamo	10-24	35-50	1.40-1.70	0.2-0.6	0.12-0.20	5.6-7.8	Moderate-----	0.32			
	24-60	30-40	1.50-1.70	0.2-0.6	0.14-0.18	7.4-8.4	Moderate-----	0.37			
82:											
Udipsamments----	0-60	0-10	1.35-1.65	>6.0	0.05-0.09	5.1-6.5	Low----------	0.12	5	1	<1
Udorthents------	0-60	2-18	1.50-1.70	0.6-2.0	0.11-0.18	---	Low----------	0.24	5	3	---
	60-80	---	---	---	---	---	----------	----			
83.											
Pits											
84:											
Histosols-------	0-51	---	---	0.2-6.0	---	---	----------	----	---	2	50-70
	51-60	---	---	---	---	---	----------	----			
Aquents---------	0-60	---	---	---	---	---	----------	----	---	---	---
85:											
Histosols-------	0-51	---	---	0.2-6.0	---	---	----------	----	---	2	50-70
	51-60	---	---	---	---	---	----------	----			
Fluvaquents-----	0-60	---	---	---	---	---	----------	----	---	---	---
87:											
Hapludalfs------	0-60	---	---	---	---	---	----------	----	---	---	---
Udipsamments----	0-60	---	---	---	---	---	----------	----	---	---	---
Histosols-------	0-60	---	---	---	---	---	----------	----	---	---	---
90B:											
Coloma----------	0-8	2-10	1.35-1.65	6.0-20	0.08-0.12	4.5-7.3	Low----------	0.17	5	2	.5-2
	8-30	0-10	1.35-1.65	6.0-20	0.05-0.12	5.1-7.3	Low----------	0.15			
	30-80	2-12	1.50-1.65	6.0-20	0.03-0.08	5.1-7.3	Low----------	0.15			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
90B:											
Boyer	0-10	0-10	1.35-1.60	6.0-20	0.08-0.12	5.6-7.3	Low	0.17	4	2	.5-3
	10-14	2-15	1.30-1.60	2.0-6.0	0.08-0.16	5.6-7.3	Low	0.17			
	14-37	10-18	1.35-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low	0.24			
	37-60	0-10	1.40-1.55	>20	0.02-0.04	7.4-8.4	Low	0.10			
90C:											
Coloma	0-8	2-10	1.35-1.65	6.0-20	0.08-0.12	4.5-7.3	Low	0.17	5	2	.5-2
	8-30	0-10	1.35-1.65	6.0-20	0.05-0.12	5.1-7.3	Low	0.15			
	30-80	2-12	1.50-1.65	6.0-20	0.03-0.08	5.1-7.3	Low	0.15			
Boyer	0-9	0-10	1.35-1.60	6.0-20	0.08-0.12	5.6-7.3	Low	0.17	4	2	.5-3
	9-15	2-15	1.30-1.60	2.0-6.0	0.08-0.16	5.6-7.3	Low	0.17			
	15-35	10-18	1.35-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low	0.24			
	35-60	0-10	1.40-1.55	>20	0.02-0.04	7.4-8.4	Low	0.10			
90D:											
Coloma	0-6	2-10	1.35-1.65	6.0-20	0.08-0.12	4.5-7.3	Low	0.17	5	2	.5-2
	6-25	0-10	1.35-1.65	6.0-20	0.05-0.12	5.1-7.3	Low	0.15			
	25-80	2-12	1.50-1.65	6.0-20	0.03-0.08	5.1-7.3	Low	0.15			
Boyer	0-4	0-10	1.35-1.60	6.0-20	0.08-0.12	5.6-7.3	Low	0.17	4	2	.5-3
	4-17	2-15	1.30-1.60	2.0-6.0	0.08-0.16	5.6-7.3	Low	0.17			
	17-35	10-18	1.35-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low	0.24			
	35-60	0-10	1.40-1.55	>20	0.02-0.04	7.4-8.4	Low	0.10			
95B:											
Urban land	0-60	---	---	---	---	---	---	---	---	---	---
Kalamazoo	0-9	8-25	1.30-1.65	0.6-2.0	0.16-0.22	5.1-7.3	Low	0.32	4	5	1-3
	9-35	18-35	1.35-1.70	0.6-2.0	0.10-0.18	5.1-7.3	Moderate	0.32			
	35-46	2-15	1.50-1.65	6.0-20	0.02-0.08	5.1-7.8	Low	0.15			
	46-60	0-10	1.50-1.65	6.0-20	0.01-0.03	7.4-8.4	Low	0.10			
95C:											
Urban land	0-60	---	---	---	---	---	---	---	---	---	---
Kalamazoo	0-8	8-25	1.30-1.65	0.6-2.0	0.16-0.22	5.1-7.3	Low	0.32	4	5	1-3
	8-35	18-35	1.35-1.70	0.6-2.0	0.10-0.18	5.1-7.3	Moderate	0.32			
	35-48	2-15	1.50-1.65	6.0-20	0.02-0.08	5.1-7.8	Low	0.15			
	48-60	0-10	1.50-1.65	6.0-20	0.01-0.03	7.4-8.4	Low	0.10			
96B, 96C:											
Urban land	0-60	---	---	---	---	---	---	---	---	---	---
Oshtemo	0-9	2-12	1.35-1.60	2.0-6.0	0.10-0.15	5.1-7.3	Low	0.24	5	3	.5-3
	9-33	10-18	1.30-1.60	2.0-6.0	0.12-0.19	5.1-6.5	Low	0.24			
	33-70	5-15	1.30-1.60	2.0-6.0	0.06-0.10	5.1-7.3	Low	0.17			
	70-80	0-15	1.30-1.50	>20	0.02-0.04	7.4-8.4	Low	0.10			
96D:											
Urban land	0-60	---	---	---	---	---	---	---	---	---	---
Oshtemo	0-8	2-12	1.35-1.60	2.0-6.0	0.10-0.15	5.1-7.3	Low	0.24	5	3	.5-3
	8-32	10-18	1.30-1.60	2.0-6.0	0.12-0.19	5.1-6.5	Low	0.24			
	32-69	5-15	1.30-1.60	2.0-6.0	0.06-0.10	5.1-7.3	Low	0.17			
	69-80	0-15	1.30-1.50	>20	0.02-0.04	7.4-8.4	Low	0.10			
99---------- Urban land	0-60	---	---	---	---	---	---	---	---	---	---

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
113B, 113C:											
Urban land------	0-60	---	---	---	---	---	----------	----	---	---	---
Coloma----------	0-8	2-10	1.35-1.65	6.0-20	0.08-0.12	4.5-7.3	Low----------	0.17	5	2	.5-2
	8-30	0-10	1.35-1.65	6.0-20	0.05-0.12	5.1-7.3	Low----------	0.15			
	30-80	2-12	1.50-1.65	6.0-20	0.03-0.08	5.1-7.3	Low----------	0.15			

TABLE 18.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "frequent," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock depth	Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Initial	Total		Uncoated steel	Concrete
					Ft			In	In	In			
2---------- Houghton	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	6-18	55-60	High-----	High-----	Moderate.
4---------- Adrian	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	6-18	29-33	High-----	High-----	Moderate.
5---------- Palms	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	4-15	25-32	High-----	High-----	Moderate.
7---------- Houghton	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	6-18	55-60	High-----	High-----	Moderate.
8---------- Edwards	B/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	4-12	25-30	High-----	High-----	Low.
9---------- Martisco	B/D	None--------	---	---	+1-0.5	Apparent	Sep-Jun	>60	3-4	4-6	High-----	High-----	Low.
12B, 12C, 12D, 12E---------- Coloma	A	None--------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	Moderate.
13B, 13C, 13D, 13E---------- Spinks	A	None--------	---	---	>6.0	---	---	>60	---	25-30	Low------	Low------	Low.
14B---------- Bronson	B	None--------	---	---	2.0-3.5	Apparent	Oct-May	>60	---	---	High-----	Low------	Moderate.
15B---------- Eleva	B	None--------	---	---	>6.0	---	---	20-40	---	---	Moderate	Low------	Moderate.
16B, 16C, 16D, 16E---------- Oshtemo	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	High.
17B, 17C, 17D, 17E---------- Boyer	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	Moderate.
21B, 21C--------- Leoni	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	Moderate.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock depth	Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Initial	Total		Uncoated steel	Concrete
					Ft			In	In	In			
22A---------- Dowagiac	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	Moderate.
23B---------- Hixton	B	None--------	---	---	>6.0	---	---	20-40	---	---	Moderate	Low------	Moderate.
25A, 25B, 25C, 25D---------- Kalamazoo	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	Low.
28B---------- Elmdale	B	None--------	---	---	2.0-3.0	Apparent	Oct-May	>60	---	---	Moderate	Low------	High.
29B, 29C, 29D, 29E---------- Hillsdale	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	High.
33B, 33C, 33E---- Riddles	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate	Moderate.
38B---------- Morley	C	None--------	---	---	3.0-6.0	Perched	Oct-May	>60	---	---	Moderate	High-----	Moderate.
39B, 39C, 39D---- Morley	C	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	High-----	Moderate.
43B---------- Brady	B	None--------	---	---	1.0-3.0	Apparent	Oct-May	>60	---	---	High-----	Low------	Moderate.
44A---------- Matherton	B	None--------	---	---	1.0-2.0	Apparent	Oct-May	>60	---	---	High-----	Moderate	Low.
45A---------- Sleeth	C	None--------	---	---	1.0-3.0	Apparent	Oct-May	>60	---	---	High-----	High-----	Low.
46B---------- Crosier	C	None--------	---	---	1.0-3.0	Apparent	Oct-May	>60	---	---	High-----	High-----	Low.
47B---------- Teasdale	B	None--------	---	---	1.0-2.0	Apparent	Oct-May	>60	---	---	High-----	Moderate	Moderate.
53A---------- Kibbie	B	None--------	---	---	1.0-2.0	Apparent	Oct-May	>60	---	---	High-----	High-----	Moderate.
58B---------- Blount	C	None--------	---	---	1.0-3.0	Perched	Oct-May	>60	---	---	High-----	High-----	High.
61---------- Algansee	B	Common------	Long------	Nov-May	1.0-2.0	Apparent	Oct-May	>60	---	---	Moderate	Low------	Low.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock depth	Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Initial	Total		Uncoated steel	Concrete
					Ft			In	In	In			
62--Granby	A/D	None	---	---	+1-1.0	Apparent	Oct-May	>60	---	---	Moderate	High	Low.
63--Gilford	B/D	None	---	---	+.5-1.0	Apparent	Oct-May	>60	---	---	High	High	Moderate.
64--Cohoctah	B/D	Frequent	Brief or long.	Jan-Dec	+.5-1.0	Apparent	Oct-May	>60	---	---	High	High	Low.
65--Sebewa	B/D	None	---	---	+1-1.0	Apparent	Oct-May	>60	---	---	High	High	Low.
72--Barry	B/D	None	---	---	+1-1.0	Apparent	Oct-May	>60	---	---	High	High	Low.
73--Pella	B/D	None	---	---	+.5-2.0	Apparent	Oct-May	>60	---	---	High	High	Low.
78--Pewamo	C/D	None	---	---	+1-1.0	Apparent	Oct-May	>60	---	---	High	High	Low.
82:													
Udipsamments	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	Moderate.
Udorthents	---	None	---	---	>6.0	---	---	>60	---	---	---	---	---
83. Pits													
84:													
Histosols	D	None	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	---	High	---	---
Aquents	D	None	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	---	High	---	---
85:													
Histosols	D	None	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	---	High	---	---
Fluvaquents	---	Frequent	Long	Jan-Dec	+1-1.0	Apparent	Sep-Jun	>60	---	---	---	---	---
87:													
Hapludalfs	---	None	---	---	---	---	---	>60	---	---	---	---	---
Udipsamments	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	Moderate.
Histosols	D	None	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	---	High	---	---

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock depth	Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Initial	Total		Uncoated steel	Concrete
					Ft			In	In	In			
90B, 90C, 90D:													
Coloma	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	Moderate.
Boyer	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Moderate.
95B, 95C:													
Urban land	---	None	---	---	---	---	---	---	---	---	---	---	---
Kalamazoo	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Low.
96B, 96C, 96D:													
Urban land	---	None	---	---	---	---	---	---	---	---	---	---	---
Oshtemo	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	High.
99---------- Urban land	---	None	---	---	---	---	---	---	---	---	---	---	---
113B, 113C:													
Urban land	---	None	---	---	---	---	---	---	---	---	---	---	---
Coloma	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	Moderate.

TABLE 19.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic Terric Medisaprists
Algansee	Mixed, mesic Aquic Udipsamments
Aquents	Aquents
Barry	Fine-loamy, mixed, mesic Typic Argiaquolls
Blount	Fine, illitic, mesic Aeric Ochraqualfs
Boyer	Coarse-loamy, mixed, mesic Typic Hapludalfs
Brady	Coarse-loamy, mixed, mesic Aquollic Hapludalfs
Bronson	Coarse-loamy, mixed, mesic Aquic Hapludalfs
Cohoctah	Coarse-loamy, mixed, mesic Fluvaquentic Haplaquolls
Coloma	Mixed, mesic Argic Udipsamments
Crosier	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Dowagiac	Fine-loamy, mixed, mesic Mollic Hapludalfs
Edwards	Marly, euic, mesic Limnic Medisaprists
Eleva	Coarse-loamy, mixed, mesic Typic Hapludalfs
Elmdale	Coarse-loamy, mixed, mesic Typic Hapludalfs
Fluvaquents	Fluvaquents
Gilford	Coarse-loamy, mixed, mesic Typic Haplaquolls
Granby	Sandy, mixed, mesic Typic Haplaquolls
Hapludalfs	Hapludalfs
Hillsdale	Coarse-loamy, mixed, mesic Typic Hapludalfs
Histosols	Histosols
Hixton	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludalfs
Houghton	Euic, mesic Typic Medisaprists
Kalamazoo	Fine-loamy, mixed, mesic Typic Hapludalfs
Kibbie	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Leoni	Loamy-skeletal, mixed, mesic Typic Hapludalfs
Martisco	Fine-silty, carbonatic, mesic Histic Humaquepts
Matherton	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Udollic Ochraqualfs
Morley	Fine, illitic, mesic Typic Hapludalfs
Oshtemo	Coarse-loamy, mixed, mesic Typic Hapludalfs
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Pella	Fine-silty, mixed, mesic Typic Haplaquolls
Pewamo	Fine, mixed, mesic Typic Argiaquolls
Riddles	Fine-loamy, mixed, mesic Typic Hapludalfs
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiaquolls
Sleeth	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Spinks	Sandy, mixed, mesic Psammentic Hapludalfs
Teasdale	Coarse-loamy, siliceous, mesic Aquic Glossudalfs
Udipsamments	Udipsamments
Udorthents	Udorthents

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