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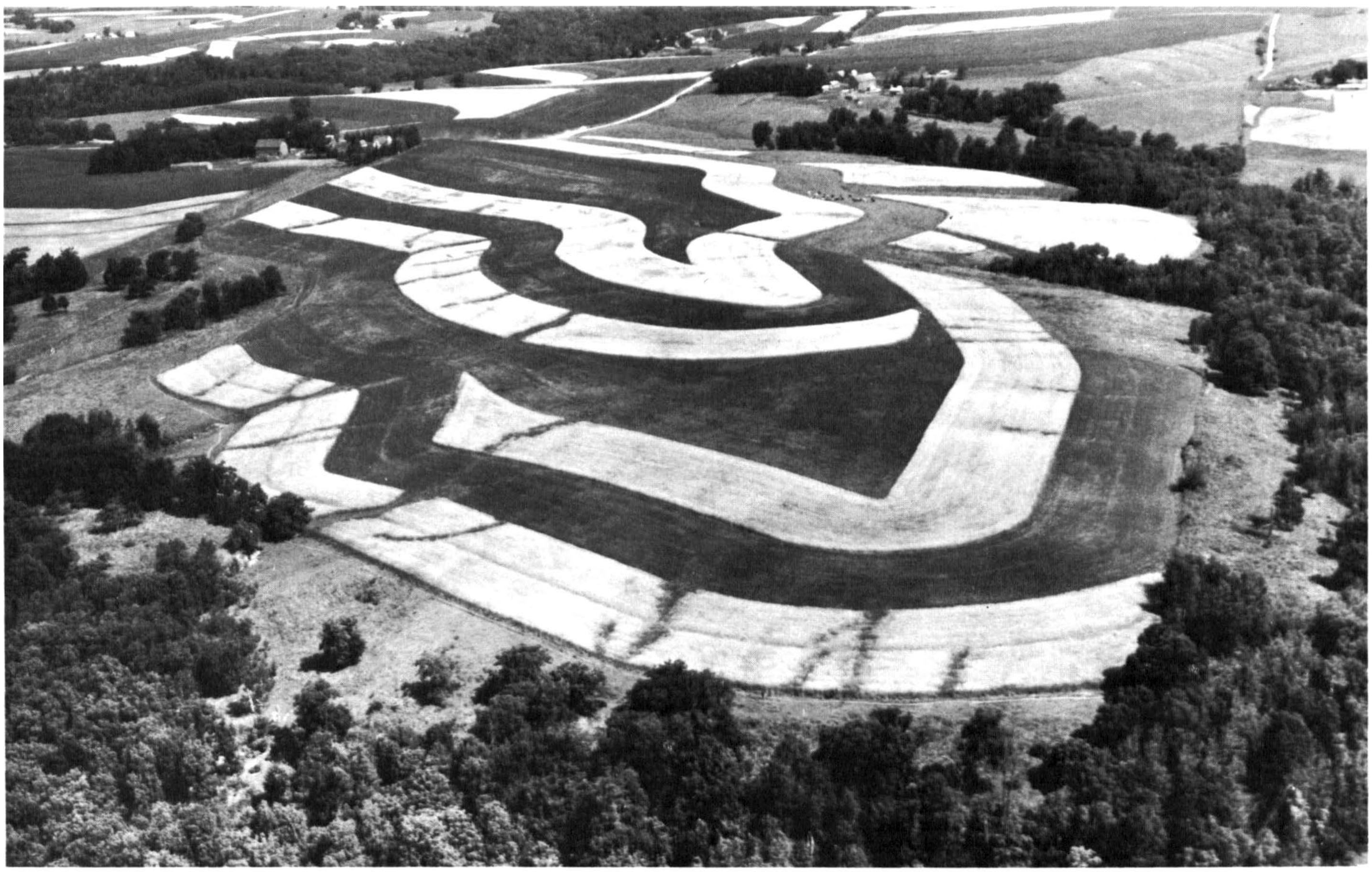
SOIL SURVEY
PEPIN COUNTY
Wisconsin



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
UNIVERSITY OF WISCONSIN
Wisconsin Geological and Natural History Survey
Soil Survey Division
and
Wisconsin Agricultural Experiment Station

HOW TO USE THE SOIL SURVEY REPORT

THIS SURVEY of Pepin County will serve several groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; serve as a reference for students and teachers; aid foresters in managing woodland; and will add to our knowledge of soil science. The survey will also help in rural planning and land appraisal and will assist buyers in selecting the proper soil for the intended use.

Locating the Soils

Turn to the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show what part of the county each sheet of the large map covers. To locate your farm on this index map, look for roads, streams, towns, and other familiar landmarks. When the correct sheet of the large map has been determined, you will note that boundaries of the soils are outlined and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil.

Suppose, for example, the area located has a symbol DdB2. The legend for the detailed map shows that this symbol identifies Downs silt loam, 2 to 6 percent slopes, moderately eroded. This soil and all others mapped in the county are described in the section "Descriptions of the Soils."

Finding Information

Some readers will be more interested in one part of the report than in another, for the report has special sections for different groups, as well as sections that may be of value to all.

Farmers and those who work with farmers can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Use and Management of the Soils." In this way, they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units" at the back of the report will simplify the use of the map and the report. This guide gives the map symbol for each soil, the name of the soil, the page on which the soil is described, the capability unit and woodland group in which the soil has been placed, and the pages where they are described.

Engineers and builders will want to refer to the section "Engineering Uses of the Soils." In the tables in that section are described the texture of the soils, the drainage, and other characteristics that affect engineering.

Scientists and others who are interested will find information on how the soils are formed and how they were classified in the section "Formation, Morphology, and Classification of Soils." They will find further information about the soils in the section "Descriptions of the Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Foresters and those interested in woodland will want to refer to the section "Woodland Uses of the Soils." In this section the types of woodland and the factors affecting their management are discussed. Estimated yields of wood products are also given for the various soils.

Newcomers in Pepin County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," where information about the physiography, drainage, and geology; climate; settlement and development; and agriculture are given.

* * *

Fieldwork for this survey was completed in 1958. Unless otherwise indicated, all statements in the report refer to conditions in the county at that time. The soil survey of Pepin County was made as part of the technical assistance furnished by the Soil Conservation Service to the Pepin County Soil and Water Conservation District.

***Cover picture.*—Stripcropping and sod waterways on soils of capability classes II, III, and IV.**

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SOIL SURVEY OF PEPIN COUNTY, WISCONSIN

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY, SOIL SURVEY DIVISION, AND THE WISCONSIN AGRICULTURAL EXPERIMENT STATION, UNIVERSITY OF WISCONSIN

PEPIN COUNTY is along the western border of Wisconsin, about halfway between the northern and southern boundaries of the State (fig. 1). Two rivers form part of its boundaries. The Mississippi River is on the southwest and separates the county from the State of Minnesota. The Chippewa River forms part of the eastern boundary. Durand, the county seat, is about 62 miles southeast of St. Paul, Minn., and 170 miles northwest of Madison, the State capital.

Agriculture is the leading occupation. Of the 151,680 acres of land in the county, more than 74,000 acres is suitable for tillage. About 95 percent of the farm income comes from livestock and livestock products, but dairying is the largest source of farm income. More than half of the farms specialize in dairying. Most of the rest are general farms or farms that raise livestock other than dairy cattle or poultry. On some farms the main cash crop is grain, and on a few farms poultry products are the chief source of income. The main crops are corn, oats, hay, and pasture, which are basic to the farming of the county. Woodlands occupy about one-third of the land area. They provide some of the wood products needed on the farm and also provide some cash income.

Most of the soils are deep or moderately deep, are gently sloping to sloping, and are silty or loamy. Many of the soils are moderate to high in fertility, but most of them are acid. Crops on these soils respond well, however, if lime and fertilizer are added. Soils that are very sandy, stony, or steep, that are wet, or that are otherwise unsuited to tilled crops are used for grazing, for wood crops, or for wildlife. The fairly large tracts of wet soils along the Mississippi and Chippewa Rivers are important recreational areas.

Figure 1.—Location of Pepin County in Wisconsin.

How Soils Are Named, Mapped, and Classified

Soil scientists made this survey to learn what kinds of soils are in Pepin County, where they are located, and how they can be used. They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the rock material that has not been changed much by leaching or by the roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first described and mapped. Hixton and Dubuque, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many soil series contain soils that differ in the texture of their surface layer. According to such differences, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Hixton loam and Hixton fine sandy loam are two soil types in the Hixton series. The difference in the texture of their surface layer is apparent from their name.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Hixton fine sandy loam, 2 to 6 percent slopes, moderately eroded, is one of several phases of Hixton fine sandy loam, a soil type that ranges from gently sloping to steep.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used these photos for their base map because they show woodland, buildings, field borders, trees, and similar details that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from the same aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientist finds that the differences between two soils are too small to justify separate recognition, even though the soils are not regularly associated geographically. Therefore, the soils are shown as one mapping unit, or called an undifferentiated group. This unit is named for the major soil series in it, for example, Seaton and Fayette silt loams, valleys. Also, in most mapping there are areas that are so rocky, so shallow, or so frequently worked by wind and water that they cannot be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Steep stony and rocky land or Riverwash, and are called land types rather than soils.

Only part of the soil survey was done when the soil scientist had named and described the soil series and mapping units, and had shown the location of the mapping units on the soil map. The mass of detailed information he had recorded then needed to be presented in different ways for different groups of users, among them farmers, managers of woodland, and engineers. To do this efficiently, he had to consult with persons in other fields of work and jointly prepare with them groupings that would be of practical value to different users. Such groupings are the capability classes, subclasses, and units, designed mainly for those interested in producing short-lived crops and tame pasture; woodland suitability groups, for those who need to manage wooded tracts; and the classifications used by engineers who build highways or structures to conserve soil and water.

General Soil Map

After study of the soils in a locality and the way they are arranged, it is possible to make a general map that shows several main patterns of soils, called soil associations. Such a map is the colored general soil map in the back of this report. Each association, as a rule, contains a few major soils and several minor soils, in a pattern that is characteristic although not strictly uniform.

The soils within any one association are likely to differ from each other in some or in many properties; for example, slope, depth, stoniness, or natural drainage. Thus, the general soil map shows, not the kind of soil at any particular place, but several distinct patterns of soils. Each pattern, furthermore, contains several kinds of soils.

Each soil association is named for the major soil series in it, but, as already noted, soils of other series may also be present. The major soils of one soil association may also be present in another association, but in a different pattern.

The general map showing patterns of soils is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the possible location of good-sized areas suitable for a certain kind of farming or other land use.

1. Seaton-Fayette-Dubuque Association

Silty soils of rolling uplands underlain by limestone

This soil association is made up chiefly of silty, well-drained Seaton, Fayette, Dubuque, Downs, and Otterholt soils and of areas of Steep stony and rocky land. It also includes small acreages of other soils. The soils are mainly in uplands on rolling ridges that are capped with loess, but minor areas are on valley slopes. They are underlain by dolomitic limestone or clayey limestone residuum at a depth of 1 to 10 feet or more. This is the largest association in the county. It makes up about 36 percent of the land area.

The Seaton, Fayette, and Dubuque soils are the principal soils on the rolling ridgetops. Other extensive soils are the downs and Otterholt. The Dubuque soils occupy narrow areas on the outer edges of board ridgetops; the other soils are on the broad, less sloping central parts of the ridges.

The Seaton, Fayette, and Downs soils formed in silty material more than 42 inches thick over bedrock. In contrast, the Dubuque soils are less than 42 inches thick over limestone or clayey limestone residuum. The Otterholt soils are underlain by glacial till at a depth of more than 42 inches. The till is loam or clay loam and caps the limestone bedrock along the western edge of the county. Except for the Downs soils, all of these soils formed under forest and have a light-colored surface layer. The surface layer of the Downs soils is moderately dark colored because the soils formed under a cover of grasses and trees, rather than mainly under forest. The Downs soils on ridges are mostly in Stockholm Township.

In the part of this association that consists mainly of valley slopes are small acreages of deeper Seaton and Fayette soils, of Downs soils on benches, and of Lindstrom, Almena, and Norden soils. There are also a few acres of Judson and Chaseburg soils on alluvial fans and along drainageways in the uplands.

The soils in this association are important to the agriculture of the county. More of the acreage is cultivated than in the other associations of the county. Water erosion is the main hazard. Except for Steep stony and rocky land, which is too steep for agriculture, the soils in this association are very productive if well managed. Steep stony and rocky land is suited only to trees.

2. Bertrand-Jackson-Curran Association

Silty soils of stream terraces

This soil association is made up mainly of deep, silty soils on stream terraces. The principal soils are those of the Bertrand, Jackson, and Curran series, which are light colored, and the dark-colored Richwood, Toddville, and Rowley soils. The association also includes small acreages of other soils. The Bertrand and Richwood soils are well drained, the Jackson and Toddville are well drained or moderately well drained, and the Curran and Rowley are somewhat poorly drained. The soils in this association are chiefly level to gently sloping. They make up about 12 percent of the land area in the county.

Areas of this association are in valleys in five different parts of the county. All of the soils formed in medium- or fine-textured materials more than 42 inches deep. In some places there is sand at a depth below 42 inches, but in most places the finer material extends to a depth of 5 feet or more.

In Plum Creek Valley the principal soils are those of the Bertrand and Jackson series. Minor areas are made up of steep terrace escarpments and of miscellaneous types of alluvial land. The soils in the Arkansaw Valley and in the valley of the Eau Galle River are similar to those in Plum Creek Valley, but the areas also include somewhat poorly drained Curran and Orion soils.

The main soils in Hicks Valley are the moderately well drained to well drained Medary soils, the somewhat poorly drained Zwingle soils, and the poorly drained variant from the Zwingle series. This is the only place in the county that these soils have been mapped, and, even though the acreage is small, they are locally important to agriculture. Nearly all of the Richwood, Toddville, and Rowley soils mapped in the county are in this association in Fox Valley in the eastern half of the county.

All of the major soils in this association are desirable for agriculture. The Rowley, Zwingle, Orion, and Curran soils require drainage and protection from overflow for high yields. The rest of the soils are also highly productive if fairly simple management practices are used. Erosion needs to be controlled on the sloping areas. The steep soils on the edges of stream terraces are susceptible to serious gully erosion.

3. Burkhardt-Dakota Association

Loamy soils of stream terraces

The principal soils in this association are those of the Burkhardt, Dakota, and Sparta series. These soils are predominantly moderately coarse textured and medium textured. They are dark colored, are nearly level to undulating, and are on stream terraces. About 5 percent of the land area in the county is made up of soils in this association.

The somewhat excessively drained Burkhardt soils are the most extensive in the association. They consist of sandy loam, 18 to 24 inches thick, that is underlain by loose sand and gravel. The well-drained Dakota soils consist of fine standy loam or loam, 24 to 36 inches thick. They are underlain by sand. Most of the Dakota soils are in a mile-wide belt in the northmost part of this association. Within areas of the Dakota soils is a small acreage of Waukegan silt loam. Steep, sandy escarpments are along the edges of the stream terraces.

Nearly all of the soils in this association have gentle relief and are easy to cultivate. Therefore, much of the acreage is in crops. These soils are droughty, and they are subject to wind and gully erosion. All of the Sparta soils, and in places the Burkhardt soils, are subject to wind erosion if not protected. Because the Sparta soils are also low in natural fertility, in some places they have been planted to trees.

4. Loamy Alluvial Land-Arenzville-Orion Association

Nearly level soils of flood plains

Dominant in this soil association are Loamy alluvial land and the Arenzville and Orion soils. These soils formed in material deposited by water along the courses of streams. The areas are nearly level. They make up about 11 percent of the land area of the county.

Loamy alluvial land, wet, occupies the largest acreage in this association. Areas of better drained Loamy alluvial land, of Sandy alluvial land, and of the Arenzville and Orion soils are the other dominant soils in the association. There is also a somewhat smaller acreage of sandy Riverwash.

Except for Arenzville soils and for the better drained areas of Loamy alluvial land, the soils in this association are limited for agriculture by wetness and flooding.

5. Plainfield-Sparta-Gotham Association

Sandy soils of stream terraces

This soil association is made up mainly of light- and dark-colored, sandy soils of stream terraces. These soils are nearly level to rolling. The principal soils are those of the Plainfield and Sparta series. Extensive areas are also occupied by the Gotham and Hubbard soils and by Loamy wet terrace land and Loamy very wet terrace land. Small acreages of other soils are also included. There are two main parts in this association. One is in the southern part of the county near the village of Pepin. The other is large and is in the eastern half of the county. This association makes up about 15 percent of the land area of the county.

The soils in this association formed in sandy and gravelly outwash that is 10 or more feet deep. Their parent material is similar to that of the soils of association 3, but their drainage is more variable.

The Plainfield and Sparta soils are deep and sandy, and they are excessively drained. They differ chiefly in the color and thickness of their surface layer. The Plainfield soils have a fairly thin, light-colored surface layer. They formed under forest, rather than under prairie as did the Sparta soils, which have a thick, dark surface layer.

The profile of the Gotham and Hubbard soils contains somewhat more fine- and medium-textured material than the profile of the Plainfield and Sparta soils. Also, the Gotham and Hubbard soils have a somewhat higher moisture-supplying capacity for plants. The Gotham soils formed under a mixture of grasses and trees. Their surface layer is moderately dark colored, unlike that of the Hubbard soils, which formed under prairie and have a thick, dark surface layer.

Loamy terrace land is in level to somewhat depressed areas where drainage is poor to very poor. The soil material consists of dark-colored loam and of sandy and gravelly outwash.

That part of the association in the southern part of the county is made up mainly of Sparta soils, but it includes smaller areas of Gotham and Hubbard soils. A small acreage of silty soils is on the terraces and bottom lands, which extend up the valleys that lead to the uplands.

In the part of this association in the eastern half of the county, the soils are more varied than in the southern part. In addition to the soils described, the areas include small acreages of the mottled subsoil variant from the Plainfield series and of soils of the Morocco, Dillon, and Watseka series. These soils are in level and depressed areas. They are moderately well drained to very poorly drained. Along the edges of the terraces are areas of Terrace escarpments, sandy, which is steep and droughty. Small areas of Meridian and Dakota soils are also within this part of the association. They are fine sandy loams and are well drained.

Most of the soils in this association are used for crops, even though they are low in natural fertility. In some places the soils are droughty and are subject to wind erosion, and those areas are planted to trees. A few areas are too wet for crops. These wet areas are used for pasture or for wildlife.

6. Norden-Urne-Hixton-Boone Association

Loamy soils of rolling uplands underlain by sandstone

This association is made up mainly of gently sloping to very steep, loamy soils that formed in sandstone residuum. The dominant soils are those of the Norden, Urne, Hixton, and Boone series. Other extensive soils are those of the Northfield series and those of the dark surface variant from the Norden series. These soils are well drained to excessively drained. Their texture ranges from fine sandy loam to sand. About 13 percent of the land area of the county is made up of soils in this association.

The Norden soils, including the dark surface variants, formed in material derived from greenish, glauconitic sandstone residuum. In a few places oxidized iron in the sandstone residuum makes the surface layer reddish. The Norden soils formed under forest and have a thin, light-colored surface layer, but the dark surface variants formed under prairie and have a thick, dark surface layer. The Urne soils also formed under forest in material from greenish sandstone, but they are shallow. Depth to the sandstone is generally less than 12 inches.

The soils in this association are droughty, erode easily, and in many places are low in natural fertility. Therefore, their use for farming is limited. Areas where the slope is between 2 and 12 percent are used mainly for crops. The steep or very steep soils are mostly in trees, but in some places they are used for pasture. A few areas, once used for crops or pasture, are reverting to trees and to plants that provide cover for wildlife.

7. Gale-Norden-Seaton-Fayette Association

Silty soils of rolling uplands underlain by sandstone

This soil association is made up mainly of moderately deep to deep, well-drained, silty soils of uplands. These soils are light colored and are gently sloping to steep. They are underlain by sandstone. The dominant soils are those of the Gale, Norden, Seaton, and Fayette series. Also extensive are areas of Steep stony and rocky land. Minor areas are made up of soils that are also in association 6 and of very poorly drained Ettrick soils along drainageways. About 8 percent of the land area of the county is made up of soils in this association.

All of these soils formed under forest. The Gale and Norden soils formed in silty material 2 to 3½ feet thick over sandstone, but the sandstone underlying the soils differs. The Norden soils are underlain by greenish, glauconitic sandstone, and the Gale soils, by yellowish, coarser grained sandstone.

The Seaton and Fayette soils formed in silty material more than 3½ feet deep. In some places on valley slopes the texture of the surface layer is loam or fine sandy loam. These areas are generally too small and intermingled with areas of Seaton and Fayette silt loams to be mapped separately. Therefore, they are mapped together in undifferentiated units.

Most of the soils in this association have slopes between 12 and 30 percent. Natural fertility is generally high, and the moisture-supplying capacity is moderately high. Sheet and gully erosion are a problem in cultivated areas. As a result, many areas are used for hay or pasture.

Use and Management of the Soils

The major problems in use and management of the soils vary somewhat in different parts of the county. West of the Chippewa River, the dominant soils are nearly level to sloping and are deep or moderately deep. Most of them are silty or loamy and are moderate to high in fertility.

In the southern part of the area, west of the Chippewa River, are several square miles of sandy soils on terraces. This terrace area is along the river. It extends a few miles to the east and a few miles to the west, and it is the site of the town of Pepin. Other areas of sandy soils are in the part of the county that lies east of the Chippewa River. Most of the sandy soils are low in fertility and have a low capacity for moisture.

Soils on the uplands east of the Chippewa River are dominantly sloping to steep and are moderately deep or deep. Most are loamy or silty and are low to moderate in fertility.

On the uplands and on the terraces where the soils are silty or loamy, the most important problems in use and management of the soils are the improvement and maintenance of fertility and the control of erosion. In addition, the sandy soils on terraces require practices that conserve moisture and provide protection from blowing.

The soils on the flood plains along the Chippewa River and some of the smaller streams are mostly wet. Some are subject to frequent flooding and require supplemental drainage and protection from overflow.

In the following pages the use and management of the soils are described. First, the system of capability classification used by the Soil Conservation Service is explained. Then, basic practices of management that apply to all of the soils are discussed. After that, management of groups of soils, the capability units, is described and information about crop yields is given. This is followed by discussion of management of the soils for woodland and for engineering.

Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere 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 country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no susceptibilty to erosion but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIe-2.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, and the subclasses and units in this county, are described in the list that follows.

Class I.—Soils that have few limitations that restrict their use.
- Unit I-1. Deep, moderately well drained to well drained, nearly level soils.

Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe. Soils subject to moderate erosion if they are not protected.
  - Unit IIe-1. Deep, moderately well drained to well drained, gently sloping soils.
  - Unit IIe-2. Moderately deep, well-drained, gently sloping, silty or loamy soils that are underlain by sand, clayey residuum, or bedrock.
  - Unit IIe-3. Deep, nearly level or gently sloping soils that have a slowly permeable subsoil.
- Subclass IIw. Soils that have moderate limitations because of excess water.
  - Unit IIw-1. Deep, somewhat poorly drained to poorly drained soils.
  - Unit IIw-2. Deep, well-drained to somewhat poorly drained soils that are subject to overflow.

Subclass IIs. Soils that have moderate limitations of moisture capacity and tilth.

Unit IIs–1. Moderately deep, nearly level soils that are underlain by loose sand.

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

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.

Unit IIIe–1. Deep, well-drained, sloping soils.

Unit IIIe–2. Deep, well-drained, sloping soils that are underlain by red clay.

Unit IIIe–3. Moderately deep, well-drained, sloping soils that are underlain by loose sand and sandstone, or by red clay and limestone bedrock.

Unit IIIe–4. Shallow, somewhat excessively drained soils that are underlain by sandstone.

Subclass IIIw. Soils that have severe limitations because of excess water.

Unit IIIw–1. Somewhat poorly drained to very poorly drained soils underlain by layers of loose, wet sand or fine sand and silt at a depth of 24 to 36 inches.

Unit IIIw–2. Peat and muck, deep.

Unit IIIw–3. Deep, moderately well drained to somewhat poorly drained land type that is subject to frequent flooding.

Subclass IIIs. Soils that have severe limitations of moisture capacity or tilth.

Unit IIIs–1. Shallow to moderately deep, well-drained soils underlain by loose sand or sandstone.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.

Unit IVe–1. Deep, sloping to moderately steep soils.

Unit IVe–2. Moderately deep, sloping to moderately steep soils underlain by red clay and limestone or sandstone.

Unit IVe–3. Shallow to moderately deep, sloping soils underlain by loose sand or sandstone.

Subclass IVw. Soils that have very severe limitations for cultivation because of excess water.

Unit IVw–1. Somewhat poorly drained to very poorly drained, sandy soils on stream terraces.

Subclass IVs. Soils that have very severe limitations of stoniness, low moisture capacity, or other features.

Unit IVs–1. Moderately deep to deep, nearly level to gently sloping soils underlain by loose sand or sandstone.

Class V.—Soils not likely to erode that have other limitations, impractical to remove, that limit their use largely to grazing, woodland, or to food and cover for wildlife.

Subclass Vw. Soils too wet for cultivation, drainage or protection not feasible.

Unit Vw–1. Shallow deposits of organic material underlain by loose sand.

Unit Vw–2. Poorly drained alluvial material on flood plains; subject to frequent overflow.

Class VI.—Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to grazing, woodland, or wildlife.

Subclass VIe. Soils severely limited, chiefly by risk of erosion if protective cover is not maintained.

Unit VIe–1. Moderately deep or deep soils that are moderately steep or steep.

Unit VIe–2. Shallow to moderately deep soils that are mostly sloping to moderately steep and are underlain by sand or sandstone.

Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses by their moisture capacity, stones, or other features.

Unit VIs–1. Deep, excessively drained, sloping, sandy soils.

Class VII.—Soils that have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion if protective cover is not maintained.

Unit VIIe–1. Shallow to deep soils that are mostly moderately steep or very steep.

Subclass VIIs. Soils very severely limited by moisture capacity, stones, or other features.

Unit VIIs–1. Sloping to very steep, dominantly sandy soils and Steep stony and rocky land.

Unit VIIs–2. Sandy, droughty land on bottoms.

Class VIII.—Soils and landforms that have limitations that preclude their use for growing plants commercially and that restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIs. Rock or soil materials that have little potential for plants.

Unit VIIIs–1. Loose sand and gravel, recently deposited by streams.

Basic Practices of Management

In the following pages, management practices suitable for all of the soils of Pepin County are discussed. In addition to these management practices, the farmer will also need to take into account all of the resources available on his particular farm. Besides the soils, he needs to consider livestock, machinery and other equipment, and the labor and capital available.

Maintain good tilth.—Maintaining good soil structure, or tilth, in the soils that are farmed is always important. It is especially important on steep slopes that are farmed. Studies made at the Upper Mississippi Valley Conservation Experiment Station near La Crosse (*3*)[1] show that soils having good structure take in and hold more water than soils in which structure has deteriorated. If good structure is maintained, erosion is less serious and more water is available for crops.

Good tilth is required for a firm, fine, granular seedbed. Such a seedbed is especially needed for alfalfa, grass, and other small-seeded crops. These sod-forming crops improve the structure, or tilth, of the soil. This is partly because such crops require no tillage, and partly because soil bacteria act to decay the organic matter or residue from the roots of the sod crop. In addition, sod-

[1] Italic number in parentheses refers to Literature Cited, p. 136.

forming crops keep a cover on the land, thus helping to reduce erosion.

Supply organic matter.—Barnyard manure, green manure, crop residues, or other organic matter applied to soils is effective in several ways. It causes crops to produce higher yields, improves the structure of the soil, increases the intake of water, decreases runoff, and reduces erosion. In addition, organic matter helps to reduce the damage from wind erosion on sandy soils. It also increases the water-storing capacity and the supply of plant nutrients.

Most of the soils of Pepin County need organic matter, especially soils that are sandy or steep. Some organic matter is supplied by decaying roots, but all of the crop residues, barnyard manure, and green manure available must be used if the soils are to have an adequate supply of organic matter. Although the Richwood and similar dark-colored soils were originally high in organic matter, they have been cropped for many years. Frequent additions of organic matter will, therefore, benefit these darker colored soils as well as the lighter colored ones.

Apply lime and fertilizer.—Most of the soils of Pepin County have been farmed for about 100 years. Much of the natural supply of plant nutrients has been exhausted, and many of the soils are now more acid than they were originally. Consequently, lime and a commercial fertilizer that contains phosphorus and potassium are widely used. Most farmers also use a fertilizer that contains nitrogen. To determine if lime and fertilizer are needed, the soils should be tested. Then apply lime and fertilizer according to the needs indicated.

Most of the silty soils in the county were originally fairly high in lime. They are now leached to a depth of 6 to 8 feet and are acid. If tests show the soils to be acid, enough ground limestone ought to be applied to correct acidity, because most crops grow best if the soils are nearly neutral (fig. 2). Sandy soils generally require less lime than the silty soils, but the lime leaches out more quickly than it does in the finer textured soils. Therefore, the sandy soils need lime more frequently. Changes in soil acidity affect the ability of the soil to supply nutrients to plants. Phosphorus, for example, is readily available to plants if the reaction of the soil is nearly neutral, but it becomes increasingly less available as the acidity of the soil increases.

***Figure 2.*—Applying lime is the first step in renovating old pastures.**

For best yields, use other good management practices, as well as adding lime and fertilizer. Good practices are the use of crop varieties that are suited to a particular soil, timely seeding and cultivation, and control of weeds and insects.

Use a suitable cropping system.—One of the keys to good soil management is a good cropping system. If a suitable cropping system is used, the tilth of the soil is improved, organic matter is supplied, and erosion is controlled. In addition, the use of a suitable cropping system provides the variety of crops needed in dairy farming.

In planning a cropping system and the accompanying practices to conserve the soil and maintain fertility, the soils of the entire farm must be considered. The better, more nearly level soils can be used for intensive cropping; that is, row crops can be grown frequently in relation to hay and small grains. These soils respond well to fertilizer and give high yields of feed and forage. The poorer soils generally are steep, sandy, or wet. For these soils, choose a cropping system that will fit the limitations of the soils and that will protect them from damage. Suitable cropping systems are discussed under the capability units.

Control erosion.—Practices to control erosion are needed on many of the soils in the county. They are especially needed on steep or sandy soils (fig. 3). Contour stripcropping, terracing, and the use of diversions are the practices most generally used.

***Figure 3.*—Soils that are too steep for cultivated crops give good yields if renovated; here, the seedbed is prepared by a field cultivator before lime and fertilizer are applied and a mixture of legumes and grasses is seeded.**

Contour stripcropping and terracing, designed and used correctly, greatly reduce the loss of soil by erosion. For contour stripcropping to be the most effective, a cropping system is needed in which hay crops are grown in strips alternating with corn or small grain. If a hay crop is grown in the alternate strips, the runoff from the strips of corn or small grain spreads out and the velocity of the water is slowed down; thus, most of the soil carried by the water settles out in the strips.

On long slopes the use of contour strips is limited. Much runoff from the upper part of the long slopes flows across the lower part of the slope and is likely to cause erosion, even if strips of hay are alternated with strips of corn or grain. On long slopes, terraces or diversions are needed to intercept the runoff and carry it safely from the field. Terraces and diversions both intercept runoff, but a well-constructed terrace can be farmed. Diversions, on the other hand, are larger and more permanent, and they divide the field.

Terraces are generally not satisfactory on slopes of more than 12 percent, but diversions can be constructed on slopes of as much as 25 percent. Terraces and diversions both require maintenance that keeps their channels open and in good operating condition.

Provide adequate drainage.—Most of the soils of uplands in Pepin County are naturally well drained. Many of the soils of the bottom lands and terraces, however, require supplementary drainage. Draining a wet soil makes it more favorable for the growth of higher plants and soil organisms, and it thus improves the structure of the soil. Furthermore, damage to the roots of plants, particularly of alfalfa and sweetclover by alternate freezing and thawing, is reduced. The water table is also lowered, making the depth in which plant nutrients are available greater. In addition, the soil warms earlier in spring if excess water is drained away because evaporation at the surface is reduced and less heat is needed to warm the soil. Soils that are inadequately drained are likely to be from 5 to 15 degrees cooler in spring than well-drained soils.

Management by Capability Units

Soils in one capability unit have about the same limitations and similar risks of damage. The soils in one unit, therefore, need about the same kind of management, though they may have formed from different kinds of parent material and in different ways. The capability units are described in the following pages. The soils in each unit are listed, and management suitable for all the soils of one unit is suggested.

Capability unit I-1

The soils in this unit are deep, moderately well drained to well drained, and nearly level. They are moderately permeable and have high moisture-supplying capacity for plants. The soils are easy to manage and conserve, and good tilth is easy to maintain. These soils are the best in the county for cultivated crops and can be used safely with good farming methods (fig. 4). The following soils are in this unit:

- Bertrand silt loam, 0 to 2 percent slopes.
- Chaseburg silt loam, 0 to 2 percent slopes.
- Jackson silt loam, 0 to 2 percent slopes.
- Judson silt loam, 0 to 2 percent slopes.
- Richwood silt loam, 0 to 2 percent slopes.
- Toddville silt loam, 0 to 2 percent slopes.

If fertility is kept high, these soils can be used intensively for corn, small grains, and forage crops and for peas, potatoes, green beans, and other special crops. The soils are also well suited to pasture and trees and as a source of food and cover for wildlife.

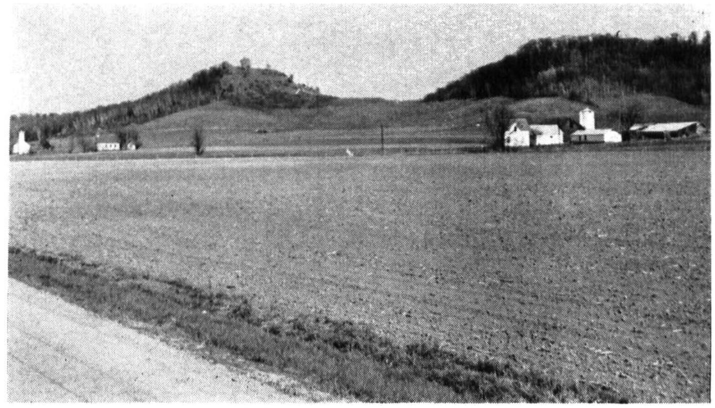

Figure 4.—**A cultivated field of Jackson silt loam is in the foreground.**

Suitable cropping systems for these soils are—

- 3 years of row crops followed by 1 year each of a small grain and hay.
- 2 years of row crops followed by 1 year of a small grain and 2 years of hay.
- Continuous row crops with a cover crop of rye, or continuous row crops if all crop residues are plowed under. If row crops are grown continuously, use minimum tillage, grow cover crops between seasons, and keep fertility high.

Nearly all of these soils need lime unless thay have been limed recently. Moderate to high amounts of phosphate and potash are also needed. The lime and fertilizer should be added according to the needs indicated by soil tests.

Capability unit IIe-1

In this unit are deep, moderately well drained to well drained, gently sloping soils. These soils are moderately permeable and have high moisture-supplying capacity for plants. They are subject to moderate erosion, but good tilth is fairly easy to maintain. The Chaseburg and Judson soils also are subject to a slight hazard of overflow.

The following soils are in this unit:

- Bertrand silt loam, 2 to 6 percent slopes.
- Bertrand silt loam, 2 to 6 percent slopes, moderately eroded.
- Chaseburg silt loam, 2 to 6 percent slopes.
- Downs silt loam, 2 to 6 percent slopes.
- Downs silt loam, 2 to 6 percent slopes, moderately eroded.
- Downs silt loam, benches, 2 to 6 percent slopes, moderately eroded.
- Dubuque silt loam, deep, 2 to 6 percent slopes.
- Dubuque silt loam, deep, 2 to 6 percent slopes, moderately eroded.
- Jackson silt loam, 2 to 6 percent slopes.
- Jackson silt loam, 2 to 6 percent slopes, moderately eroded.
- Judson silt loam, 2 to 6 percent slopes.
- Otterholt silt loam, loamy substratum, 2 to 6 percent slopes.
- Otterholt silt loam, loamy substratum, 2 to 6 percent slopes, moderately eroded.
- Richwood silt loam, 2 to 6 percent slopes.
- Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes.
- Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes, moderately eroded.
- Seaton and Fayette silt loams, valleys, 2 to 6 percent slopes.
- Toddville silt loam, 2 to 6 percent slopes.

These soils are well suited to corn, small grains, and forage crops, and to green beans, potatoes, peas, and other special crops. They are also suited to pasture or trees, and to use as wildlife areas. Contour stripcropping and terracing are suitable practices to help control erosion, and diversions and grassed waterways are suitable for safely disposing of excess water.

Suggested cropping systems and conservation practices are—

Contour stripcropping: 2 years of row crops and 1 year of a small grain followed by 2 years of hay.
Terracing: 2 years of row crops and 1 year each of a small grain and hay, or 1 year each of a row crop, a small grain, and hay.

If special conservation practices are not used, a suitable cropping system is—

1 year each of a row crop and a small grain followed by 2 years of hay.

These soils should be tested to determine the need for lime and fertilizer. Most of the soils need lime unless they have been limed recently, and generally moderate amounts of phosphate and potash are needed. For high yields, corn requires supplemental applications of nitrogen in addition to manure. The content of organic matter, especially in the moderately eroded soils, needs to be increased in many places. This can be done by adding large amounts of manure or by growing more legumes or grasses than other crops in the cropping system. Plowing under green-manure crops and returning crop residues to the soils also help to increase the content of organic matter.

Capability unit IIe-2

In this unit are moderately deep, well-drained silty or loamy soils that are underlain by sand, clayey residuum, or bedrock. These gently sloping soils are 2 to 3 feet thick. They are moderately permeable and have moderate moisture-supplying capacity for plants. They are slightly droughty and are subject to moderate erosion. The following soils are in this unit:

Dakota loam, 2 to 6 percent slopes.
Dakota loam, 2 to 6 percent slopes, moderately eroded.
Dubuque silt loam, 2 to 6 percent slopes, moderately eroded.
Norden fine sandy loam, 2 to 6 percent slopes, moderately eroded.
Norden silt loam, 2 to 6 percent slopes.
Norden silt loam, 2 to 6 percent slopes, moderately eroded.
Waukegan silt loam, 2 to 6 percent slopes.
Waukegan silt loam, 2 to 6 percent slopes, moderately eroded.

These soils are well suited to corn, small grains, grasses, and legumes. They are also suited to pasture, to trees, or to use as wildlife areas.

If these soils are used for tilled crops, practices are required to help control erosion. The soils are easy to work if the content of organic matter is kept high. Contour stripcropping and terracing help to control erosion and to prevent a corresponding lowering of the moisture-holding capacity.

Suggested conservation practices and cropping systems are—

Contour stripcropping: 1 year each of a row crop and a small grain followed by 2 years of hay, or 2 years of row crops followed by 1 year of a small grain and 2 years of hay.
Terracing: 2 years of row crops followed by 1 year of a small grain and then by 2 years of hay, or 2 years of row crops followed by 1 year each of a small grain and hay.

If special conservation practices are not used, a suitable cropping system is—

1 year each of a row crop and a small grain and then 3 years of hay.

All of these soils need lime unless they have been limed recently. Phosphate and potash should be applied according to the needs indicated by soil tests, and nitrogen, according to the needs of the crop. These soils, especially the moderately eroded ones, are likely to be low in organic matter. The content of organic matter can be increased by including more legumes and grasses than other crops in the cropping system, returning all crop residues to the soils, and adding large amounts of manure.

Capability unit IIe-3

In this unit are deep, nearly level or gently sloping soils that have a slowly permeable subsoil. These soils are dominantly well drained or moderately well drained, but a minor acreage is somewhat poorly drained. All of the soils have high moisture-supplying capacity for plants and are slowly permeable. The following soils are in this unit:

Almena silt loam, 2 to 6 percent slopes, moderately eroded.
Medary silt loam, 0 to 2 percent slopes.
Medary silt loam, 2 to 6 percent slopes.

The Medary soils occupy the largest acreage in this unit. They are well drained or moderately well drained and formed in silty material on high stream terraces. Their subsoil and substratum is reddish, clayey material that is plastic when wet and hard when dry. The Almena soil formed in deep silt and is somewhat poorly drained. The soils in this unit are of minor extent in the county, and nearly all areas are used for cultivated crops. Corn, small grains, grasses, and legumes are the most common crops.

If these soils are cultivated, careful management is required to maintain good tilth and control erosion, to keep fertility high, and to maintain the supply of organic matter. If part of the surface layer is removed through erosion and tillage extends into the clayey subsoil, these soils become difficult to work. Adding large amounts of barnyard manure and green manure helps to keep these soils in good tilth. Also, if deep-rooted grasses and legumes are grown, they help to develop more pore space in the soils and thus increase movement of water through the surface and subsurface layers.

Because of the slowly permeable subsoil, water moves down through these soils slowly. Therefore, in flat areas and in slight depressions, water ponds in places for short periods. The Almena soil is likely to require drainage in a few places if it is to produce high yields. Diversions, terraces, surface drains, or grassed waterways can generally be used to dispose of excess runoff.

A suitable cropping system is—

1 year each of a row crop and a small grain and then 2 years of hay.

The soils in this unit require moderate amounts of phosphate and potash. Legumes also need lime, and corn requires supplemental additions of nitrogen for high yields.

Capability unit IIw-1

This capability unit is made up of deep, somewhat poorly drained to poorly drained soils. These nearly level, light- to dark-colored soils are on high stream terraces. They have high moisture-supplying capacity for plants and require drainage for best yields. The following soils are in this unit:

Curran silt loam.
Rowley silt loam.
Zwingle silt loam.
Zwingle silt loam, poorly drained variant.

If flooding has been controlled and if the soils have been adequately drained, they can be used intensively and are well suited to corn, small grains, grasses, and legumes. In areas that have not been adequately drained, alsike clover and ladino clover can be grown instead of alfalfa. These soils are also well suited to trees and to use as wildlife areas.

Generally, surface drains can be used to provide drainage. If outlets are available, tile drains can be used. If tile drains are used, good structure must be maintained so that excess moisture can enter the soil and move down to the tile. Adding organic matter and working the soil only when it is dry enough to prevent puddling help to maintain good structure. In many places diversions and grassed waterways can be used to provide supplemental drainage.

Suggested cropping systems are—

1 year each of a row crop, a small grain, and hay if stover and straw are left on the field.

2 years of row crops followed by 1 year each of a small grain and hay if the content of organic matter is kept high.

These soils need lime in places, and they generally need moderately large amounts of phosphate and potash. Lime, phosphate, and potash should be applied according to the needs indicated by soil tests, and nitrogen, according to the needs of the crop. These soils are somewhat slow to warm in spring, and a fertilizer that contains nitrogen is needed to start crops growing.

Capability unit IIw-2

In this unit are deep, well-drained to somewhat poorly drained soils that are subject to overflow. Most of these nearly level soils are on flood plains and on the bottoms of narrow valleys, but the Wallkill soil is between areas of terraces and bottom lands. All of the soils are moderately permeable and have high moisture-supplying capacity for plants. Good tilth is fairly easy to maintain. The hazard of flooding is slight to moderate. The following soils are in this unit:

Arenzville silt loam.
Huntsville silt loam.
Orion silt loam.
Wallkill silt loam.

Nearly level relief and high natural fertility make these soils suited to intensive cropping. Most areas are in corn, small grains, grasses, and legumes.

Except for some gullying and cutting of channels, these soils are not subject to serious erosion. They are, however, susceptible to flooding. When the streams overflow, a thin layer of sediment is deposited on the surface in some places. In addition to flooding, the Orion and Wallkill soils have poor surface and internal drainage; ditches generally are needed to improve the drainage of these soils. Where needed, dikes, grassed waterways, and diversions can be used to control flooding.

Suitable cropping systems are—

1 year each of a row crop, a small grain, and hay.

1 year each of a row crop and a small grain followed by 2 years of hay.

Continuous row crops can be grown on the soils of this unit if good tilth and a high level of fertility are maintained and if a large amount of organic matter is kept in the soils. This can be done by plowing under plant residues or green-manure crops and by adding large amounts of barnyard manure. Areas of these soils that are inaccessible or that are subject to frequent flooding are better suited to permanent pasture and trees or to use as wildlife areas than to other uses.

Crops on these soils respond well if lime and fertilizer are applied according to the needs indicated by soil tests. These soils are nearly neutral and require little or no lime unless they have been cropped intensively for many years.

Capability unit IIs-1

This unit is made up of moderately deep, nearly level soils that are underlain by loose sand. These well-drained soils are on terraces along streams. They have moderate moisture-supplying capacity for plants, but during extended dry periods they are likely to be slightly droughty. The following soils are in this unit:

Dakota loam, 0 to 2 percent slopes.
Waukegan silt loam, 0 to 2 percent slopes.

These soils are suited to corn, small grains, grasses, and legumes. They also are suited to trees and to use as wildlife areas.

If the content of organic matter is kept high, these soils are fairly easy to work. Practices are required to conserve moisture, especially in dry seasons. Using a suitable cropping system and adding manure will help to build up the supply of organic matter. These practices also help to improve tilth and conserve moisture for plants.

Suggested cropping systems are—

2 or 3 years of row crops followed by 1 year each of a small grain and hay if crop residues are left on the field.

1 year each of a row crop and a small grain followed by 2 years of hay if crop residues are removed from the field.

These soils generally need moderate amounts of phosphate and potash. They should be tested to determine the specific amounts of lime and fertilizer needed.

Capability unit IIIe-1

The soils in this unit are deep, well drained, and sloping. Except for the Judson soil, which is on bottom lands, the soils are on stream terraces and uplands. Favorable tilth is easy to maintain if good management is used. These soils have high moisture-supplying capacity for plants. The hazard of erosion is moderately severe. The following soils are in this unit:

Bertrand silt loam, 6 to 12 percent slopes.
Bertrand silt loam, 6 to 12 percent slopes, moderately eroded.
Downs silt loam, 6 to 12 percent slopes, moderately eroded.

Downs silt loam, benches, 6 to 12 percent slopes, moderately eroded.
Jackson silt loam, 6 to 12 percent slopes.
Jackson silt loam, 6 to 12 percent slopes, moderately eroded.
Judson silt loam, 6 to 12 percent slopes.
Lindstrom silt loam, 6 to 12 percent slopes.
Lindstrom silt loam, 6 to 12 percent slopes, moderately eroded.
Otterholt silt loam, loamy substratum, 6 to 12 percent slopes, moderately eroded.
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes.
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, moderately eroded.
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, severely eroded.
Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes.
Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes, moderately eroded.

Most areas of these soils are used for cultivated crops, mainly corn, small grains, grasses, and legumes. Areas that are not cultivated are used for permanent pasture and for woodlots. These soils also can be used as wildlife areas.

If these soils are cultivated, they are highly susceptible to sheet and gully erosion because of runoff. Contour stripcropping, terracing, diversions, and grassed waterways can be used to control erosion. Practices are also needed to keep fertility high and to maintain the content of organic matter.

Suggested management practices and cropping systems are—

Contour stripcropping: 1 year each of a row crop and a small grain followed by 2 years of hay.
Terracing: 2 years of row crops and 1 year of a small grain followed by 2 years of hay; or 1 year each of a row crop, a small grain, and hay.

If no special management practices are used, a suitable cropping system is—

1 year each of a row crop and a small grain followed by 4 years of hay.

Crops on these soils respond well if lime and fertilizer are applied according to the needs indicated by soil tests. Lime is required for high yields of crops and for pastures that contain legumes. In places the content of organic matter is low. It is especially low in the moderately eroded and severely eroded soils, unless suitable cropping systems have been used and all crop residues returned to the soils. Organic matter can be supplied by adding large amounts of manure and using cropping systems that include more legumes and grasses than row crops.

Capability unit IIIe-2

In this unit are deep, well-drained, sloping soils that are underlain by red clay at a depth between 20 and 42 inches. The red clay overlies dolomitic limestone and ranges from a few inches to several feet in thickness. These soils are moderately permeable and have high moisture-supplying capacity for plants. The hazard of erosion is moderately severe. The following soils are in this unit:

Dubuque silt loam, deep, 6 to 12 percent slopes.
Dubuque silt loam, deep, 6 to 12 percent slopes, moderately eroded.

These soils are well suited to row crops, small grains, and hay. They are also suited to permanent pasture, to trees, or to use as wildlife areas.

Most of the moderately eroded soil in this unit is cultivated. The less eroded one is generally on the ends of ridges, in other areas not suited to farming, or in areas that are inaccessible to farm equipment. These areas are mostly in trees.

If the silty surface layer of these soils is removed through erosion, tilth will be impaired and yields lowered. Contour stripcropping, terracing, grassed waterways, and diversions are practices that can be used to control erosion.

Suggested management practices and cropping systems are—

Contour stripcropping: 1 year each of a row crop and a small grain followed by 2 years of hay.
Terracing: 2 years of row crops and 1 year of a small grain followed by 2 years of hay.

If no special management practices are used, a suitable cropping system is—

2 years of a small grain followed by 3 years of hay.

These soils should be tested to determine the needs for lime and fertilizer. Except where they have been limed recently, areas that have been cultivated require lime. Moderate amounts of phosphate and potash are generally needed. In addition to manure, supplemental nitrogen is needed for high yields of corn. The content of organic matter in the moderately eroded soil needs to be increased by adding large amounts of manure or by using a cropping system in which legumes or grasses are grown more than other crops. The organic matter can also be increased by plowing green-manure crops under and returning crop residues to the soils.

Capability unit IIIe-3

In this unit are moderately deep, well-drained, sloping soils that are underlain by loose sand and sandstone or by red clay and limestone bedrock. These soils are moderately permeable and have moderate moisture-supplying capacity for plants. Good tilth can be maintained if good management is used. In dry periods, however, yields are lowered in places because of lack of moisture. The hazard of water erosion is moderately severe. The following soils are in this unit:

Dakota loam, 6 to 12 percent slopes, moderately erodod.
Dubuque silt loam, 6 to 12 percent slopes.[1]
Dubuque silt loam, 6 to 12 percent slopes, moderately eroded.[1]
Gale silt loam, 6 to 12 percent slopes.
Gale silt loam, 6 to 12 percent slopes, moderately eroded.
Norden fine sandy loam, 6 to 12 percent slopes.
Norden fine sandy loam, 6 to 12 percent slopes, moderately eroded.
Norden silt loam, 6 to 12 percent slopes.
Norden silt loam, 6 to 12 percent slopes, moderately eroded.
Waukegan silt loam, 6 to 12 percent slopes, moderately eroded.

Most areas of these soils are under cultivation. A fairly large acreage of Dubuque, Gale, and Norden soils, however, is on narrow ridges, in small areas on the ends of ridges, or in other positions that are not well suited to tillage. These areas are used for permanent pasture and woodlots. The soils are well suited to those uses and are also suitable for use as wildlife areas.

In the areas that are cultivated, these soils are highly susceptible to water erosion. Because of their moderate

[1] Areas in which limestone is at a depth of less than 18 inches are not suitable for terracing.

depth, the loss of additional soil material through erosion could reduce the moisture-supplying capacity and lower yields. These soils are also subject to gullying. Gullying is especially damaging if erosion has removed all of the soil material above the substratum because the substratum is unfavorable for the growth of plants. Management practices that control erosion and that protect the soils from gullying are essential if tilled crops are to be grown. Stripcropping, terracing, grassed waterways, and diversions can be used to control erosion. Applying barnyard manure and green manure and returning crop residues to the soils help to maintain the moisture-supplying capacity.

Suggested management practices and cropping systems are—

Contour stripcropping: 1 year each of a row crop and a small grain followed by 3 years of hay.

Terracing: 2 years of row crops followed by 1 year of a small grain and 3 years of hay.

If no special management practices are used, a suitable cropping system is—

year of a small grain and 3 or more years of hay.

Crops on these soils respond well if lime and fertilizer are added. The lime and fertilizer should be applied according to the needs indicated by soil tests. The soils that have been used for crops are acid unless lime has been added. The content of organic matter, especially in the moderately eroded soils, is generally low. It can be replenished by adding large amounts of manure frequently and by using a cropping system in which legumes and grasses are grown more of the time than other crops.

Capability unit IIIe-4

In this capability unit are shallow, somewhat excessively drained soils that are underlain by sandstone. The sandstone is platy and is at a depth between 10 and 20 inches. These soils are gently sloping. They have moderately rapid permeability and low moisture capacity for plants. The hazard of erosion is moderately severe, and the soils are droughty. The following soils are in this unit:

Northfield very fine sandy loam, 2 to 6 percent slopes.
Northfield very fine sandy loam, 2 to 6 percent slopes, moderately eroded.

These soils are easy to till, but their productivity is fairly low. Good tilth can be maintained by adding frequently those amendments that supply organic matter. Nearly all of the acreage is cultivated, but a small part is in permanent pasture and woodlots. The soils are suited to trees if suitable species are planted, and they are also suitable for wildlife areas. Corn, soybeans, small grains, grasses, and legumes are the principal crops.

These soils are shallow over sandstone, and roots cannot penetrate deeply. Special practices are required to control erosion and to prevent a corresponding lowering of the water-holding capacity and yields. Contour stripcropping and grassed waterways can be used to help control erosion. Moisture can be conserved by adding barnyard manure and plowing under green-manure crops and crop residues.

Suggested conservation practices and cropping systems are—

Contour stripcropping: 1 year each of a row crop and a small grain followed by 2 years of hay.

If no conservation practices are used, a suitable cropping system is—

1 year each of a row crop and a small grain followed by 4 or more years of hay.

Crops on these soils respond moderately well if lime and fertilizer are added. The lime and fertilizer should be applied according to the needs indicated by soil tests.

Capability unit IIIw-1

In this unit are somewhat poorly drained to very poorly drained soils underlain by layers of loose, wet sand or fine sand and silt at a depth of 24 to 36 inches. The soils are in flats and in slight depressions on low stream terraces and bottom lands. They have a high water table and slow surface drainage. The content of organic matter is moderately high, and the soils are easy to work if they are adequately drained. The following soils are in this unit:

Ettrick silt loam, coarse silt substratum.
Loamy wet terrace land.

Most of Loamy wet terrace land is used for cultivated crops. Row crops, small grains, red clover, and ladino clover are the main crops. The Ettrick soil lacks adequate drainage and protection from overflow. Therefore, it is largely in permanent pasture or is used to provide cover for wildlife.

The soils in this unit must be drained if good yields are to be obtained. Many areas also require protection from overflow. Drainage ditches, diversions, and grassed waterways can be used to improve drainage, but tile drains are not well suited. In addition to drainage, management practices to build up fertility and maintain organic matter in the soils are essential for good crop yields.

Suggested cropping systems are—

1 year each of a row crop, a small grain, and hay.
2 years of row crops, 1 year of a small grain, and 2 years of hay.
1 year each of a row crop and a small grain and 2 years of hay.

If these soils have been drained, crops on them respond well to applications of fertilizer. The soils are naturally medium acid to nearly neutral. The requirement for lime depends on past cropping systems and on the kind of crop to be grown. The lime and fertilizer should be applied according to the needs indicated by soil tests.

Capability unit IIIw-2

This unit consists only of Peat and muck, deep, which is made up of organic materials that are more than 42 inches thick. The areas are on flats in depressions on the broad bottoms of stream valleys. This soil is subject to flooding. It has a high water table and slow surface drainage.

If this soil is adequately drained and well managed otherwise, it is potentially highly productive. This soil is easy to work. With proper drainage and good management, it is well suited to special crops, and row crops can be grown continuously. This soil is also well suited to pasture or can be used for wildlife.

Some areas of this soil have been drained and are used for crops. More than half of the acreage, however, is still in sedges, grasses, sparse stands of tamarack, and in brush, and these areas are used for pasture and wildlife. Most areas that have been drained are used intensively for row crops or special crops.

If this soil is used for crops, deep ditches or tile drains are needed to improve the drainage. In many places surface drains or diversions on adjacent land divert overflow water and are used to complement the deep drainage system. After the areas have been drained, they require protection from wind erosion and from fire.

This soil requires fairly large applications of potash. It also requires nitrogen fertilizer as a starter for crops. Lime generally is not needed, because the soil is nearly neutral. This soil should be tested and fertilizer applied in the kinds and amounts indicated by the tests.

Capability unit IIIw–3

This unit consists only of deep Loamy alluvial land, which is moderately well drained to somewhat poorly drained and is subject to frequent flooding. This land type is on bottom lands along streams. The areas are predominantly silty, but small areas covered by coarser textured overwash material are included.

If this land type is adequately drained and is protected from overflow, it is easy to work. Where flooding is difficult to control, the areas are used mainly for permanent pasture. In areas where crops are not damaged by flooding, corn, soybeans, small grains, grasses, red clover, and ladino clover are grown. A small acreage is wooded.

If this land type is to be used for crops, most areas will require drainage or protection from flooding. Dikes or diversions may be needed to control flooding, and surface drains are helpful on the level areas. Practices to control erosion on adjoining, higher areas reduce flooding and keep overwash sediments from being deposited on these soils.

Suggested cropping systems for these soils are—

- 1 year each of a row crop, a small grain, and hay.
- 2 years of row crops followed by 1 year each of a small grain and hay.

Row crops can be grown continuously if the fertility and organic matter is kept high and good tilth is maintained. Pastures on this land type need lime and fertilizer and should be reseeded. They also need protection from overgrazing.

If this land type is adequately drained and is protected from overflow, crops grown on it respond well to applications of fertilizer. Lime may also be needed if legumes are to be grown. The lime and fertilizer should be applied according to the needs indicated by soil tests.

Capability unit IIIs–1

This unit is made up of shallow to moderately deep, well-drained soils that are underlain by loose sand or sandstone. These soils are nearly level to sloping. They are on uplands and on terraces along streams. They have moderately rapid permeability and moderately low to low moisture-supplying capacity for plants. The following soils are in this unit:

- Burkhardt sandy loam, 0 to 2 percent slopes.
- Burkhardt sandy loam, 2 to 6 percent slopes.
- Burkhardt sandy loam, 2 to 6 percent slopes, moderately eroded.
- Dakota fine sandy loam, 0 to 2 percent slopes.
- Dakota fine sandy loam, 2 to 6 percent slopes.
- Dakota fine sandy loam, 2 to 6 percent slopes, moderately eroded.
- Hixton fine sandy loam, 2 to 6 percent slopes, moderately eroded.
- Meridian fine sandy loam, 0 to 2 percent slopes.
- Meridian fine sandy loam, 2 to 6 percent slopes.
- Meridian fine sandy loam, 2 to 6 percent slopes, moderately eroded.
- Norden fine sandy loam, dark surface variant, 2 to 6 percent slopes, moderately eroded.
- Urne and Norden fine sandy loams, 2 to 6 percent slopes, moderately eroded.

These soils are easy to till, but they are only moderately productive. Good tilth can be maintained if those amendments that supply organic matter are added frequently. Nearly all areas are cultivated, but a minor acreage is used for permanent pasture and woodlots. Corn, soybeans, small grains, grasses, and legumes are the principal crops.

The sandy texture and moderate depth of these soils cause them to be somewhat droughty, especially during periods when rainfall is low or is poorly distributed. If the soils are cultivated, they are subject to wind and water erosion. The Burkhardt soils are slightly more susceptible to wind erosion and are slightly more droughty than the other soils. Therefore, they need more careful management if they are used for cultivated crops.

If the soils in this unit are to be used safely for crops over a long time, and if good yields are to be obtained, special management practices are required. These practices include adding barnyard manure and plowing under green-manure crops and crop residues to improve the moisture-holding capacity of the soils. These practices also help to control wind and water erosion. Using a shelterbelt on the more nearly level areas, in conjunction with stripcropping, is a good practice to prevent damage from warm, drying winds during the growing season. With this practice, hay crops are grown in strips alternating with strips of small grains or row crops.

In sloping areas contour stripcropping or using terraces, diversions, and other supporting management practices help to control water erosion. Adequate amounts of fertilizer must be applied for good yields. Crops on these soils respond well to supplemental irrigation during periods when rainfall is low or poorly distributed.

Suggested management practices and cropping systems for the gently sloping soils are—

- Contour stripcropping: 2 years of row crops followed by 1 year of a small grain and 2 years of hay.
- 1 year each of a row crop and a small grain followed by 2 years of hay.
- Terracing: 1 year each of a row crop, a small grain, and hay.
- 2 years of row crops followed by 1 year each of a small grain and hay.

If no special management practices are used, a suitable cropping system for the gently sloping soils is—

- 1 year of a row crop followed by a small grain and 4 years of hay.

The nearly level soils are suitable for intensive cropping if wind erosion is controlled and if the fertility and the content of organic matter are kept high.

Suitable cropping systems for the nearly level soils are—

2 years of row crops followed by 1 year each of a small grain and hay, if all crop residues are returned to the soil.

2 years of row crops, 1 year of a small grain, and 2 years of hay, if crop residues are not returned to the soil.

Capability unit IVe-1

In this unit are deep, sloping to moderately steep soils. These soils are on uplands and stream terraces. They are well drained and are moderately permeable. The soils that have slopes of 6 to 12 percent are severely eroded, and those that have slopes of 12 to 20 percent are slightly or moderately eroded. All of the soils can be kept in good tilth if adequate practices are used to control erosion and if a good supply of organic matter is maintained. These soils have moderate to moderately high moisture-supplying capacity for plants. Contour stripcropping, diversions, and grassed waterways can be used to help control erosion. The following soils are in this unit:

Bertrand silt loam, 6 to 12 percent slopes, severely eroded.
Bertrand silt loam, 12 to 20 percent slopes, moderately eroded.
Downs silt loam, benches, 12 to 20 percent slopes.
Downs silt loam, benches, 12 to 20 percent slopes, moderately eroded.
Dubuque silt loam, deep, 12 to 20 percent slopes.
Dubuque silt loam, deep, 12 to 20 percent slopes, moderately eroded.
Jackson silt loam, 6 to 12 percent slopes, severely eroded.
Lindstrom silt loam, 12 to 20 percent slopes.
Lindstrom silt loam, 12 to 20 percent slopes, moderately eroded.
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes.
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, moderately eroded.
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes.
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, moderately eroded.
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, severely eroded.

Some areas of these soils are used for crops and pastures, and others are in trees. A fairly large acreage that consists mainly of areas that are not easily accessible for farming is used for permanent pasture and woodlots.

The soils in this unit are too steep or severely eroded to be cropped intensively. Nevertheless, if practices are used to control erosion and if other good management is used, row crops can be grown safely on them. Careful management is required, however, to maintain a good supply of plant nutrients and organic matter in the soils. Good returns can be realized by growing a small grain and hay crop in rotation or by renovating and seeding the pastures. In addition to the other practices described, diversions may be needed to control erosion, especially on the long slopes.

Suggested management practices and cropping systems are—

Contour stripcropping: 1 year each of a row crop and a small grain followed by 4 years of hay.

If no special management practices are used, a suitable cropping system is–

1 year of a small grain followed by 3 years of hay.

Crops on these soils respond well if lime and fertilizer are applied. Moderate amounts of phosphate and potash are needed. Legumes are generally the main crop grown, and lime therefore is essential in most areas. The lime and fertilizer should be applied according to the needs indicated by soil tests. If these soils are cultivated, the content of organic matter needs to be increased by adding large amounts of manure. If feasible, all crop residues should be returned to the soil.

Capability unit IVe-2

In this unit are moderately deep, sloping to moderately steep soils underlain by red clay and limestone or sandstone. This underlying material is at a depth between 2 and 3 feet. These soils are well drained and have moderate permeability. The ones that have slopes of 6 to 12 percent are severely eroded, and those that have slopes of 12 to 20 percent are slightly eroded or moderately eroded. In all of the soils, good tilth can be maintained only by managing the soils carefully. Because the soils are limited in depth and have steep slopes, their moisture-supplying capacity for plants is only moderate. The following soils are in this unit:

Dubuque silt loam, 12 to 20 percent slopes.
Dubuque silt loam, 12 to 20 percent slopes, moderately eroded.
Dubuque soils, 6 to 12 percent slopes, severely eroded.
Gale silt loam, 12 to 20 percent slopes.
Gale silt loam, 12 to 20 percent slopes, moderately eroded.
Norden fine sandy loam, 12 to 20 percent slopes.
Norden fine sandy loam, 12 to 20 percent slopes, moderately eroded.
Norden loam, 12 to 20 percent slopes, moderately eroded.
Norden silt loam, 6 to 12 percent slopes, severely eroded.
Norden silt loam, 12 to 20 percent slopes.
Norden silt loam, 12 to 20 percent slopes, moderately eroded.

The soils in this unit are suited to small grains and hay, and they are also suited to trees and to use as wildlife areas. Most of the acreage is in crops. Many areas, however, are unfavorable for tillage, because of their shape or steep slope, and are in permanent pasture or trees. Other areas are not easily accessible for farming.

These soils require practices that conserve moisture and control erosion. The loss of additional soil material through erosion would reduce the thickness of the root zone and would permanently reduce the capacity of the soils to make good yields. Using contour stripcropping and establishing diversions and grassed waterways help to control erosion. The moisture-supplying capacity can be maintained by adding barnyard manure, plowing under green-manure crops, and returning crop residues to the soils.

Suggested management practices and cropping systems are—

Contour stripcropping: 1 year of a small grain followed by 3 years of hay.

If no special management practices are used, seeding of pastures should be done only when the areas are renovated.

Crops on these soils respond moderately well if lime and fertilizer are applied according to the needs indicated by soil tests. Moderately large amounts of phosphate and potash are required, and lime is needed for high yields of legumes.

Capability unit IVe-3

In this unit are shallow to moderately deep, sloping soils that are underlain by loose sand or sandstone. These well-drained soils have moderate to moderately rapid permeability. They are moderately low in fertility and in moisture-supplying capacity. Good tilth can be maintained if organic matter is added frequently. The soils are somewhat droughty and are subject to severe water erosion. Contour stripcropping and grassed waterways help to control erosion. In some areas diversions may be needed on the upper parts of slopes to divert runoff water from other areas away from these soils. The following soils are in this unit:

Hixton fine sandy loam, 6 to 12 percent slopes.
Hixton fine sandy loam, 6 to 12 percent slopes, moderately eroded.
Meridian fine sandy loam, 6 to 12 percent slopes.
Meridian fine sandy loam, 6 to 12 percent slopes, moderately eroded.
Norden fine sandy loam, 6 to 12 percent slopes, severely eroded.
Norden fine sandy loam, dark surface variant, 6 to 12 percent slopes, moderately eroded.
Urne and Norden fine sandy loams, 6 to 12 percent slopes, moderately eroded.

The soils in this unit are suited to row crops, small grains, and hay. They also are suited to trees and to use as wildlife areas. They are used mainly for crops, but some areas are in pasture and trees.

These soils require frequent applications of organic matter and plant nutrients to maintain yields and to retain their moisture-supplying capacity. Organic matter can be supplied by adding manure, by returning all crop residues to the soils, and by growing more grasses or legumes in the cropping system than other crops.

Suggested management practices and cropping systems are—

Contour stripcropping: 1 year each of a row crop and a small grain followed by 3 years of hay.

If no conservation practices are used, a suitable cropping system is-

1 year of a small grain followed by 3 years of hay.

These soils should be tested to determine their needs for lime and fertilizer. All of them need lime unless they have been limed recently. Moderate amounts of phosphate and potash are also needed. Legumes require supplemental applications of potash each year.

Capability unit IVw-1

This unit is made up of somewhat poorly drained to very poorly drained, sandy soils on stream terraces. These soils are in nearly level to slightly depressed areas. Because the parent material is coarse textured, these soils are rapidly permeable. They have a high water table, however, and are wet much of the year. In late summer or during seasons when rainfall is low, the water table recedes and plants are likely to be damaged by lack of moisture. These soils are naturally moderately high in organic matter. They are easy to farm if drained. The following soils are in this unit:

Dillon fine sandy loam.
Loamy very wet terrace land.
Morocco loamy fine sand.

The soils in this unit require drainage for high yields. Areas that are not drained remain in native vegetation. They are used for pasture or as wildlife areas, to which they are well suited. The soils are too wet to be suitable for trees.

In many areas of these soils, surface ditches, diversions, and grassed waterways are required to remove excess runoff from adjacent higher soils. These soils are naturally low in fertility, but crops grown on them respond well if lime and fertilizer are added.

Suitable cropping systems are—

2 years of row crops followed by 1 year of a small grain and 2 years of hay.
1 year each of a row crop and a small grain followed by 2 years of hay.

Capability unit IVs-1

In this unit are moderately deep to deep, nearly level to gently sloping soils underlain by loose sand or sandstone. Some of these soils have thin layers of fine-textured material in the underlying sand. The soils are on uplands and on terraces along streams.

The Watseka soil and the variant from the Plainfield series have a fluctuating water table. They have a slightly more favorable moisture supply at the start of the growing season than the other soils. All of these soils, however, dry out rapidly. If they are not protected, they are highly susceptible to wind erosion. The sloping areas are also subject to water erosion; they are highly susceptible to gullying if the areas are not protected from runoff from adjacent areas. Once gullies form, they enlarge rapidly and are hard to control.

The supply of plant nutrients is naturally low in these soils. The soils also are low in moisture-supplying capacity for plants, especially during periods of low rainfall or if rainfall is poorly distributed. Lack of coherence of the soil particles and lack of stability in the surface layer make many of the areas difficult to till. The following soils are in this unit:

Boone loamy fine sand, 2 to 6 percent slopes.
Boone loamy fine sand, 2 to 6 percent slopes, eroded.
Gotham loamy fine sand, 0 to 2 percent slopes.
Gotham loamy fine sand, 2 to 6 percent slopes.
Gotham loamy fine sand, 2 to 6 percent slopes, moderately eroded.
Hubbard loamy fine sand, 0 to 3 percent slopes.
Plainfield loamy fine sand, 0 to 2 percent slopes.
Plainfield loamy fine sand, 2 to 6 percent slopes.
Plainfield loamy fine sand, 2 to 6 percent slopes, eroded.
Plainfield loamy fine sand, mottled subsoil variant, 0 to 2 percent slopes.
Sparta loamy fine sand, 0 to 2 percent slopes.
Sparta loamy fine sand, 2 to 6 percent slopes.
Sparta loamy fine sand, 2 to 6 percent slopes, eroded.
Watseka loamy fine sand.

These soils are used mostly for crops, mainly soybeans, corn, rye, oats, clover, and alfalfa. In addition, grasses are included in some of the hay crops. The soils are not used extensively for permanent pasture. Because these soils are droughty, some areas have been planted to pine trees. Only a small acreage remains in woodlots made up of hardwoods. Some areas, once used for crops, have been abandoned and are idle. The soils are better suited to use as permanent pastures, woodlots, or wildlife areas than for tilled crops. Idle areas or areas where yields are low should be planted to pine trees.

If the soils are used for crops, shelterbelts should be established (fig. 5) and wind stripcropping practiced to control wind erosion. The use of shelterbelt and wind stripcropping protects the soils from warm, drying winds

Figure 5.—**Snow trapped by a shelterbelt on soils of capability unit IVs-1; the shelterbelt protects the soils from wind erosion and helps to conserve moisture.**

in summer. In sloping areas contour stripcropping helps to control wind and water erosion.

Adding barnyard manure and turning under green-manure crops and crop residues are particularly valuable practices. Besides protecting the soils from wind, they supply plant nutrients and improve the moisture-supplying capacity. Commercial fertilizer is essential to keep a supply of plant nutrients in the soils.

Suggested practices and a suitable cropping system are—

Contour stripcropping or wind stripcropping: 1 year each of a row crop and a small grain followed by 2 years of hay.

If crop residues are turned under, if practices are used to control erosion, and if the seedbed is prepared with a field cultivator or similar tillage implement, a suitable cropping system is—

1 year each of a row crop, a small grain, and hay.

If no practices are used to protect the soils, the cropping system should consist of small grains and hay.

Crops on these soils respond to applications of lime and fertilizer. A fertilizer that contains a high proportion of potash, and some boron, if the soil is deficient in boron, is especially needed for hay crops of legumes and grasses. Legumes require regular applications of lime. Pastures on these soils need careful management that prevents damage from overgrazing.

Capability unit Vw-1

This unit consists only of Peat and muck, shallow, which is made up of shallow deposits of organic material underlain by loose sand. The areas are nearly level and are on stream bottoms. The water table is at or near the surface of this soil. It generally does not pay to protect the areas from flooding or to provide adequate drainage for crops.

Because this soil is shallow to loose sand, has a high water table, and is subject to flooding, it is poorly suited to crops. It is better suited to permanent pasture than to other uses, but some areas that cannot feasibly be used for pasture can be used for wildlife. In some places pastures can be improved by installing surface drains and by adding fertilizer and using other renovation practices. The soils should be tested, and lime and fertilizer added according to the needs indicated.

Capability unit Vw-2

This unit consists only of Loamy alluvial land, wet. This land type is made up of poorly drained alluvial material on flood plains where it is subject to frequent overflow. It is a mixture of nearly level, silty, sandy, or gravelly soils that are poorly drained. Also included are some small, marshy areas. Areas that are on the flood plains of the Chippewa and Mississippi Rivers are made up mainly of coarse-textured sand that is low in fertility. On the flood plains of the tributary streams, however, the material is largely medium textured. In all of the areas, the water table is high.

It generally is not economical to protect the areas in this unit from overflow or to provide enough drainage to grow tilled crops. The areas are well suited to pasture. Some areas that are in pasture can be protected from overflow and then improved by fertilizing and renovating them.

Areas that are in trees require protection from fire and from grazing. Replanting desirable kinds of trees is somewhat restricted. Therefore, desirable kinds of trees need to be encouraged.

The areas of marshy land are best suited to use as areas for wildlife (fig. 6). Plantings that will provide food and cover will encourage many kinds of wildlife. In many of the marshy areas, dikes can be used to control the level of the water and thus improve the sites for waterfowl and fur-bearing animals. Marshy areas, where grasses and sedges grow, require protection from fire.

Figure 6.—**Muskrat houses on marshy land along the Chippewa River; marshy areas that are too wet or are flooded too frequently for pasture can be used to provide food and cover for wildlife.**

Capability unit VIe-1

This unit consists of moderately deep or deep soils that are moderately steep or steep. These well-drained soils are moderately permeable and have moderate to moderately low moisture-supplying capacity for plants. The severely eroded soils have slopes of 12 to 20 percent, and the slightly eroded and moderately eroded ones have slopes of 20 to 30 percent. All of the soils have a severe hazard of water erosion. The steep slopes and severe hazard of erosion restrict the kind of tillage that can be used on these soils. The following soils are in this unit:

Bertrand silt loam, 12 to 20 percent slopes, severely eroded.
Downs silt loam, benches, 12 to 20 percent slopes, severely eroded.
Downs silt loam, benches, 20 to 30 percent slopes, moderately eroded.
Dubuque silt loam, 20 to 30 percent slopes.
Dubuque silt loam, 20 to 30 percent slopes, moderately eroded.
Dubuque silt loam, deep, 20 to 30 percent slopes.
Dubuque silt loam, deep, 20 to 30 percent slopes, moderately eroded.
Dubuque soils, deep, 12 to 20 percent slopes, severely eroded.
Gale silt loam, 12 to 20 percent slopes, severely eroded.
Gale silt loam, 20 to 30 percent slopes.
Gale silt loam, 20 to 30 percent slopes, moderately eroded.
Lindstrom silt loam, 20 to 30 percent slopes.
Lindstrom silt loam, 20 to 30 percent slopes, moderately eroded.
Norden loam, 20 to 30 percent slopes.
Norden loam, 20 to 30 percent slopes, moderately eroded.
Norden silt loam, 12 to 20 percent slopes, severely eroded.
Norden silt loam, 20 to 30 percent slopes.
Norden silt loam, 20 to 30 percent slopes, moderately eroded.
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, severely eroded.
Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes.
Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, moderately eroded.
Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes.
Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, moderately eroded.

These soils are used for pasture or hay crops, for trees, or as wildlife areas. Generally, they are best suited to pasture, but if the areas are not too steep, hay crops can be grown. The soils are too steep and susceptible to erosion to be used for row crops.

If adequate lime and fertilizer are applied, good yields of legume-grass mixtures are obtained. To protect the soils from erosion, pastures should be seeded only when renovated, and preferably in contour strips. Renovation permits tillage without causing serious losses through erosion, and it limits the risk of gullies forming. It also leaves the surface soil in condition to absorb and hold large amounts of runoff water (fig. 7).

Figure 7.—**Seeding steep areas of pasture that have previously been prepared by a field cultivator.**

Moderately large amounts of lime, phosphate, and potash are needed for most of the soils that are not in trees. The soils should be tested to determine the needs for lime and fertilizer.

Many areas of these soils are in trees. If proper management is used, good returns can be realized from the woodlots. These areas need protection from livestock and fire. The damage caused by grazing greatly offsets the value of the small amount of forage obtained. The woodland contains sparse forage of low quality, and some of the plants are harmful to livestock. The animals trample and damage the young trees. They also damage the leaf litter that absorbs and stores rainfall. In addition, runoff concentrates on the trails left by livestock and causes gullies to form in many places. Once gullies form, they are difficult to control and are likely to advance quickly into adjacent cropland.

If more pasture is needed, brush and trees should be removed and the areas renovated. By doing this, higher returns will be realized than if an attempt is made to use the same area for both woodland and pasture.

If these soils are to be planted to trees or left in trees, the areas should be managed according to suggestions given in the section "Woodland Uses of the Soils." A local agricultural technician or forester will also be glad to give suggestions. If the woodlots are well managed, runoff is reduced and lower lying fields will be less damaged by erosion. Flooding in the valleys of streams will also be reduced.

Capability unit VIe-2

In this unit are shallow to moderately deep soils that are mostly sloping to moderately steep and are underlain by loose sand or sandstone. These soils are subject to severe erosion if cultivated. Their moisture-holding capacity and natural fertility are moderately low, and they are somewhat droughty. Diversions or other water-spreading practices are needed in many areas to divert runoff water from higher lying areas. The following soils are in this unit:

Hixton fine sandy loam, 12 to 20 percent slopes.
Hixton fine sandy loam, 12 to 20 percent slopes, moderately eroded.
Meridian fine sandy loam, 6 to 12 percent slopes, severely eroded.
Meridian fine sandy loam, 12 to 20 percent slopes, moderately eroded.
Norden fine sandy loam, 12 to 20 percent slopes, severely eroded.
Norden fine sandy loam, 20 to 30 percent slopes.
Norden fine sandy loam, 20 to 30 percent slopes, moderately eroded.
Urne and Norden fine sandy loams, 6 to 12 percent slopes, severely eroded.
Urne and Norden fine sandy loams, 12 to 20 percent slopes.
Urne and Norden fine sandy loams, 12 to 20 percent slopes, moderately eroded.

These soils are not suited to tilled crops, but they are suited to pasture, trees, or to use as wildlife areas. Moderately high yields of pasture can be obtained if a mixture of legumes and grasses is seeded and adequate lime and fertilizer are applied. In areas where the soils are not too steep, the forage can be harvested for hay. Adding manure and returning crop residues to the soils help increase the moisture-supplying capacity and fertility.

Capability unit VIs-1

This unit is made up of deep, excessively drained, sloping, sandy soils. These soils are underlain by loose sand or weathered sandstone. In some of the areas, there are thin layers of finer textured material in the underlying sand. The soils have rapid permeability and low moisture-supplying capacity for plants. They dry out rapidly. If they are not protected, they are subject to wind and water erosion. These soils are naturally low in fertility. They are also droughty, especially in years when rainfall is low or poorly distributed. The following soils are in this unit:

- Boone loamy fine sand, 6 to 12 percent slopes.
- Boone loamy fine sand, 6 to 12 percent slopes, eroded.
- Burkhardt sandy loam, 6 to 12 percent slopes, severely eroded.
- Gotham loamy fine sand, 6 to 12 percent slopes.
- Gotham loamy fine sand, 6 to 12 percent slopes, moderately eroded.
- Plainfield loamy fine sand, 6 to 12 percent slopes.
- Plainfield loamy fine sand, 6 to 12 percent slopes, eroded.
- Sparta loamy fine sand, 6 to 12 percent slopes.
- Sparta loamy fine sand, 6 to 12 percent slopes, eroded.

The soils in this unit are too droughty and too susceptible to wind and water erosion to be used for row crops. They are, however, suited to hay and pasture if carefully managed. They are also suited to pine trees and to use as wildlife areas.

To conserve moisture and control erosion, the areas should be renovated for forage crops. Overgrazing can be prevented if rotational grazing is practiced. Areas planted to pines require protection from fire and grazing.

Crops on these soils require a complete fertilizer. A fertilizer that is high in potash and contains some boron is especially needed for legume-grass hay; it should be applied as a topdressing each year. In areas of permanent bluegrass pasture, fertilizer high in nitrogen is required to increase the cover of plants and to provide protection from erosion. Lime is needed unless the soils have been limed recently.

Capability unit VIIe-1

This unit is made up of shallow to deep soils that are mostly steep or very steep. These soils are subject to severe erosion if a protective cover of grass or trees is not maintained. The following soils are in this unit:

- Dubuque silt loam, 30 to 45 percent slopes.
- Dubuque soils, deep, 20 to 30 percent slopes, severely eroded.
- Gale silt loam, 20 to 30 percent slopes, severely eroded.
- Gale silt loam, 30 to 40 percent slopes.
- Hixton fine sandy loam, 20 to 30 percent slopes.
- Hixton fine sandy loam, 20 to 30 percent slopes, moderately eroded.
- Hixton fine sandy loam, 20 to 30 percent slopes, severely eroded.
- Hixton fine sandy loam, 30 to 45 percent slopes.
- Hixton fine sandy loam, 30 to 45 percent slopes, moderately eroded.
- Hixton fine sandy loam, 30 to 45 percent slopes, severely eroded.
- Norden silt loam, 20 to 30 percent slopes, severely eroded.
- Norden silt loam and loam, 30 to 40 percent slopes.
- Norden silt loam and loam, 30 to 40 percent slopes, moderately eroded.
- Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, severely eroded.
- Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, severely eroded.
- Terrace escarpments, loamy.
- Urne fine sandy loam, 30 to 45 percent slopes.
- Urne fine sandy loam, 30 to 45 percent slopes, moderately eroded.
- Urne fine sandy loam, 30 to 45 percent slopes, severely eroded.
- Urne and Norden fine sandy loams, 12 to 20 percent slopes, severely eroded.
- Urne and Norden fine sandy loams, 20 to 30 percent slopes.
- Urne and Norden fine sandy loams, 20 to 30 percent slopes, moderately eroded.
- Urne and Norden fine sandy loams, 20 to 30 percent slopes, severely eroded.

The soils in this unit are suited to permanent pasture, to trees, or to use as wildlife areas. A good cover of plants should be kept on the pastured areas. Some of the pastured areas can be renovated if the slopes are not too steep for tillage. In areas used for permanent bluegrass pasture, a fertilizer high in nitrogen is needed to increase yields and to provide a better protective cover of plants. Grazing needs to be managed carefully to keep gullies from forming.

Areas that are in trees should be kept in trees, and the areas managed according to practices given in the section "Woodland Uses of the Soils." Wooded areas and areas that are free of trees can be improved for wildlife by planting conifers, shrubs, hedges, grasses, and legumes.

Capability unit VIIs-1

This unit is made up of sloping to very steep, dominantly sandy soils and Steep stony and rocky land. These soils are low in moisture-supplying capacity for plants and are droughty. The steep slopes and stones limit their use. Most of the soils are subject to wind and water erosion. All of the soils are naturally low in fertility and in moisture-supplying capacity. Therefore, it is hard to keep a protective cover of plants on them. The soils are also subject to gullying by runoff from higher lying areas, which readily cuts a channel through them. Because of wind erosion, some areas on which plants once grew now have no vegetation and require special practices that will help to establish a protective cover. The following soils are in this unit:

- Boone loamy fine sand, 12 to 30 percent slopes, eroded.
- Boone soils, 12 to 30 percent slopes, severely eroded.
- Boone soils, 30 to 60 percent slopes.
- Plainfield loamy fine sand, 12 to 20 percent slopes.
- Plainfield loamy fine sand, 12 to 20 percent slopes, eroded.
- Sparta fine sand and Dune land.
- Sparta loamy fine sand, 12 to 20 percent slopes, eroded.
- Steep stony and rocky land.
- Terrace escarpments, sandy.

These soils are better suited to trees and to use as wildlife areas than to other uses. Most areas of Steep stony and rocky land are in hardwoods. They should be kept in trees and managed according to practices given in the section "Woodland Uses of the Soils." Soils that are not in trees should be planted to pine trees if feasible. The trees furnish merchantable timber, help control soil blowing, provide habitats for wildlife, and help hold moisture in the soil.

Capability unit VIIs-2

This unit consists only of Sandy alluvial land, which is droughty and is on bottoms where it is subject to frequent overflow. Fresh deposits of sandy overwash are deposited during floods, and new stream channels are formed in the flood plain.

Nearly all areas of this land type are in trees or in permanent pasture, or they are used to provide cover for wildlife. The soils are not suited to cultivation, because they are loose and sandy, are low in fertility, and are flooded frequently. If the areas are managed carefully, some returns can be realized from the pastures and woodlots. The areas are better suited to use for wildlife than to other uses.

Capability unit VIIIs-1

This unit consists only of Riverwash, which is made up of loose sand and gravel, recently deposited by streams. It generally occurs as sandbars in streams or along the banks of streams. Because new sediments are deposited rapidly, and because the soil material is droughty and lacks plant nutrients, little or no useful vegetation grows on this land. Riverwash is used only as wildlife areas or for recreation.

Estimated Yields

Table 1 gives estimated average yields per acre for the crops commonly grown in the county. The estimates were based on interviews with farmers, on results obtained by the agricultural experiment station on experimental test plots, and on observations made by soil surveyors and other agricultural workers who are familiar with the soils.

Yields in table 1 are given for each soil under two levels of management. In the columns marked "Average" are yields to be expected under the system of management most farmers were practicing at the time the soil survey was made. The management used to obtain the yields in the columns marked "High" is at the level now used by only a few farmers in the county.

For corn, average management consists of growing about 12,000 plants of hybrid corn per acre and of applying about 8 tons of barnyard manure and about 100 pounds of commercial fertilizer as a starter. The seedbed is prepared in the usual manner. For seedings of oats or alfalfa-bromegrass, 100 to 200 pounds of a fertilizer high in phosphorus and potassium is applied under average management. Only a minimum of lime is used, and no special practices are used to prepare the seedbed or to cultivate. Hayfields are cut twice a year and grazed in fall.

TABLE 1.—*Estimated average acre yields of the principal crops*

[Absence of yield indicates that the soil is not suitable for the crop or that the crop ordinarily is not grown]

Soil unit	Corn		Oats		Alfalfa-bromegrass hay		Pasture	
	Average	High	Average	High [1]	Average	High	Average	High
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]
Almena silt loam, 2 to 6 percent slopes, moderately eroded [3]	60	95	50	65	3. 0	4. 0	95	145
Arenzville silt loam [3]	65	105	50	62	2. 8	3. 5	110	145
Bertrand silt loam, 0 to 2 percent slopes	65	105	55	70	3. 0	4. 0	95	130
Bertrand silt loam, 2 to 6 percent slopes	65	105	55	70	2. 8	4. 0	85	125
Bertrand silt loam, 2 to 6 percent slopes, moderately eroded	63	105	52	68	2. 8	4. 0	85	125
Bertrand silt loam, 6 to 12 percent slopes	60	100	48	60	2. 6	3. 5	80	125
Bertrand silt loam, 6 to 12 percent slopes, moderately eroded	58	97	45	55	2. 6	3. 5	80	125
Bertrand silt loam, 6 to 12 percent slopes, severely eroded	50	85	40	50	2. 4	3. 2	75	120
Bertrand silt loam, 12 to 20 percent slopes, moderately eroded	52	83	40	50	2. 6	3. 2	80	125
Bertrand silt loam, 12 to 20 percent slopes, severely eroded	45	80	40	50	2. 4	3. 0	75	120
Boone loamy fine sand, 2 to 6 percent slopes	35	48	20	35	1. 0	2. 0	40	65
Boone loamy fine sand, 2 to 6 percent slopes, eroded	30	45	20	35	1. 0	1. 8	35	60
Boone loamy fine sand, 6 to 12 percent slopes	------	------	------	------	------	------	20	40
Boone loamy fine sand, 6 to 12 percent slopes, eroded	------	------	------	------	------	------	20	40
Boone loamy fine sand, 12 to 30 percent slopes, eroded	------	------	------	------	------	------	20	35
Boone soils, 12 to 30 percent slopes, severely eroded	------	------	------	------	------	------	------	------
Boone soils, 30 to 60 percent slopes	------	------	------	------	------	------	------	------
Burkhardt sandy loam, 0 to 2 percent slopes	40	60	35	45	1. 7	2. 4	60	90
Burkhardt sandy loam, 2 to 6 percent slopes	40	60	35	45	1. 5	2. 2	60	90
Burkhardt sandy loam, 2 to 6 percent slopes, moderately eroded	40	58	35	45	1. 5	2. 2	60	90
Burkhardt sandy loam, 6 to 12 percent slopes, severely eroded	------	------	30	38	1. 2	2. 0	50	80
Chaseburg silt loam, 0 to 2 percent slopes	70	105	55	65	3. 0	4. 0	110	145
Chaseburg silt loam, 2 to 6 percent slopes	65	100	55	65	3. 0	3. 5	105	140
Curran silt loam	50	90	45	55	2. 0	3. 0	90	130
Dakota fine sandy loam, 0 to 2 percent slopes	50	73	40	50	2. 2	3. 0	80	115
Dakota fine sandy loam, 2 to 6 percent slopes	50	70	40	50	2. 2	3. 0	80	115
Dakota fine sandy loam, 2 to 6 percent slopes, moderately eroded	45	68	38	45	2. 0	2. 8	75	110
Dakota loam, 0 to 2 percent slopes	60	85	45	55	2. 5	3. 2	85	120
Dakota loam, 2 to 6 percent slopes	60	80	45	55	2. 5	3. 2	85	120
Dakota loam, 2 to 6 percent slopes, moderately eroded	58	78	45	55	2. 3	3. 0	85	120
Dakota loam, 6 to 12 percent slopes, moderately eroded	50	70	40	50	2. 0	3. 0	80	110
Dillon fine sandy loam	35	60	------	50	------	2. 5	60	90
Downs silt loam, 2 to 6 percent slopes	65	105	55	70	3. 0	4. 0	100	140
Downs silt loam, 2 to 6 percent slopes, moderately eroded	65	105	50	70	2. 8	4. 0	100	140
Downs silt loam, 6 to 12 percent slopes, moderately eroded	60	100	48	65	2. 7	3. 5	90	135
Downs silt loam, benches, 2 to 6 percent slopes, moderately eroded	65	105	50	70	2. 8	4. 0	100	140

See footnotes at end of table.

TABLE 1.—*Estimated average acre yields of the principal crops*—Continued

Soil unit	Corn		Oats		Alfalfa-bromegrass hay		Pasture	
	Average	High	Average	High [1]	Average	High	Average	High
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]
Downs silt loam, benches, 6 to 12 percent slopes, moderately eroded	60	100	48	65	2.7	3.5	90	135
Downs silt loam, benches, 12 to 20 percent slopes	55	80	45	60	2.5	3.0	80	130
Downs silt loam, benches, 12 to 20 percent slopes, moderately eroded	50	75	40	60	2.5	3.0	80	130
Downs silt loam, benches, 12 to 20 percent slopes, severely eroded	45	70	38	55	2.2	3.0	75	125
Downs silt loam, benches, 20 to 30 percent slopes, moderately eroded	------	------	35	45	2.0	2.8	70	115
Dubuque silt loam, 2 to 6 percent slopes, moderately eroded	45	75	45	55	2.2	3.2	80	120
Dubuque silt loam, 6 to 12 percent slopes	45	70	40	55	2.0	3.2	80	120
Dubuque silt loam, 6 to 12 percent slopes, moderately eroded	40	68	38	53	2.0	3.0	75	115
Dubuque silt loam, 12 to 20 percent slopes	40	65	38	50	2.0	2.8	65	105
Dubuque silt loam, 12 to 20 percent slopes, moderately eroded	38	60	35	45	1.8	2.5	60	100
Dubuque silt loam, 20 to 30 percent slopes	------	------	30	45	1.8	2.5	60	90
Dubuque silt loam, 20 to 30 percent slopes, moderately eroded	------	------	30	45	1.8	2.3	55	85
Dubuque silt loam, 30 to 45 percent slopes	------	------	------	------	------	------	55	------
Dubuque silt loam, deep, 2 to 6 percent slopes	60	95	50	65	2.8	3.8	95	140
Dubuque silt loam, deep, 2 to 6 percent slopes, moderately eroded	58	95	50	65	2.8	3.8	95	140
Dubuque silt loam, deep, 6 to 12 percent slopes	55	90	50	60	2.5	3.5	90	135
Dubuque silt loam, deep, 6 to 12 percent slopes, moderately eroded	53	88	45	55	2.5	3.5	90	135
Dubuque silt loam, deep, 12 to 20 percent slopes	50	80	40	50	2.4	3.2	80	125
Dubuque silt loam, deep, 12 to 20 percent slopes, moderately eroded	45	75	40	50	2.2	3.0	75	115
Dubuque silt loam, deep, 20 to 30 percent slopes	------	------	35	45	2.2	3.0	75	115
Dubuque silt loam, deep, 20 to 30 percent slopes, moderately eroded	------	------	30	45	2.0	2.8	70	110
Dubuque soils, 6 to 12 percent slopes, severely eroded	35	60	35	45	1.8	2.5	60	95
Dubuque soils, deep, 12 to 20 percent slopes, severely eroded	------	------	35	45	2.0	2.8	70	110
Dubuque soils, deep, 20 to 30 percent slopes, severely eroded	------	------	------	40	1.8	2.5	60	95
Ettrick silt loam, coarse silt substratum [3]	------	90	------	55	------	3.5	80	145
Gale silt loam, 6 to 12 percent slopes	55	80	45	58	2.5	3.5	70	110
Gale silt loam, 6 to 12 percent slopes, moderately eroded	52	75	45	55	2.2	3.3	70	110
Gale silt loam, 12 to 20 percent slopes	50	65	40	45	2.2	2.8	65	110
Gale silt loam, 12 to 20 percent slopes, moderately eroded	40	60	35	43	1.8	2.5	65	105
Gale silt loam, 12 to 20 percent slopes, severely eroded	------	------	30	40	1.6	2.2	60	100
Gale silt loam, 20 to 30 percent slopes	------	------	32	40	1.6	2.3	65	100
Gale silt loam, 20 to 30 percent slopes, moderately eroded	------	------	32	40	1.5	2.1	60	90
Gale silt loam, 20 to 30 percent slopes, severely eroded	------	------	------	------	------	------	50	75
Gale silt loam, 30 to 40 percent slopes	------	------	------	------	------	------	50	------
Gotham loamy fine sand, 0 to 2 percent slopes	40	58	35	45	1.5	2.1	50	85
Gotham loamy fine sand, 2 to 6 percent slopes	38	55	32	40	1.3	2.0	50	85
Gotham loamy fine sand, 2 to 6 percent slopes, moderately eroded	35	50	30	40	1.2	2.0	45	80
Gotham loamy fine sand, 6 to 12 percent slopes	------	------	25	35	1.0	2.0	40	75
Gotham loamy fine sand, 6 to 12 percent slopes, moderately eroded	------	------	25	35	1.0	2.0	40	75
Hixton fine sandy loam, 2 to 6 percent slopes, moderately eroded	45	70	38	47	1.8	2.5	65	100
Hixton fine sandy loam, 6 to 12 percent slopes	43	65	35	45	1.6	2.2	65	95
Hixton fine sandy loam, 6 to 12 percent slopes, moderately eroded	40	65	35	45	1.6	2.2	60	90
Hixton fine sandy loam, 12 to 20 percent slopes	------	------	32	40	1.2	2.0	55	85
Hixton fine sandy loam, 12 to 20 percent slopes, moderately eroded	------	------	30	40	1.2	2.0	50	85
Hixton fine sandy loam, 20 to 30 percent slopes	------	------	------	------	1.4	2.0	45	75
Hixton fine sandy loam, 20 to 30 percent slopes, moderately eroded	------	------	------	------	1.3	1.7	40	65
Hixton fine sandy loam, 20 to 30 percent slopes, severely eroded	------	------	------	------	------	------	35	60
Hixton fine sandy loam, 30 to 45 percent slopes	------	------	------	------	------	------	35	------
Hixton fine sandy loam, 30 to 45 percent slopes, moderately eroded	------	------	------	------	------	------	35	------
Hixton fine sandy loam, 30 to 45 percent slopes, severely eroded	------	------	------	------	------	------	35	------
Hubbard loamy fine sand, 0 to 3 percent slopes	42	58	38	45	1.6	2.2	60	85
Huntsville silt loam [3]	65	110	55	65	3.2	3.7	115	150
Jackson silt loam, 0 to 2 percent slopes	65	110	55	70	3.0	4.0	100	145
Jackson silt loam, 2 to 6 percent slopes	63	105	55	65	3.0	4.0	95	140
Jackson silt loam, 2 to 6 percent slopes, moderately eroded	60	105	50	65	2.8	4.0	95	140
Jackson silt loam, 6 to 12 percent slopes	58	100	50	60	2.5	3.8	90	135
Jackson silt loam, 6 to 12 percent slopes, moderately eroded	58	100	50	60	2.5	3.8	90	135
Jackson silt loam, 6 to 12 percent slopes, severely eroded	55	85	40	50	2.3	3.5	85	130
Judson silt loam, 0 to 2 percent slopes	65	110	55	65	3.2	3.8	115	150
Judson silt loam, 2 to 6 percent slopes	60	105	53	65	3.0	3.5	105	145
Judson silt loam, 6 to 12 percent slopes	60	100	50	60	3.0	3.5	100	145
Lindstrom silt loam, 6 to 12 percent slopes	60	100	50	62	3.0	4.0	95	140
Lindstrom silt loam, 6 to 12 percent slopes, moderately eroded	58	100	45	62	2.8	4.0	90	140
Lindstrom silt loam, 12 to 20 percent slopes	55	85	40	60	2.8	3.5	90	135
Lindstrom silt loam, 12 to 20 percent slopes, moderately eroded	50	80	40	55	2.6	3.5	90	130

See footnotes at end of table.

TABLE 1.—*Estimated average acre yields of the principal crops*—Continued

Soil unit	Corn		Oats		Alfalfa-bromegrass hay		Pasture	
	Average	High	Average	High [1]	Average	High	Average	High
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]
Lindstrom silt loam, 20 to 30 percent slopes	------	------	40	50	2.5	3.2	85	125
Lindstrom silt loam, 20 to 30 percent slopes, moderately eroded	------	------	38	45	2.3	3.0	80	120
Loamy alluvial land [3]	50	70	40	50	1 8	3.0	95	135
Loamy alluvial land, wet	------	------	------	------	------	------	40	65
Loamy wet terrace land [3]	50	75	40	50	2.0	3.0	90	11
Loamy very wet terrace land [3]	------	75	------	50	------	2.8	90	11
Medary silt loam, 0 to 2 percent slopes	65	95	55	65	3.0	4.0	95	140
Medary silt loam, 2 to 6 percent slopes	60	90	50	60	2.8	3.8	95	140
Meridian fine sandy loam, 0 to 2 percent slopes	50	70	42	45	2.0	2.5	60	100
Meridian fine sandy loam, 2 to 6 percent slopes	45	68	40	45	1.8	2.4	55	90
Meridian fine sandy loam, 2 to 6 percent slopes, moderately eroded	40	65	38	45	1.6	2.2	50	85
Meridian fine sandy loam, 6 to 12 percent slopes	38	62	35	43	1.5	2.1	50	85
Meridian fine sandy loam, 6 to 12 percent slopes, moderately eroded	38	60	32	40	1.5	2.1	50	85
Meridian fine sandy loam, 6 to 12 percent, severely eroded	------	------	------	38	1.2	2.0	45	80
Meridian fine sandy loam, 12 to 20 percent slopes, moderately eroded	------	------	30	40	1.5	2.1	50	85
Morocco loamy fine sand [3]	45	58	30	45	------	2.3	55	90
Norden fine sandy loam, 2 to 6 percent slopes, moderately eroded	50	75	43	50	2.3	3.0	75	115
Norden fine sandy loam, 6 to 12 percent slopes	48	70	40	47	2.0	2.8	65	105
Norden fine sandy loam, 6 to 12 percent slopes, moderately eroded	45	68	40	47	1.8	2.5	65	100
Norden fine sandy loam, 6 to 12 percent slopes, severely eroded	40	60	35	43	1.5	2.0	60	90
Norden fine sandy loam, 12 to 20 percent slopes	42	63	35	43	1.7	2.3	65	100
Norden fine sandy loam, 12 to 20 percent slopes, moderately eroded	40	58	35	43	1.6	2.3	60	90
Norden fine sandy loam, 12 to 20 percent slopes, severely eroded	7	------	30	40	1.5	2.0	55	85
Norden fine sandy loam, 20 to 30 percent slopes	------	------	33	43	1.6	2.3	60	85
Norden fine sandy loam, 20 to 30 percent slopes, moderately eroded	------	------	30	40	1.5	2.0	55	85
Norden fine sandy loam, dark surface variant, 2 to 6 percent slopes, moderately eroded	45	68	35	48	1.5	2.3	65	95
Norden fine sandy loam, dark surface variant, 6 to 12 percent slopes, moderately eroded	40	65	33	45	1.3	2.0	60	90
Norden loam, 12 to 20 percent slopes, moderately eroded	43	65	38	45	2.0	2.8	70	110
Norden loam, 20 to 30 percent slopes	------	------	35	43	1.6	2.6	60	105
Norden loam, 20 to 30 percent slopes, moderately eroded	------	------	33	43	1.5	2.5	55	100
Norden silt loam, 2 to 6 percent slopes	63	90	55	65	2.8	3.8	95	140
Norden silt loam, 2 to 6 percent slopes, moderately eroded	60	90	55	65	2.5	3.8	90	140
Norden silt loam, 6 to 12 percent slopes	58	85	53	60	2.3	3.6	85	135
Norden silt loam, 6 to 12 percent slopes, moderately eroded	55	80	50	60	2.1	3.6	80	130
Norden silt loam, 6 to 12 percent slopes, severely eroded	45	75	40	50	2.0	3.0	70	125
Norden silt loam, 12 to 20 percent slopes	45	75	40	50	2.1	3.3	80	125
Norden silt loam, 12 to 20 percent slopes, moderately eroded	43	70	38	50	2.0	3.0	75	120
Norden silt loam, 12 to 20 percent slopes, severely eroded	------	------	35	45	1.8	2.6	70	110
Norden silt loam, 20 to 30 percent slopes	------	------	38	48	1.8	2.4	75	110
Norden silt loam, 20 to 30 percent slopes, moderately eroded	------	------	35	43	1.7	2.3	65	100
Norden silt loam, 20 to 30 percent slopes, severely eroded	------	------	------	------	1.3	2.0	60	80
Norden silt loam and loam, 30 to 40 percent slopes	------	------	------	------	------	------	55	------
Norden silt loam and loam, 30 to 40 percent slopes, moderately eroded	------	------	------	------	------	------	55	------
Northfield very fine sandy loam, 2 to 6 percent slopes	40	65	35	45	1.5	2.0	60	90
Northfield very fine sandy loam, 2 to 6 percent slopes, moderately eroded	37	60	33	45	1.3	1.8	55	90
Orion silt loam	50	95	40	55	------	3.5	95	145
Otterholt silt loam, loamy substratum, 2 to 6 percent slopes	65	100	55	70	3.0	4.0	95	140
Otterholt silt loam, loamy substratum, 2 to 6 percent slopes, moderately eroded	60	100	50	78	2.8	4.0	90	135
Otterholt silt loam, loamy substratum, 6 to 12 percent slopes, moderately eroded	58	100	45	63	2.6	3.8	85	130
Peat and muck, deep	------	100	------	50	------	3.0	60	130
Peat and muck, shallow	------	------	------	------	------	------	55	130
Plainfield loamy fine sand, 0 to 2 percent slopes	28	45	25	38	1.2	1.8	35	60
Plainfield loamy fine sand, 2 to 6 percent slopes	25	40	22	35	1.0	1.6	30	50
Plainfield loamy fine sand, 2 to 6 percent slopes, eroded	22	38	20	32	1.0	1.4	25	50
Plainfield loamy fine sand, 6 to 12 percent slopes	------	------	------	------	.8	1.2	25	45
Plainfield loamy fine sand, 6 to 12 percent slopes, eroded	------	------	------	------	.8	1.2	25	45
Plainfield loamy fine sand, 12 to 20 percent slopes	------	------	------	------	------	------	------	------
Plainfield loamy fine sand, 12 to 20 percent slopes, eroded	------	------	------	------	------	------	------	------
Plainfield loamy fine sand, mottled subsoil variant, 0 to 2 percent slopes	40	50	30	40	1.2	2.0	50	80
Richwood silt loam, 0 to 2 percent slopes	70	110	55	70	3.2	4.0	110	145
Richwood silt loam, 2 to 6 percent slopes	65	105	55	65	3.0	3.8	105	140
Riverwash	------	------	------	------	------	------	------	------

See footnotes at end of table.

TABLE 1.—*Estimated average acre yields of the principal crops*—Continued

Soil unit	Corn		Oats		Alfalfa-bromegrass hay		Pasture	
	Average	High	Average	High [1]	Average	High	Average	High
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]
Rowley silt loam [3]	------	115	------	60	------	4.0	95	150
Sandy alluvial land	------	------	------	------	------	------	20	40
Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes	65	100	55	70	3.0	4.0	95	140
Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes, moderately eroded	63	100	53	70	3.0	4.0	90	135
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes	60	100	50	65	3.0	3.8	90	135
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, moderately eroded	60	100	45	63	2.6	3.8	85	130
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, severely eroded	50	85	40	50	2.4	3.0	75	120
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes	55	83	40	50	2.6	3.3	85	130
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, moderately eroded	50	80	40	50	2.4	3.0	75	120
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, severely eroded	40	70	38	45	2.2	2.8	70	110
Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes	------	------	38	48	2.2	2.8	70	110
Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, moderately eroded			35	45	2.0	2.6	70	110
Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, severely eroded	------	------	------	------	1.6	2.2	65	105
Seaton and Fayette silt loams, valleys, 2 to 6 percent slopes	65	100	50	70	3.2	3.8	105	145
Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes	60	100	50	65	3.0	3.5	100	140
Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes, moderately eroded	55	100	50	60	2.8	3.5	90	140
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes	53	85	40	50	3.8	3.5	90	135
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, moderately eroded	50	80	40	50	2.3	3.3	85	130
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, severely eroded	40	70	38	45	2.2	3.0	75	125
Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes	------	------	38	48	2.2	3.0	75	125
Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, moderately eroded			38	45	2.0	2.8	70	115
Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, severely eroded	------	------	------	------	------	------	65	105
Sparta fine sand and Dune land	------	------	------	------	------	------	------	------
Sparta loamy fine sand, 0 to 2 percent slopes	30	45	25	38	1.2	1.8	40	60
Sparta loamy fine sand, 2 to 6 percent slopes	28	42	25	35	1.0	1.6	35	50
Sparta loamy fine sand, 2 to 6 percent slopes, eroded	25	40	22	32	1.0	1.5	30	50
Sparta loamy fine sand, 6 to 12 percent slopes	------	------	------	------	.8	1.2	25	45
Sparta loamy fine sand, 6 to 12 percent slopes, eroded	------	------	------	------	.8	1.2	25	45
Sparta loamy fine sand, 12 to 20 percent slopes, eroded	------	------	------	------	------	------	------	------
Steep stony and rocky land	------	------	------	------	------	------	------	------
Terrace escarpments, loamy	------	------	------	------	1.5	2.0	50	85
Terrace escarpments, sandy	------	------	------	------	------	------	------	------
Toddville silt loam, 0 to 2 percent slopes	65	115	55	70	3.0	4.0	110	150
Toddville silt loam, 2 to 6 percent slopes	60	110	55	70	3.0	4.0	105	150
Urne fine sandy loam, 30 to 45 percent slopes	------	------	------	------	------	------	35	------
Urne fine sandy loam, 30 to 45 percent slopes, moderately eroded	------	------	------	------	------	------	35	------
Urne fine sandy loam, 30 to 45 percent slopes, severely eroded	------	------	------	------	------	------	------	------
Urne and Norden fine sandy loams, 2 to 6 percent slopes, moderately eroded	40	65	35	45	1.8	2.5	65	105
Urne and Norden fine sandy loams, 6 to 12 percent slopes, moderately eroded	38	60	33	40	1.6	2.2	60	100
Urne and Norden fine sandy loams, 6 to 12 percent slopes, severely eroded	------	------	------	35	1.5	2.0	55	90
Urne and Norden fine sandy loams, 12 to 20 percent slopes	------	------	------	38	1.6	2.2	60	90
Urne and Norden fine sandy loams, 12 to 20 percent slopes, moderately eroded	------	------	------	38	1.5	2.0	55	90
Urne and Norden fine sandy loams, 12 to 20 percent slopes, severely eroded	------	------	------	35	1.3	1.8	50	80
Urne and Norden fine sandy loams 20 to 30 percent slopes	------	------	------	35	1.3	1.8	55	85
Urne and Norden fine sandy loams, 20 to 30 percent slopes, moderately eroded	------	------	------	35	1.2	1.6	50	80
Urne and Norden fine sandy loams, 20 to 30 percent slopes, severely eroded	------	------	------	------	------	1.5	50	75
Wallkill silt loam [3]	------	100	------	55	------	3.0	65	145
Watseka loamy fine sand	35	50	35	45	1.5	2.5	50	80
Waukegan silt loam, 0 to 2 percent slopes	65	95	55	70	3.0	3.5	110	140
Waukegan silt loam, 2 to 6 percent slopes	60	90	50	65	3.0	3.5	105	135
Waukegan silt loam, 2 to 6 percent slopes, moderately eroded	58	90	48	65	3.8	3.3	100	130
Waukegan silt loam, 6 to 12 percent slopes, moderately eroded	55	85	45	60	2.5	3.0	90	125
Zwingle silt loam [3]	65	100	45	60	2.5	3.5	95	150
Zwingle silt loam, poorly drained variant [3]	------	110	------	60	------	4.0	95	150

[1] High yields given can be obtained if disease-resistant varieties are planted and weeds are controlled.

[2] The term cow-acre-days refers to the carrying capacity of pasture. This value is obtained by multiplying the number of animal units carried per acre by the number of days the pasture is grazed during a single grazing season without injury to the sod.

[3] The soil must be adequately drained or protected from overflow before high yields can be expected.

The management used to obtain the yields in the columns marked "High" is better than that used to obtain average yields. For corn, it includes (1) having the soils tested; (2) manuring heavily; (3) fertilizing and adding lime according to the needs indicated by soil tests; (4) growing from 12,000 to 20,000 corn plants per acre, according to the kind of soil; and (5) seeding, spraying, and cultivating at the right time.

For oats, the level of management needed to get the yields given in the columns marked "High" consists of planting good seed of a variety suited to the soil and of using large amounts of phosphate and potash. For alfalfa, especially alfalfa grown in long rotations, it includes (1) adding lime according to the needs indicated by soil tests; (2) seeding varieties that are resistant to wilt and to winterkill; (3) cutting at the right time so that two or three crops can be harvested during an average growing season; (4) allowing little or no grazing in fall; and (5) topdressing each fall with manure or a commercial fertilizer, such as 0–10–30 or 0–10–30 that also contains borax. Supplementary management practices suggested in the section "Basic Practices of Management" should also be used.

Even higher yields than those shown in table 1 can be obtained. Many farmers can produce more corn than 100 bushels per acre, but to do so will require that large amounts of fertilizer be applied and careful management used. Consult your county agent, experiment station, or soil conservationist about the kinds and amounts of lime, fertilizer, and seeding mixtures to use.

For pasture, the same general management principles apply that apply to field crops. To get the yields in the columns marked "Average," farmers reseed their pasture infrequently or not at all and use only minimum amounts of lime and fertilizer. The "High" level of management includes (1) using lime and fertilizer in the amounts indicated by soil tests; (2) reseeding with suitable grasses and legumes, principally alfalfa-bromegrass mixtures, and applying fertilizer that is high in nitrogen on steep soils in bluegrass; (3) preparing the seedbed properly; and (4) stocking and grazing the pastures properly. More detailed information about the pastures in the county is given in the section "Agriculture."

Past management influences the fertility of the soils. Misuse of a good soil over many years may lower its productivity to the point that the casual observer would conclude that the soil had little value for future cropping. It is possible to restore a soil that is badly run down, however, so that better yields are obtained on it than on another seemingly better soil that has been farmed more carefully. For example, a crop on Dakota loam, 0 to 2 percent slopes, that has been poorly managed may make no better yields than a similar crop on a well-managed field of Gotham loamy fine sand, 0 to 2 percent slopes. If proper management practices are used, however, the yields on the Dakota soil can easily be raised to a level that cannot be attained on the Gotham soil.

The estimates given in table 1 can be used in many ways. They can be used as a check to determine if the management practices are adequate and to help in deciding the kind of management practices that will give the most profit. If the average yields obtained for the past 5 or 10 years are less than those given for the same soil in table 1, then the management and cropping systems should be examined carefully. By applying the practices suggested in the section "Management by Capability Units," it will be possible to obtain better yields.

Woodland Uses of the Soils

Originally, about 75 percent of Pepin County had a cover of forests, mainly hardwoods. Most of the high-quality hardwoods were on soils in the western part of the county, and much of the acreage was made up of soils that were among the better soils for farming. It was these areas that were among the first to be cleared by the early settlers.

Pepin County is in a transitional zone between areas of the Central Hardwood Forest Region, to the south, and the Northern Forest Region. Most of the woodland is made up of trees from both forest regions, chiefly various kinds of oak. On the south- and west-facing slopes, there are stands of various kinds of oaks, a scattering of hickory trees, and a few white birch trees. Northern red oak predominates on the cooler east- and north-facing slopes, on the broad, gently sloping ridgetops, and on the nearly level floors of valleys; associated species are white oak, black oak, sugar maple, basswood, butternut, white birch, and aspen. Redcedar makes up a large part of the woodlands on steep bluffs along the Mississippi River. On the bottom lands the trees consist mainly of American elm, river birch, cottonwood, and willow, but there are a few black ash trees. There are only a few tamarack trees remaining. They are in the eastern part of the county on areas of peat and muck.

In 1959, according to the U.S. Census of Agriculture, 45,754 acres, or 30.2 percent, of the total land in farms was in trees. Most of the wooded areas are steep, are along the bottoms of streams, or are not suited to farming.

About 49 percent of the woodland is pastured. There is an increased emphasis on improving woodland, however, and the trend is away from pasturing wooded areas. Restocking has been hindered in most places by burning, grazing, and poor logging practices, and these practices greatly threaten the remaining good stands of timber. Burning, as a practice, has been largely eliminated, but the wooded areas require protection from unexpected fires.

The woodlots provide products for sale or for use on the farm. Among the woodland products harvested are firewood, charcoal, fenceposts, saw logs, veneer logs, box bolts, and ties. In 1959, 304,000 board feet of saw logs and veneer logs were cut on the farms, about 6,260 cords of wood were cut for fuel, and about 39,300 fenceposts were harvested.

In the pages that follow, the limitations to the growing of trees and the ratings given for each limitation are discussed. Then, under each woodland management group, the soils in the group are listed and management that applies to the soils of that group when used as woodland is explained. Following that, yield information for hardwoods and conifers is given.

Woodland management groups [2]

The soils of Pepin County have been placed in woodland management groups to assist owners of woodland

[2] By A. WILLIAM JIPSON, woodland conservationist, Soil Conservation Service.

in planning the use of their soils. Each group is made up of soils that have about the same water-supplying capacity and other characteristics that influence the growth of trees. The soils also have similar limitations and are subject to the same hazards when used for trees. All of the soils in one group, therefore, have about the same potential productivity and require the use of similar kinds of conservation practices and other management. The management groups are discussed in the pages that follow, the soils in each group are listed, and management suitable for all the soils in the group is suggested.

The objectives of woodland management are to attain the largest amount of wood crops of the best quality as rapidly as the soil, the climate, and the amount of moisture available permits, and to use the timber as rapidly as it is produced without impairing the productivity of the site. To attain such an objective requires strict control of the stock throughout the life of the stand and the using of such good management practices as (1) keeping the stands well stocked but not overstocked; (2) removing cull trees and maintaining the stands in good condition; (3) encouraging the more desirable species of trees to grow; (4) removing merchantable trees and improving the stand by cutting, thinning, salvaging damaged trees, and fully using all trees cut; (5) keeping seedling mortality at a minimum; (6) planting suitable species in open areas where the trees do not grow naturally; (7) protecting the areas from fire and grazing; and (8) controlling insects and diseases.

For each group, site index ratings are given for suitable trees. The site index as given is the total height of the dominant trees in the stand at 50 years of age, and it is a rating of potential productivity. The ratings are based on measurements made on individual plots of representative soils of most of the groups.

Discussed for each group are the hazards of seedling mortality, or the loss of seedlings as related to the kinds of soils; the risk of competition to the trees from other plants; the limitations to the use of equipment; the hazards to seedlings from disease, insects, or pests; and the hazards of windthrow and erosion. Also discussed are the kinds of trees that grow best on the soils of each group. A rating of *slight* means that no special problems have been recognized, and that the use of the soils in the group for trees would not be affected, except as noted, by the particular hazard. A rating of *moderate* means that the use of the soils for trees would be affected by the stated hazard, but not to the extent of precluding such use, and that ordinary management practices can be used to control the hazard. A rating of *severe* means that the stated hazard makes it impractical to manage the soils for trees, or that difficult or expensive practices are required to control the hazard.

WOODLAND GROUP 1

This group is made up of deep to moderately deep, medium-textured soils. These soils are moderately well drained to well drained. The slope is no greater than 12 percent. The following soils are in the group:

Arenzville silt loam.
Bertrand silt loam, 0 to 2 percent slopes.
Bertrand silt loam, 2 to 6 percent slopes.
Bertrand silt loam, 2 to 6 percent slopes, moderately eroded.
Bertrand silt loam, 6 to 12 percent slopes.
Bertrand silt loam, 6 to 12 percent slopes, moderately eroded.
Bertrand silt loam, 6 to 12 percent slopes, severely eroded.
Chaseburg silt loam, 0 to 2 percent slopes.
Chaseburg silt loam, 2 to 6 percent slopes.
Downs silt loam, 2 to 6 percent slopes.
Downs silt loam, 2 to 6 percent slopes, moderately eroded.
Downs silt loam, 6 to 12 percent slopes, moderately eroded.
Downs silt loam, benches, 2 to 6 percent slopes, moderately eroded.
Downs silt loam, benches, 6 to 12 percent slopes, moderately eroded.
Dubuque silt loam, 2 to 6 percent slopes, moderately eroded.
Dubuque silt loam, 6 to 12 percent slopes.
Dubuque silt loam, 6 to 12 percent slopes, moderately eroded.
Dubuque silt loam, deep, 2 to 6 percent slopes.
Dubuque silt loam, deep, 2 to 6 percent slopes, moderately eroded.
Dubuque silt loam, deep, 6 to 12 percent slopes.
Dubuque silt loam, deep, 6 to 12 percent slopes, moderately eroded.
Dubuque soils, 6 to 12 percent slopes, severely eroded.
Gale silt loam, 6 to 12 percent slopes.
Gale silt loam, 6 to 12 percent slopes, moderately eroded.
Jackson silt loam, 0 to 2 percent slopes.
Jackson silt loam, 2 to 6 percent slopes.
Jackson silt loam, 2 to 6 percent slopes, moderately eroded.
Jackson silt loam, 6 to 12 percent slopes.
Jackson silt loam, 6 to 12 percent slopes, moderately eroded.
Jackson silt loam, 6 to 12 percent slopes, severely eroded.
Medary silt loam, 0 to 2 percent slopes.
Medary silt loam, 2 to 6 percent slopes.
Norden silt loam, 2 to 6 percent slopes.
Norden silt loam, 2 to 6 percent slopes, moderately eroded.
Norden silt loam, 6 to 12 percent slopes.
Norden silt loam, 6 to 12 percent slopes, moderately eroded.
Norden silt loam, 6 to 12 percent slopes, severely eroded.
Otterholt silt loam, loamy substratum, 2 to 6 percent slopes.
Otterholt silt loam, loamy substratum, 2 to 6 percent slopes, moderately eroded.
Otterholt silt loam, loamy substratum, 6 to 12 percent slopes, moderately eroded.
Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes.
Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes, moderately eroded.
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes.
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, moderately eroded.
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, severely eroded.
Seaton and Fayette silt loams, valleys, 2 to 6 percent slopes.
Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes.
Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes, moderately eroded.

In this group the predominant trees are various kinds of oaks or mixtures of other hardwoods. The site index for red oak ranges from 63 to 75. In sloping areas the site index on the lower slopes is generally higher than that on the middle or upper slopes, but the direction of the slope does not appreciably affect the site index.

Hardwoods on soils of this group generally have long, clear trunks that are suitable for veneer and saw logs. On the Downs soils, however, the length of the limb-free trunk is generally less than that of trees growing on the other soils.

Seedling mortality is moderate to severe, particularly for oaks. The supply of seed is greatly reduced by rodents and insects. In addition, diseases, intermittent drought, and frost heaving kill large numbers of established seedlings. Skillful management is needed to help establish seedlings of desirable trees. This can be done by group cutting or shelterwood cutting. By this method, when stands of mature trees are harvested, limited areas close to desirable seed trees are opened. In this way seedlings are encouraged to grow in the shelter of the seed trees.

In stands of native hardwoods, large amounts of seed are produced and good stands are obtained in many places through natural regeneration.

Regeneration of oak stands presents some problems. Oaks are fairly demanding of light. Therefore, any system of cutting should open the woodland enough to permit reproduction and establishment of oaks. Scarification of the soil is also helpful in increasing the likelihood of reproduction of oaks. However, even these methods are not always successful.

Competition from low-grade hardwoods, brush, weeds, and grass hinders the natural growth of desirable trees. In oak stands the more valuable red oaks may be replaced by the less desirable ironwood, hickory, and elm trees because those trees are more tolerant of competition from other plants. If satisfactory stocking is to be attained in a short time, growth of the less desirable trees must be controlled. To get a good stand of trees on open areas that have not been clean tilled, plant the seedlings in furrows or in spots from which the vegetation has been removed.

Limitations to the use of mechanized equipment are slight. Logging equipment generally can be operated in all seasons, except in spring when thawing takes place. Prolonged rains make roads in wooded areas temporarily unserviceable in a few places. During periods of heavy rainfall, the Arenzville and Chaseburg soils are likely to be flooded in places. Using heavy equipment on the soils of this group while the surface is spongy causes the soil to be compacted. Such damage can be avoided by carrying out logging operations in winter. Generally, tree planting can be done by machine, but in gullied areas the planting of trees needs to be planned so that the need for crossing gullies is kept to a minimum.

The hazard to seedlings from diseases, insects, or pests presents no special problems once the seedlings are established. Windthrow is not a hazard, and harvesting and thinning can be done without special precautions.

The hazard of erosion is slight to moderate. Runoff from surrounding fields concentrates in waterways and forms gullies. It can be controlled by controlling runoff on adjacent areas that are not wooded. On the steeper slopes, roads and skid trails are likely to be eroded if runoff is not diverted away from the areas. If furrows are used for planting trees, they should be laid out on the contour to help control erosion.

Red oak, sugar maple, basswood, white ash, and other native hardwoods of high quality are the trees that are best suited to these soils. They should be encouraged if present in a stand, and they can be planted if the soil is undisturbed and planting is necessary to obtain a stand of trees. In areas where the soil has been altered by tillage, grazing, or erosion, white pine, white spruce, red pine, white-cedar, Norway spruce, or green ash are the preferred trees to plant.

WOODLAND GROUP 2

The soils in this group have steeper slopes than those in woodland group 1, but they are otherwise similar. The following soils are in the group:

Bertrand silt loam, 12 to 20 percent slopes, moderately eroded.
Bertrand silt loam, 12 to 20 percent slopes, severely eroded.
Downs silt loam, benches, 12 to 20 percent slopes.
Downs silt loam, benches, 12 to 20 percent slopes, moderately eroded.
Downs silt loam, benches, 12 to 20 percent slopes, severely eroded.
Downs silt loam, benches, 20 to 30 percent slopes, moderately eroded.
Dubuque silt loam, 12 to 20 percent slopes.
Dubuque silt loam, 12 to 20 percent slopes, moderately eroded.
Dubuque silt loam, 20 to 30 percent slopes.
Dubuque silt loam, 20 to 30 percent slopes, moderately eroded.
Dubuque silt loam, 30 to 45 percent slopes.
Dubuque silt loam, deep, 12 to 20 percent slopes.
Dubuque silt loam, deep, 12 to 20 percent slopes, moderately eroded.
Dubuque silt loam, deep, 20 to 30 percent slopes.
Dubuque silt loam, deep, 20 to 30 percent slopes, moderately eroded.
Dubuque soils, deep, 12 to 20 percent slopes, severely eroded.
Dubuque soils, deep, 20 to 30 percent slopes, severely eroded.
Gale silt loam, 12 to 20 percent slopes.
Gale silt loam, 12 to 20 percent slopes, moderately eroded.
Gale silt loam, 12 to 20 percent slopes, severely eroded.
Gale silt loam, 20 to 30 percent slopes.
Gale silt loam, 20 to 30 percent slopes, moderately eroded.
Gale silt loam, 20 to 30 percent slopes, severely eroded.
Gale silt loam, 30 to 40 percent slopes.
Norden loam, 12 to 20 percent slopes, moderately eroded.
Norden loam, 20 to 30 percent slopes.
Norden loam, 20 to 30 percent slopes, moderately eroded.
Norden silt loam, 12 to 20 percent slopes.
Norden silt loam, 12 to 20 percent slopes, moderately eroded.
Norden silt loam, 12 to 20 percent slopes, severely eroded.
Norden silt loam, 20 to 30 percent slopes.
Norden silt loam, 20 to 30 percent slopes, moderately eroded.
Norden silt loam, 20 to 30 percent slopes, severely eroded.
Norden silt loam and loam, 30 to 40 percent slopes.
Norden silt loam and loam, 30 to 40 percent slopes, moderately eroded.
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes.
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, moderately eroded.
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, severely eroded.
Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes,
Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, moderately eroded.
Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, severely eroded.
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes.
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, moderately eroded.
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, severely eroded.
Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes.
Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, moderately eroded.
Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, severely eroded.
Terrace escarpments, loamy.

On the soils of this group, the site index for red oak ranges from about 63 to 75 or is about the same as for the soils in woodland group 1. There generally is a wider variation within the range, however, because of the direction of slope. The site index on slopes that face south and west is generally lower than on slopes that face north and east or on areas in coves. It is even lower on the steep and shallow soils. There is little difference in the quality of the trees grown on these soils as compared to those grown on the soils of woodland group 1.

Equipment limitations are moderate to severe, mainly because of the steepness of the slope. It is generally necessary to place woodland roads along the ridgetops or in draws and skid the logs up or down the slope. Mechanical tree planters generally do not operate well on slopes steeper than 12 percent. Therefore, tree planting is done mostly by hand.

The hazard of erosion is moderate to severe. If runoff from surrounding fields used for crops is not controlled, it concentrates in waterways that run through wooded areas and forms gullies. Roads built in draws or on the sides of hills are subject to severe erosion and are likely to be washed out. Skid trails are also subject to severe erosion. Logging in winter, when the ground cover and the soil are less likely to be damaged, helps to control erosion.

Generally, trees that are suitable for the soils in woodland group 1 are also suited to the soils of this group. White pine, white spruce, and white-cedar, however, are probably not suitable for soils on exposed slopes that face south and west. These trees do not tolerate extreme hot or cold weather or drying winds as well as red pine and Norway spruce.

WOODLAND GROUP 3

The soils in this group are moderately coarse textured or coarse textured and are well drained to excessively drained. They consist of sandy soils on uplands and on outwash. Their slope is less than 12 percent. The following soils are in the group:

- Burkhardt sandy loam, 0 to 2 percent slopes.
- Burkhardt sandy loam, 2 to 6 percent slopes.
- Burkhardt sandy loam, 2 to 6 percent slopes, moderately eroded.
- Burkhardt sandy loam, 6 to 12 percent slopes, severely eroded.
- Dakota fine sandy loam, 0 to 2 percent slopes.
- Dakota fine sandy loam, 2 to 6 percent slopes.
- Dakota fine sandy loam, 2 to 6 percent slopes, moderately eroded.
- Hixton fine sandy loam, 2 to 6 percent slopes, moderately eroded.
- Hixton fine sandy loam, 6 to 12 percent slopes.
- Hixton fine sandy loam, 6 to 12 percent slopes, moderately eroded.
- Meridian fine sandy loam, 0 to 2 percent slopes.
- Meridian fine sandy loam, 2 to 6 percent slopes.
- Meridian fine sandy loam, 2 to 6 percent slopes, moderately eroded.
- Meridian fine sandy loam, 6 to 12 percent slopes.
- Meridian fine sandy loam, 6 to 12 percent slopes, moderately eroded.
- Meridian fine sandy loam, 6 to 12 percent slopes, severely eroded.
- Norden fine sandy loam, 2 to 6 percent slopes, moderately eroded.
- Norden fine sandy loam, 6 to 12 percent slopes.
- Norden fine sandy loam, 6 to 12 percent slopes, moderately eroded.
- Norden fine sandy loam, 6 to 12 percent slopes, severely eroded.
- Norden fine sandy loam, dark surface variant, 2 to 6 percent slopes, moderately eroded.
- Norden fine sandy loam, dark surface variant, 6 to 12 percent slopes, moderately eroded.
- Northfield very fine sandy loam, 2 to 6 percent slopes.
- Northfield very fine sandy loam, 2 to 6 percent slopes, moderately eroded.
- Urne and Norden fine sandy loams, 2 to 6 percent slopes, moderately eroded.
- Urne and Norden fine sandy loams, 6 to 12 percent slopes, moderately eroded.
- Urne and Norden fine sandy loams, 6 to 12 percent slopes, severely eroded.

These soils have a native cover of black oak, pin oak, white oak, brush, or prairie grasses. It is probable that at some time there may have been stands of red oak and other hardwoods in places. The site index for black oak ranges from 43 to 57. The quality of the trees is fair to poor. The trunks are short and have numerous branches or knots. They are used for saw logs, ties, fenceposts, and fuelwood. Generally, the Northfield, Urne, Hixton, and Norden soils and the dark surface variant from the Norden series are more productive of timber than the other soils.

The mortality of hardwood seedlings is moderate to severe because of intermittent drought. Damage from insects and rodents is not so serious on these soils as on heavier textured soils, and damage from frost heaving is negligible.

Oaks are easier to establish from sprouts than from seed. Therefore, in harvesting oak, cutting should be done so as to make large openings in the forest canopy and thus encourage natural reproduction.

Transplanted conifers, especially pines, grow well if ordinary planting precautions are used. Because there is no risk of frost heaving, successful planting can be done in fall if there is enough moisture in the soil and the weather is favorable. Prolonged hot, dry spells are especially damaging to young seedlings; therefore, it is important to use vigorous stock that has a good root system if planting is done in warm weather.

Competition from other plants is slight to moderate. Brush is likely to encroach on understocked stands. Also, the establishment of the more desirable conifers is hindered in many places by dense stands of low-quality oak.

If seed is sown or seedlings are planted in existing stands, the removal of the upper part of the crown cover should be fairly complete. Controlling brush prior to planting on areas in brush or on areas that have a cover of sod, and then planting in furrows or in spots from which the vegetation has been removed, help to establish a good stand of trees.

Limitations to the use of equipment are slight to moderate. Tractors, trucks, and planting machines can be operated in all seasons. The soils are subject to only slight damage by heavy equipment moving over them, and it generally is not necessary to restrict the movement of heavy equipment. A few areas are gullied, and the gullies may be difficult to cross with heavy equipment. The cost of constructing roads is reasonable.

Seedlings are likely to be damaged by root rot and stem rot, especially seedlings of jack pine on soils that are droughty. Root-collar weevils have wiped out most of the plantations of Scotch pine, and they occasionally decimate red pine and jack pine grown on these soils.

Pocket gophers damage young plantations by working among the roots of the trees and weakening the root system so that the tree overturns. If a heavy cover of dry grass has been permitted to accumulate, field mice are likely to congregate and cause damage to the seedlings by bark girdling.

Windthrow is not a hazard, except as the result of damage from insects and rodents.

The hazard of erosion because of runoff is slight to moderate. Water moves down into the soils rapidly, and rainfall is quickly absorbed. Nevertheless, concentrations of runoff water are likely to cause severe gullying.

If these soils are cleared of vegetation, they are subject to severe wind erosion. A protective cover is needed on such areas until the seedlings are well established. Sand blows and other actively eroding areas should be stabilized before planting to keep the wind from exposing the roots of seedlings or covering the tops with sand. A cover crop is difficult to establish on actively eroding areas, but brush, crop residues, or manure can be scattered over the areas to provide temporary cover.

Field windbreaks or shelterbelts can be used to protect fields and crops from wind erosion. The trees that are suitable for planting on these soils are also suitable for windbreaks. In addition, Norway spruce and redcedar can be used.

The quantity and quality of timber from pines on these soils is higher than that of hardwoods. Yields of pines are about twice the yields of hardwoods. Consequently, it is mostly pines that are planted on these soils.

Red (Norway) pine can be grown on soils that are exposed to normal weather or to severe weather. It is the tree most widely used for planting on the soils of this group.

White pine tolerates shade better than other pines and requires protection from exposure and insects. Therefore, it is the best pine to plant in existing stands. If the site is not too severely exposed, white pine also is highly desirable for plantings in open fields. It is susceptible to blister rust and damage by weevils, however, and should not be planted in areas where the hazard from these pests is severe.

Jack pine is more drought resistant than red and white pine and is grown chiefly on very droughty soils. It produces large amounts of seed and is therefore valuable for natural reforestation.

WOODLAND GROUP 4

These soils have steeper slopes than the soils in woodland group 3, but they are otherwise similar. The following soils are in the group:

- Hixton fine sandy loam, 12 to 20 percent slopes.
- Hixton fine sandy loam, 12 to 20 percent slopes, moderately eroded.
- Hixton fine sandy loam, 20 to 30 percent slopes.
- Hixton fine sandy loam, 20 to 30 percent slopes, moderately eroded.
- Hixton fine sandy loam, 20 to 30 percent slopes, severely eroded.
- Hixton fine sandy loam, 30 to 45 percent slopes.
- Hixton fine sandy loam, 30 to 45 percent slopes, moderately eroded.
- Hixton fine sandy loam, 30 to 45 percent slopes, severely eroded.
- Meridian fine sandy loam, 12 to 20 percent slopes, moderately eroded.
- Norden fine sandy loam, 12 to 20 percent slopes.
- Norden fine sandy loam, 12 to 20 percent slopes, moderately eroded.
- Norden fine sandy loam, 12 to 20 percent slopes, severely eroded.
- Norden fine sandy loam, 20 to 30 percent slopes.
- Norden fine sandy loam, 20 to 30 percent slopes, moderately eroded.
- Steep stony and rocky land.
- Urne fine sandy loam, 30 to 45 percent slopes.
- Urne fine sandy loam, 30 to 45 percent slopes, moderately eroded.
- Urne fine sandy loam, 30 to 45 percent slopes, severely eroded.
- Urne and Norden fine sandy loams, 12 to 20 percent slopes.
- Urne and Norden fine sandy loams, 12 to 20 percent slopes, moderately eroded.
- Urne and Norden fine sandy loams, 12 to 20 percent slopes, severely eroded.
- Urne and Norden fine sandy loams, 20 to 30 percent slopes.
- Urne and Norden fine sandy loams, 20 to 30 percent slopes, moderately eroded.
- Urne and Norden fine sandy loams, 20 to 30 percent slopes, severely eroded.

The native cover on these soils is black oak, pin oak, white oak, redcedar, jack pine, brush, and prairie grasses. Stands of red oak and other hardwoods are on the more favorable sites. The site index for black oak ranges from 43 to 57. It is higher on the slopes that face north and east and on areas in sheltered coves than on more exposed areas. The quality of the trees ranges from good to poor and is directly related to the site index. The logs cut from the native stands are used mainly for saw logs, ties, fenceposts, and fuelwood.

The mortality of hardwood seedlings is slight to moderate on slopes that face north and east, and moderate to severe on those that face south and west. The loss of seedlings is caused mainly by extremes in temperature and lack of moisture. Damage from frost heaving is not a serious hazard.

Generally, oaks are easier to establish from sprouts than from seed. Therefore, in harvesting oak, cutting should be done so as to make large openings in the forest canopy and thus encourage natural reproduction.

The survival of pine seedlings is good, except on soils where the exposure to extremes in weather is severe. In those areas the mortality of newly planted seedlings is likely to be high. Because the risk of frost heaving is not serious, successful planting generally can be done in fall. Then, the supply of moisture in the soil is also favorable. Seedlings to be planted on the warmer, south- and west-facing slopes should be selected carefully for sturdiness and vigor because of the risk of intermittent droughts.

Trees on the soils of this group have about the same hazards from competing plants as those in woodland group 3. On slopes that are exposed to hot weather, however, the competition from other plants is likely to be slight.

Limitations to the use of equipment are moderate to severe. Seasons of intermittent wetness that would limit the use of equipment are negligible. It is risky, however, to operate trucks and tractors on the steep slopes or to use machines for planting. If feasible, build logging roads along the ridgetops or in draws and skid the logs up or down the slope.

The hazard from diseases and insects are the same on these soils as on the soils of woodland group 3. Windthrow is not a hazard in stands that are not damaged by disease, insects, and other pests.

The hazard of erosion is moderate to severe. Gullying can be avoided if logging is done in winter and if disturbance of the soil is kept to a minimum. Locally, the hazard of wind erosion is severe, and management practices similar to those used for the soils of woodland group 3 are required.

On the more favorable sites, where the slopes face north and east or on areas in coves, the suitable trees are the same as those preferred for the soils in woodland group 3. Jack pine and red pine are preferred for planting on slopes where the exposure is severe; redcedar can be planted to furnish cover on sites that are even less favorable for trees.

WOODLAND GROUP 5

The soils in this group are coarse textured and are excessively drained. They consist of sandy soils on uplands and on outwash. The slope is less than 12 percent. The following soils are in the group:

Boone loamy fine sand, 2 to 6 percent slopes.
Boone loamy fine sand, 2 to 6 percent slopes, eroded.
Boone loamy fine sand, 6 to 12 percent slopes.
Boone loamy fine sand, 6 to 12 percent slopes, eroded.
Gotham loamy fine sand, 0 to 2 percent slopes.
Gotham loamy fine sand, 2 to 6 percent slopes.
Gotham loamy fine sand, 2 to 6 percent slopes, moderately eroded.
Gotham loamy fine sand, 6 to 12 percent slopes.
Gotham loamy fine sand, 6 to 12 percent slopes, moderately eroded.
Hubbard loamy fine sand, 0 to 3 percent slopes.
Plainfield loamy fine sand, 0 to 2 percent slopes.
Plainfield loamy fine sand, 2 to 6 percent slopes.
Plainfield loamy fine sand, 2 to 6 percent slopes, eroded.
Plainfield loamy fine sand, 6 to 12 percent slopes.
Plainfield loamy fine sand, 6 to 12 percent slopes, eroded.
Sparta loamy fine sand, 0 to 2 percent slopes.
Sparta loamy fine sand, 2 to 6 percent slopes.
Sparta loamy fine sand, 2 to 6 percent slopes, eroded.
Sparta loamy fine sand, 6 to 12 percent slopes.
Sparta loamy fine sand, 6 to 12 percent slopes, eroded.
Watseka loamy fine sand.

Northern pin oak, jack pine, brush, and praire grasses make up the native cover on these soils. The site index for pin oak ranges from 35 to 47. The quality of the trees generally is poor. They are used principally for fenceposts and fuelwood. The average site index for jack pine is 48. It indicates that the yield of jack pine would be about double the yield of oak on these soils.

Natural regeneration of trees is fair to good on these soils because the sites generally provide a good seedbed. Seedling mortality is likely to be high, however, during periods of hot, dry weather. The best natural growth of trees is in areas where surrounding land or vegetation provides some shelter.

Plantings of conifers are generally successful, although in places the entire planting may be lost because of severe drought. Most of these soils provide choice sites for pine because of the ease of planting on the areas and the low cost of the land.

Competition from other plants is slight because the amount of available moisture is low. Many areas have a thick cover of scrub oak, and it is difficult to get a good stand of desirable trees on them. If the soil has a moderate cover of scrub oak, however, pines can be established.

Generally, competing vegetation is scanty, and it is not necessary to remove the vegetation before planting seedlings. The competing plants provide the protection needed by the young trees in many places. Planting seedlings in furrows is probably not practical, for the blowing soil may fill the furrows and cover the trees.

There is little or no limitation to the traffic of planting and logging equipment on the soils of this group. A few gullies cannot be crossed by machinery and may need to be bypassed by logging roads, but the hazards to the equipment or to the soil from traffic are slight. Roads can be traveled in all seasons. Furthermore, the construction of roads costs less on these soils than on other soils in the county.

The principal insect enemy of pines on these soils is the root-collar weevil, which attacks red pine, jack pine, and Scotch pine. Scotch pine is particularly susceptible to damage, and the stands are generally wiped out before the trees are 10 feet tall. Old fields of sod are infested by white grubs, which destroy young pine seedlings. Root and stem rot affect both oak and pine somewhat. In areas next to open meadows, pocket gophers are likely to damage plantings of pine.

Windthrow is not a hazard, except on sites where the trees have been damaged or weakened by diseases or by insects or other pests.

The hazard of water erosion is slight because the slope is moderate and water moves quickly down into the soils. If these soils are cleared of vegetation or are clean tilled, they are highly susceptible to wind erosion. A protective cover should be provided before planting is done. Where seedlings can be established, rye can be used to provide cover. In sandblows, however, it may be necessary to spread manure, crop residues, or brush to prevent the seedlings from being buried by sand or torn out of the soil by the wind.

Jack pine and red pine are suitable trees to plant in open fields. White pine is suitable for planting in existing stands because it tolerates shade better than other plants. It is also useful for plantings in open areas on the more favorable sites, particularly if the white pine is planted along with other trees.

WOODLAND GROUP 6

The soils in this group have steeper slopes, but they are otherwise similar to the soils in woodland group 5. Therefore, limitations to their use are more severe. The following soils are in the group:

Boone loamy fine sand, 12 to 30 percent slopes, eroded.
Boone soils, 12 to 30 percent slopes, severely eroded.
Boone soils, 30 to 60 percent slopes.
Plainfield loamy fine sand, 12 to 20 percent slopes.
Plainfield loamy fine sand, 12 to 20 percent slopes, eroded.
Sparta fine sand and Dune land.
Sparta loamy fine sand, 12 to 20 percent slopes, eroded.
Terrace escarpments, sandy.

Various kinds of oak, jack pine, brush, and prairie grasses make up the native vegetation on these soils. Areas of Steep stony and rocky land, especially in the western part of the country, have stands of redcedar and bur oak. The site index for suitable trees is the same as for the soils in woodland group 5, but variation in yields is wider. Trees on slopes that face south and west are subject to severe exposure, but those on slopes that face north and east are protected and give better yields.

Limitations to the use of equipment are moderate to severe. Operating trucks and tractors on the steep slopes is difficult and risky. It is also difficult to operate machine planters on the steep slopes.

Trees that tolerate extremes of temperature and drought are suitable for these soils. Jack pine and red pine can be planted on most sites, but redcedar is needed in places to secure a cover on exposed, hot south- and west-facing slopes. White pine can be planted successfully on sites that are well protected.

WOODLAND GROUP 7

The soils in this group have a surface layer that is medium to coarse textured. Some of the soils have a substratum that is finer textured than the material in the upper part of the profile, and the others have a high water table. As a result, trees on these soils generally have a higher growth potential than those on soils that are excessively drained. The following soils are in the group:

Dillon fine sandy loam.
Loamy wet terrace land.
Loamy very wet terrace land.
Morocco loamy fine sand.
Plainfield loamy fine sand, mottled subsoil variant, 0 to 2 percent slopes.
Sandy alluvial land.

The native vegetation on these soils generally consists of combinations of various kinds of pines and oaks. Stands of aspen, soft maple, or other hardwoods are also common. The site index is not available for trees on these soils, but yield information for hardwoods and conifers is given in table 2.

Natural regeneration of trees is fair to good. The sites are moderately exposed to the weather, and available moisture is only fair. Consequently, the mortality of seedlings is generally low. If conditions favor a good seedbed and if sources of natural seed are nearby, natural regeneration of native trees is generally good. In most areas plantings of pines are successful. If native oaks are planted on the more favorable sites, the chance that the planting will succeed is good.

Limitations to the use of equipment are slight to moderate, but during wet periods the use of heavy equipment is somewhat limited. Machines can be used for planting in most places. The cost of building and maintaining roads is moderate.

White grubs and the root-collar weevil damage young trees. White grubs weaken young trees planted in old fields of sod, and the root-collar weevil destroys red pine, jack pine, and Scotch pine.

Root and stem rot affect hardwoods and conifers on all of the soils in this group. The trees are also damaged by gophers, mice, and rabbits. These pests become a serious hazard in areas where vegetation is not controlled.

Windthrow is a hazard on all of the soils, except on the variant from the Plainfield series, and if pests damage the roots of trees on that soil, windthrow is also a hazard.

Erosion is not a hazard, unless the areas have been cleared of vegetation or have been clean cultivated. If the soils are used for crops, field windbreaks are needed to control erosion.

White pine, red pine, white spruce, and Norway spruce are the principal trees suitable for planting on these soils. Early mortality of spruce seedlings can be expected, however, in periods of drought. Red oak and other native hardwoods should be encouraged if they are growing in a stand. Cottonwood is suitable on the soils that have a high water table, and it is a fast-growing tree.

WOODLAND GROUP 8

In this group are wet soils in low areas and in areas that are subject to overflow. The soils differ slightly in elevation or in composition, and these differences affect the kind of timber that can be grown. The following soils are in the group:

Almena silt loam, 2 to 6 percent slopes, moderately eroded.
Curran silt loam.
Ettrick silt loam, coarse silt substratum.
Loamy alluvial land.
Loamy alluvial land, wet.
Orion silt loam.
Rowley silt loam.
Zwingle silt loam.
Zwingle silt loam, poorly drained variant.

The native vegetation on these soils consists of willow, cottonwood, river birch, elm, various kinds of oaks, and other hardwoods. There are also a few tamarack trees. The stands are made up of combinations of these trees or of a single species. The site index is not available for trees on these soils. Records indicate, however, that the annual productivity ranges from very low in some places to several hundred board feet per acre of timber in other places.

Much of the acreage is unsuitable for cultivation. As a result, the soils in this group have a good cover of trees in many places. Many of the wooded areas have been grazed and the trees severely damaged. The quality of the timber is often poor. The water table fluctuates, and the stands are subject to flooding, extremes in temperature, and damage from diseases and insects. Therefore, the production of timber is suitable for saw log and veneer timber, ties, fenceposts, and fuelwood.

If the stands have not been grazed or overcut, natural regeneration is generally good. Most kinds of trees on these soils sprout readily from stumps and then grow rapidly. Areas that have been cleared, however, are likely to become overgrown with brush or weeds. On these areas it is difficult to reestablish stands of timber.

Competition from other plants is severe. Cleared areas are invaded quickly by many kinds of vegetation. Consequently, harvesting of mature trees must be regulated carefully to maintain a good stand of desirable trees.

Limitations to the use of equipment are severe. The soils are generally wet and are frequently flooded. Logging is better done in winter when the ground is frozen than in other seasons, but most sites dry out enough during the dryer seasons for equipment to move over them. The soils are nearly level and are free of stones. Construction of roads is not difficult. Machine planting is not generally feasible, because the areas are likely to be wet during the planting season.

The hazard to seedlings from root and stem rot and from wood-boring insects is moderate to severe. Rodents, particularly rabbits, are likely to damage young trees. Beavers also cause damage to the trees by felling them or by flooding the site and drowning the trees.

The hazard of windthrow is moderate to severe on these soils. The water table is high or fluctuates and causes shallow rooting. Consequently, the trees lack the windfirmness of trees on soils that are better drained. When harvesting trees, cutting should be done so as to avoid making large openings in the stand.

Except on streambanks, erosion is not a hazard. When trees are felled, care is needed to prevent them from falling into the streams and thus increasing the hazard of streambank erosion.

If native hardwoods or conifers are in the stand, they should be encouraged. Open areas and areas along the banks of streams can be planted to silver maple, American elm, white-cedar, white spruce, cottonwood, or willow. Cottonwoods or willows are easy to establish from cuttings.

WOODLAND GROUP 9

The soils in this group formed under prairie. Natural stands of timber are few and are scattered. The following soils are in the group:

- Dakota loam, 0 to 2 percent slopes.
- Dakota loam, 2 to 6 percent slopes.
- Dakota loam, 2 to 6 percent slopes, moderately eroded.
- Dakota loam, 6 to 12 percent slopes, moderately eroded.
- Huntsville silt loam.
- Judson silt loam, 0 to 2 percent slopes.
- Judson silt loam, 2 to 6 percent slopes.
- Judson silt loam, 6 to 12 percent slopes.
- Lindstrom silt loam, 6 to 12 percent slopes.
- Lindstrom silt loam, 6 to 12 percent slopes, moderately eroded.
- Lindstrom silt loam, 12 to 20 percent slopes.
- Lindstrom silt loam, 12 to 20 percent slopes, moderately eroded.
- Lindstrom silt loam, 20 to 30 percent slopes.
- Lindstrom silt loam, 20 to 30 percent slopes, moderately eroded.
- Richwood silt loam, 0 to 2 percent slopes.
- Richwood silt loam, 2 to 6 percent slopes.
- Toddville silt loam, 0 to 2 percent slopes.
- Toddville silt loam, 2 to 6 percent slopes.
- Waukegan silt loam, 0 to 2 percent slopes.
- Waukegan silt loam, 2 to 6 percent slopes.
- Waukegan silt loam, 2 to 6 percent slopes, moderately eroded.
- Waukegan silt loam, 6 to 12 percent slopes, moderately eroded.

Most of the acreage of these soils is in cultivation. The main trees on uncultivated areas are bur oak and redcedar. They typically have short trunks and heavy, widespreading branches. Their value is chiefly esthetic.

The vigor of seedlings on these soils is generally low. This is probably because the soil lacks mycorrhiza, which is a soil fungus that most forest trees need to develop good root systems. Inoculating the seedlings with forest soil helps to correct this deficiency.

Competition from other plants, which are mostly herbaceous, is moderate to severe. The plants hinder the growth of newly planted stock. Planting the seedlings in furrows or in spots from which the vegetation has been removed generally controls the competing plants.

Little logging is done on these soils, and limitations to the use of equipment apply only to areas where planting takes place. Planting should be done by hand on soils that have slopes of more than 12 percent.

Trees planted on these soils are probably no more subject to disease than those grown on other soils if the vigor of the stock is good. If the stock lacks vigor, the mortality of seedlings would likely be higher than that of seedlings planted in their native habitat.

Green ash, willow, cottonwood, Norway spruce, redcedar, and European larch are suitable trees for planting on the soils of this group.

WOODLAND GROUP 10

The soils in this group are wet and lack essential plant nutrients. They are poorly suited to trees. The following soils are in the group:

- Peat and muck, deep.
- Peat and muck, shallow.
- Wallkill silt loam.

Generally, these soils support poor stands of willow or cottonwood. Attempts to establish commercial stands of timber are nearly always unsuccessful.

Competition from other plants is severe on these soils. Logging equipment can be operated only in winter or on roads that have been constructed with care. Machine planting is not feasible, unless the areas have been drained.

The hazard of windthrow is severe. Trees on these soils are shallow rooted, and the soils are not able to anchor them firmly.

Soils that are cultivated are subject to severe wind erosion, and field windbreaks are needed to protect the areas. Willow and poplar are suitable trees to plant, and they are used primarily for shelterbelts.

Yield information

The estimated potential annual acre yields of upland oaks and conifers for the soil types and miscellaneous land types in Pepin County are given in table 2. The estimates are for well-stocked stands that have good tree density. They are based mainly on studies made in the field and on the results of research. They are also based on the experience and judgment of soil scientists, woodland conservationists, foresters, and local owners of woodland. The data are based on production estimates made by the Lake State Forest Experiment Station (*2*) and the Wis-

TABLE 2.—*Estimated potential annual acre yields of usable timber produced from well-managed stands that have good tree density*

[Absence of yield indicates trees generally do not grow on the soil type or that the soil type is not suited to the species indicated; board feet according to Scribner decimal C log rule; cords are standard]

Soil	North- and east-facing sites [1]		South- and west-facing sites [2]	
	Hardwoods	Conifers	Hardwoods	Conifers
	Bd. ft.	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*
Almena silt loam	200			
Arenzville silt loam	275			
Bertrand silt loam	250	350		
Boone loamy fine sand	(3)	175	(4)	(4)
Boone soils	(3)	150	(4)	(4)
Burkhardt sandy loam	(3)	225		
Chaseburg silt loam	275	300		
Curran silt loam	175	250		
Dakota fine sandy loam [5]		250		
Dakota loam		275		
Dillon fine sandy loam				
Downs silt loam	200		175	
Downs silt loam, benches	200		175	
Dubuque silt loam	150		100	
Dubuque silt loam, deep	200		150	
Ettrick silt loam, coarse silt substratum	125			
Gale silt loam	150	275	125	250
Gotham loamy fine sand [5]	125	225		
Hixton fine sandy loam	125	250	(4)	200
Hubbard loamy fine sand [5]		225		
Huntsville silt loam				
Jackson silt loam	225	300		
Judson silt loam				
Lindstrom silt loam				
Loamy alluvial land	250			
Loamy alluvial land, wet	150			
Loamy wet terrace land	150			
Loamy very wet terrace land				
Medary silt loamy	175	250		
Meridian fine sandy loam	125	250	(4)	200

See footnotes at end of table.

TABLE. 2.—*Estimated potential annual acre yields of usable timber produced from well-managed stands that have good tree density*—Continued

Soil	North- and east-facing sites [1]		South- and west-facing sites [2]	
	Hardwoods	Conifers	Hardwoods	Conifers
	Bd. ft.	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*
Morocco loamy fine sand	150	250	------	------
Norden fine sandy loam, dark surface variant	------	250	------	200
Norden loam	175	275	150	250
Norden silt loam	200	300	175	250
Northfield very fine sandy loam	100	225	(4)	200
Orion silt loam	200	------	------	------
Otterholt silt loam, loamy substratum	250	300	200	250
Peat and muck, deep	------	------	------	------
Peat and muck, shallow	------	------	------	------
Plainfield loamy fine sand [5]	(3)	200	------	(4)
Plainfield loamy fine sand, mottled subsoil variant	(3)	225	------	------
Richwood silt loam	------	------	------	------
Riverwash	------	------	------	------
Rowley silt loam	------	------	------	------
Sandy alluvial land	100	------	------	------
Seaton and Fayette silt loams, uplands	225	300	150	250
Seaton and Fayette silt loams, valleys	275	300	175	275
Sparta loamy fine sand [5]	------	200	------	(4)
Sparta fine sand and Dune land	------	(3)	------	(4)
Steep stony and rocky land	150	------	(4)	------
Terrace escarpments, loamy	175	275	(4)	200
Terrace escarpments, sandy	(3)	175	(4)	(4)
Toddville silt loam	------	------	------	------
Urne fine sandy loam	175	275	150	250
Urne and Norden fine sandy loams	175	275	150	250
Wallkill silt loam	------	------	------	------
Watseka loamy fine sand	(3)	200	------	------
Waukegan silt loam	------	------	------	------
Zwingle silt loam	------	------	------	------
Zwingle silt loam, poorly drained variant.	------	------	------	------

[1] Sites are in narrow valleys and on nearly level valley flats and broad ridgetops, where the soils are partly protected from heat and drying winds.

[2] Sites are on exposed ridgetops and slopes, where the soils are exposed to high temperatures and drying winds.

[3] On the north- and east-facing slopes, hardwoods on Boone loamy fine sands, on Burkhardt sandy loams, and on Plainfield loamy fine sand, mottled subsoil variant, yield 0.3 cord per acre; hardwoods yield 0.2 cord per acre on Boone soils, on the Plainfield loamy fine sands, on Terrace escarpments, sandy, and on Watseka loamy fine sand; and the conifers yield 0.3 cord per acre on Sparta fine sand and Dune land.

[4] On the south- and west-facing slopes, hardwoods on Boone loamy fine sands, on Boone soils, and on Terrace escarpments, sandy, yield 0.1 cord per acre; they yield 0.2 cord per acre on Hixton fine sandy loams, Meridian fine sandy loams, on Northfield very fine sandy loams, and on Steep stony and rocky land; and they yield 0.3 cord per acre on Terrace escarpments, loamy. Conifers yield 0.3 cord per acre on Boone loamy fine sands, Plainfield loamy fine sands, Sparta loamy fine sands, on Boone soils, and on Terrace escarpments, sandy; and 0.1 cord per acre on Sparta fine sand and Dune land.

[5] If the water table is within 5 to 12 feet of the surface, or if there are bands of finer textured material within that depth, larger yields than those indicated can be expected.

consin Conservation Department (*13*), with interpolations for individual soil types.

Most of the woodland areas in the county are producing far below their potential. Better management than is now practiced will be required to attain the yields shown in table 2. Many areas in timber have low tree density because of logging, fires, and grazing by livestock. Selective cutting has not been practiced. Therefore, many stands consist of cull trees and of other low-grade trees. With good management, including those practices described in the section "Woodland Management Groups," many of these wooded areas can be developed to provide excellent stands of salable timber.

It can be assumed in table 2, for purposes of interpretation, that 1,000 board feet of saw logs is equal to about 2 standard cords of pulpwood. The relationship varies considerably, depending on the diameter of the trunks measured.

The kinds of hardwoods and conifers referred to in table 2, are those that commonly grow on the soil type indicated and are harvested for commercial purposes, or are the preferred species for planting. Black oak, for example, is the most common hardwood that grows on the Hixton fine sandy loams in woodland group 3. The principal hardwoods on the Seaton and Fayette silt loams in woodland group 2, however, are maple, birch, red oak, aspen, hickory, and some sugar maple and basswood. Aspen, however, grows faster than some of the other hardwoods. Therefore, if aspen is dominant in a stand, higher yields can be expected.

In Pepin County trees on hot south- and west-facing slopes are exposed to heat and to dry winds in summer and winter. They do not make so high a yield as trees on slopes facing north or east or that are on valley flats and broad ridgetops where the slope is gentle. The productivity of the trees is also affected by the amount of moisture available. Yields on a normally droughty soil, for example, are generally much increased if the water table is within 5 to 12 feet of the surface, or if a layer of finer textured soil material occurs within that depth.

Engineering Uses of the Soils [3]

This section describes the properties of soils important to engineering. It contains information that engineers can use to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Assist in designing drainage and irrigation systems, farm ponds, and other structures for conserving soil and water (fig. 8).
3. Make preliminary surveys of soil and ground conditions that will aid in selecting locations for high-

[3] By A. W. KOWITZ, engineer, and A. J. KLINGELHOETS, soil scientist, Soil Conservation Service, U.S. Department of Agriculture. Assistance in testing of samples and preparing engineering interpretations was given by personnel of the State Highway Commission of Wisconsin under a cooperative agreement with the U.S. Department of Commerce, Bureau of Public Roads.

***Figure 8.*—Drop inlet under construction in a large gully to keep the gully under control; all engineering properties of the soil must be considered in designing and building such a structure.**

ways and airports and in planning detailed surveys of the soils at the selected locations.

4. Locate probable sources of sand and gravel and other construction materials.
5. Correlate pavement performance with the soil mapping units and thus develop information that will be useful in designing and maintaining pavements.
6. Determine the suitability of soil units for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.

The mapping and the descriptive report are somewhat generalized, however, and should be used only in planning more detailed field surveys to determine the in-place condition of the soil at the site of the proposed engineering construction.

Additional information helpful to engineers can be obtained from the detailed map and the general soil map. For some information, it may be necessary to refer to other parts of the report, particularly to the section "Descriptions of the Soils" and to the more detailed descriptions of the soils in the section "Formation, Morphology, and Classification of Soils," which also discusses how the soils formed. The descriptions of the soil profiles, as well as the soil map and the tables in this section, should be used in planning a detailed survey at the construction site. These will help the engineer to concentrate on the most suitable soils, indicate sources of sand and gravel, and minimize the number of soil samples needed for testing in the laboratory.

TABLE 3.—*Brief description of the soils and*

Map symbol	Soil	Brief description of soil and site	Depth to bedrock	Kind of bedrock
			Feet	
AmB2	Almena silt loam, 2 to 6 percent slopes, moderately eroded.	Somewhat poorly drained soil on nearly level to sloping ridges of the uplands; the surface layer and the subsoil are silt loam, and the substratum is clay loam.	4–10	Sandstone or dolomite.
Ar	Arenzville silt loam.[5]	Moderately well drained to well drained, silty soil on the nearly level flood plains of streams. More than 40 inches thick.	10–100	Sandstone____
BeA	Bertrand silt loam, 0 to 2 percent slopes.	Well-drained soils on level to sloping stream benches; the surface layer is silt loam, the subsoil is silty clay loam, and the substratum is silty or sandy. More than 40 inches thick.	10–100	Sandstone____
BeB	Bertrand silt loam, 2 to 6 percent slopes.			
BeB2	Bertrand silt loam, 2 to 6 percent slopes, moderately eroded.			
BeC	Bertrand silt loam, 6 to 12 percent slopes.			
BeC2	Bertrand silt loam, 6 to 12 percent slopes, moderately eroded.			
BeC3	Bertrand silt loam, 6 to 12 percent slopes, severely eroded.			
BeD2	Bertrand silt loam, 12 to 20 percent slopes, moderately eroded.			
BeD3	Bertrand silt loam, 12 to 20 percent slopes, severely eroded.			
BnB	Boone loamy fine sand, 2 to 6 percent slopes.	Excessively drained, sandy soils on sloping to steep ridges of the uplands.	1–5	Sandstone____
BnB2	Boone loamy fine sand, 2 to 6 percent slopes, eroded.			
BnC	Boone loamy fine sand, 6 to 12 percent slopes.			
BnC2	Boone loamy fine sand, 6 to 12 percent slopes, eroded			
BnD2	Boone loamy fine sand, 12 to 30 percent slopes, eroded.			
BsD3	Boone soils, 12 to 30 percent slopes, severely eroded.	Excessively drained, sandy soils on sloping to steep ridges of the uplands.	1–5	Sandstone____
BsF	Boone soils, 30 to 60 percent slopes.			

See footnotes at end of table.

Some of the terms used by the soil scientist may be unfamiliar to the engineer, and some words—for example, soil, clay, silt, and sand—may have special meanings in soil science. These and other special terms that are used are defined in the Glossary at the end of the report.

Engineering classification systems

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (*1*). In this system soil materials are classified in seven principal groups. The groups range from A–1, which consists of gravelly soils of high bearing capacity, to A–7, which consists of clay soils having low strength when wet. Within each group the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. The group index number is shown in parentheses, following the soil group symbol, in table 5.

Some engineers prefer to use the Unified soil classification system (*12*). In this system soil materials are identified as coarse grained, 8 classes; fine grained, 6 classes; and highly organic. The last column of table 5 gives the classification of the tested soils, according to the Unified system.

Engineering properties of the soils

Table 3 gives a brief description of the soils of Pepin County and their estimated physical properties. In preparing this table the soil test data given in table 5 were used, information in the rest of the report was examined, and the soils were studied in the fields.

The map symbols and the names of the soils are listed alphabetically in table 3, and a brief description of the soil and site are given. The kind of bedrock is given, and depth to bedrock and depth to the water table are indicated. In the column that shows depth from the surface, the layers shown are fairly typical of the layers in all the soils in any one series. The depths indicated, however, are not the same as those in the representative profile for that particular series, which is given in the sections that describe the soils in detail.

The percolation rate is the downward movement, or the rate of infiltration, of water into a soil. In American Society of Civil Engineers Hydrology Handbook, R. E. Horton describes the range of values of the infiltration capacity through the profile of bare soils after 1 hour of continuous rainfall as follows: High—0.50+ inches per hour; intermediate—0.10 to 0.50+ inches per hour; low—less than 0.10 inches per hour.

Wet consistence was determined when the soils were at or slightly above field moisture capacity. The terms describe the attributes of the soil material resulting from their kind of cohesion and adhesion, or from their resistance to deformation or rupture.

estimated properties significant to engineering

Depth to water table [1]	Moisture-supplying capacity [2]	Horizon [3]	Depth from surface	Classification		Percolation rate [4]	Wet consistence
				AASHO	Unified		
Feet			*Inches*			*Inches per hour*	
100+	Moderate to high	A	0–12	A–4	ML	0. 8–2. 5	Slightly plastic.
		B	12–40	A–6	ML-CL	0. 2–0. 8	Slightly plastic to plastic.
		C	40+	A–7	CL	0. 8–2. 5	Plastic.
4–10	Moderate	A	0–10	A–4	ML	0. 8–2. 5	Slightly plastic.
		C	10+	A–4, A–7	ML	0. 8–2. 5	Slightly plastic to plastic.
10–100	Moderate	A	0–12	A–4	ML-CL	0. 8–2. 5	Slightly plastic.
		B	12–40	A–7	CL	0. 8–2. 5	Plastic.
		C	40+	A–4	ML-CL	0. 2–0. 8	Plastic.
100+	Low	A	0–8	A–2	SM	5. 0–10	Nonplastic.
		C	8+	A–3	SP	10+	Nonplastic.
100+	Very low	A	0–8	A–3	SP	5. 0–10	Nonplastic.
		C	8+	A–3	SP	10+	Nonplastic.

TABLE 3.—*Brief description of the soils and estimated*

Map symbol	Soil	Brief description of soil and site	Depth to bedrock	Kind of bedrock
			Feet	
BuA BuB BuB2 BuC3	Burkhardt sandy loam, 0 to 2 percent slopes. Burkhardt sandy loam, 2 to 6 percent slopes. Burkhardt sandy loam, 2 to 6 percent slopes, moderately eroded. Burkhardt sandy loam, 6 to 12 percent slopes, severely eroded.	Well-drained sandy loams, on nearly level to sloping stream benches; underlain by loose sand and gravel at a depth between 1 and 2 feet.	10–100	Sandstone
CaA CaB	Chaseburg silt loam, 0 to 2 percent slopes. Chaseburg silt loam, 2 to 6 percent slopes.	Moderately well drained to well drained, silty soils on nearly level to sloping alluvial fans and on the bottoms of narrow valleys. More than 40 inches thick.	4–10	Sandstone
Cu	Curran silt loam.	Somewhat poorly drained soil on nearly level stream benches; the surface layer is silt loam, the subsoil is silty clay loam, and the substratum is silty or sandy. More than 40 inches thick.	10–100	Sandstone
DaA DaB DaB2	Dakota fine sandy loam, 0 to 2 percent slopes. Dakota fine sandy loam, 2 to 6 percent slopes. Dakota fine sandy loam, 2 to 6 percent slopes, moderately eroded.	Well-drained soils on nearly level to sloping stream benches; underlain by loose sand at a depth of more than 2 feet.	10–100	Sandstone
DbA DbB DbB2 DbC2	Dakota loam, 0 to 2 percent slopes. Dakota loam, 2 to 6 percent slopes. Dakota loam, 2 to 6 percent slopes, moderately eroded. Dakota loam, 6 to 12 percent slopes, moderately eroded.	Well-drained soils on nearly level to sloping stream benches; the surface layer is loam, and the subsoil is sandy clay loam; underlain by loose sand at a depth between 2 and 3 feet.	10–100	Sandstone
Dc	Dillon fine sandy loam.	Very poorly drained soils on nearly level stream benches; underlain by loose sand at a depth of 1 foot or more; high water table.	10–100	Sandstone
DdB DdB2 DdC2	Downs silt loam, 2 to 6 percent slopes. Downs silt loam, 2 to 6 percent slopes, moderately eroded Downs silt loam, 6 to 12 percent slopes, moderately eroded.	Well-drained soils on nearly level to sloping ridges in the uplands; the surface layer is silty, and the subsoil is silty clay loam that is underlain by silt.	4–10	Dolomite
DeB2 DeC2 DeD DeD2 DeD3 DeE2	Downs silt loam, benches, 2 to 6 percent slopes, moderately eroded. Downs silt loam, benches, 6 to 12 percent slopes, moderately eroded. Downs silt loam, benches, 12 to 20 percent slopes. Downs silt loam, benches, 12 to 20 percent slopes, moderately eroded. Downs silt loam, benches, 12 to 20 percent slopes, severely eroded. Downs silt loam, benches, 20 to 30 percent slopes, moderately eroded.	Well-drained soils on nearly level to sloping high stream benches; the surface layer is silty, and the subsoil is silty clay loam that is underlain by silt.	4–20	Sandstone
DfB2 DfC DfC2 DfD DfD2 DfE DfE2 DfF	Dubuque silt loam, 2 to 6 percent slopes, moderately eroded. Dubuque silt loam, 6 to 12 percent slopes. Dubuque silt loam, 6 to 12 percent slopes, moderately eroded. Dubuque silt loam, 12 to 20 percent slopes. Dubuque silt loam, 12 to 20 percent slopes, moderately eroded. Dubuque silt loam, 20 to 30 percent slopes. Dubuque silt loam, 20 to 30 percent slopes, moderately eroded. Dubuque silt loam, 30 to 45 percent slopes.	Well-drained soils on sloping to steep ridges in the uplands; the surface layer is silt loam; the subsoil is clayey and is underlain by clayey material weathered from limestone bedrock.	2–4	Dolomite
DpB DpB2 DpC	Dubuque silt loam, deep, 2 to 6 percent slopes. Dubuque silt loam, deep, 2 to 6 percent slopes, moderately eroded. Dubuque silt loam, deep, 6 to 12 percent slopes.	Well-drained soils on sloping to steep ridges in the uplands; the surface layer is silt loam; the subsoil is silty clay loam to clay and is underlain by	3–5	Dolomite

See footnotes at end of table.

properties significant to engineering—Continued

Depth to water table [1]	Moisture-supplying capacity [2]	Horizon [3]	Depth from surface	Classification: AASHO	Classification: Unified	Percolation rate [4]	Wet consistence
Feet			*Inches*			*Inches per hour*	
10–100	Low to moderate	A	0–10	A–2	SM	2. 5–5. 0	Slightly plastic.
		B	10–18	A–2	SM–SC	0. 8–2. 5	Slightly plastic.
		C	18+	A–1	SW	10+	Slightly plastic.
5–100	Moderate	A	0–12	A–4	ML	0. 8–2. 5	Slightly plastic.
		C	12–36+	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
4–100	High	A	0–12	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
		B	12–36	A–7	CL	0. 2–0. 8	Plastic.
		C	36+	A–7	CL	0. 2–0. 8	Plastic.
5–100	Low to moderate	A	0–10	A–2	SM	2. 5–5. 0	Slightly plastic.
		B	10–30	A–2	SP–SM	0. 8–2. 5	Slightly plastic.
		C	30+	A–3	SP	5. 0–10	Nonplastic.
5–100	Moderate	A	0–12	A–4	SC	0. 8–2. 5	Slightly plastic.
		B	12–36	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
		C	36+	A–3	SP	5. 0–10	Nonplastic.
1–3	High	A	0–12	A–2	SM	5. 0–10	Slightly plastic.
		C	12+	A–3	SP	10+	Nonplastic.
100+	Moderate	A	0–12	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
		B	12–40	A–6	ML–CL	0. 8–2. 5	Plastic.
		C	40+	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
100+	Moderate	A	0–12	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
		B	12–40	A–6	ML–CL	0. 8–2. 5	Plastic.
		C	40+	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
100+	Moderate	A	0–12	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
		B	12–30	A–6	ML–CL	0. 8–2. 5	Plastic.
		C	30 +	A–7	MH–CH	0. 8–2. 5	Very plastic.
100+	Moderate	A	0–12	A–4	ML–CL	0. 8–2. 5	Slightly plastic to plastic.
		B	12–36	A–6	ML–CL	0. 2–0. 8	Plastic.
		C	36 +	A–7	MH–CH	05–0. 2	Very plastic.

TABLE 3.—*Brief description of the soils and estimated*

Map symbol	Soil	Brief description of soil and site	Depth to bedrock	Kind of bedrock
			Feet	
DpC2	Dubuque silt loam, deep, 6 to 12 percent slopes, moderately eroded.	clayey material weathered from limestone bedrock.		
DpD	Dubuque silt loam, deep, 12 to 20 percent slopes.			
DpD2	Dubuque silt loam, deep, 12 to 20 percent slopes, moderately eroded.			
DpE	Dubuque silt loam, deep, 20 to 30 percent slopes.			
DpE2	Dubuque silt loam, deep, 20 to 30 percent slopes, moderately eroded.			
DsC3	Dubuque soils, 6 to 12 percent slopes, severely eroded.	Well-drained soils on sloping to steep ridges in the uplands; the surface layer is mixed silty to clayey material; the subsoil is clayey and is underlain by clayey material weathered from limestone bedrock.	1–4	Dolomite
DtD3	Dubuque soils, deep, 12 to 20 percent slopes, severely eroded.			
DtE3	Dubuque soils, deep, 20 to 30 percent slopes, severely eroded.			
Ec	Ettrick silt loam, coarse silt substratum.[6]	Poorly drained soil on nearly level flood plains of streams; the surface layer is silt loam, the subsoil is silty clay loam, and the substratum is coarse silt.	10–100	Sandstone
GaC	Gale silt loam, 6 to 12 percent slopes.	Well-drained soils of sloping to steep valleys; the surface layer is silt loam, and the subsoil is silty clay loam; underlain by loose sand or sandstone bedrock at a depth between 2 and 3 feet.	2–4	Sandstone
GaC2	Gale silt loam, 6 to 12 percent slopes, moderately eroded.			
GaD	Gale silt loam, 12 to 20 percent slopes.			
GaD2	Gale silt loam, 12 to 20 percent slopes, moderately eroded.			
GaD3	Gale silt loam, 12 to 20 percent slopes, severely eroded.			
GaE	Gale silt loam, 20 to 30 percent slopes.			
GaE2	Gale silt loam, 20 to 30 percent slopes, moderately eroded.			
GaE3	Gale silt loam, 20 to 30 percent slopes, severely eroded.			
GaF	Gale silt loam, 30 to 40 percent slopes.			
GoA	Gotham loamy fine sand, 0 to 2 percent slopes.	Excessively drained, sandy soils on nearly level to sloping stream benches; underlain by loose sand at a depth of more than 2 feet.	10–100	Sandstone
GoB	Gotham loamy fine sand, 2 to 6 percent slopes.			
GoB2	Gotham loamy fine sand, 2 to 6 percent slopes, moderately eroded.			
GoC	Gotham loamy fine sand, 6 to 12 percent slopes.			
GoC2	Gotham loamy fine sand, 6 to 12 percent slopes, moderately eroded.			
HfB2	Hixton fine sandy loam, 2 to 6 percent slopes, moderately eroded.	Well-drained soils of sloping to steep valleys; underlain by loose sand or sandstone bedrock at a depth of more than 2 feet.	2–4	Sandstone
HfC	Hixton fine sandy loam, 6 to 12 percent slopes.			
HfC2	Hixton fine sandy loam, 6 to 12 percent slopes, moderately eroded.			
HfD	Hixton fine sandy loam, 12 to 20 percent slopes.			
HfD2	Hixton fine sandy loam, 12 to 20 percent slopes, moderately eroded.			
HfE	Hixton fine sandy loam, 20 to 30 percent slopes.			
HfE2	Hixton fine sandy loam, 20 to 30 percent slopes, moderately eroded.			
HfE3	Hixton fine sandy loam, 20 to 30 percent slopes, severely eroded.			
HfF	Hixton fine sandy loam, 30 to 45 percent slopes.			
HfF2	Hixton fine sandy loam, 30 to 45 percent slopes, moderately eroded.			
HfF3	Hixton fine sandy loam, 30 to 45 percent slopes, severely eroded.			
HmA	Hubbard loamy fine sand, 0 to 3 percent slopes.	Excessively drained, sandy soil on nearly level to sloping stream benches; underlain by loose sand at a depth of more than 2 feet.	10–100	Sandstone
Hv	Huntsville silt loam.	Moderately well drained to well drained, silty soil on the nearly level flood plains of streams. More than 40 inches thick.	10–100	Sandstone

See footnotes at end of table.

properties significant to engineering—Continued

Depth to water table [1]	Moisture-supplying capacity [2]	Horizon [3]	Depth from surface	Classification: AASHO	Classification: Unified	Percolation rate [4]	Wet consistence
Feet			*Inches*			*Inches per hour*	
100+	Low to moderate	A B C	0–7 7–30 30+	A–6 A–6 A–7	CL CL MH–CH	0. 8–2. 5 0. 2–0. 8 . 05–0. 2	Plastic. Plastic. Very plastic.
1–3	High	A B C	0–12 12–36 36+	A–4 A–6, A–7 A–6	ML–CL CL–CH CL	2. 5–5. 0 0. 8–2. 5 0. 2–0. 8	Slightly plastic. Plastic. Plastic.
100+	Moderate	A B C	0–12 12–36 36+	A–4 A–6 A–3	ML–CL CL SP	0. 8–2. 5 0. 8–2. 5 0. 8–2. 5	Slightly plastic. Plastic. Nonplastic.
5–100	Low	A B C	0–10 10–30 30+	A–2 A–2 A–3	SM SM–SP SP	5. 0–10 5. 0–10 5. 0–10	Nonplastic. Nonplastic. Nonplastic.
100+	Low to moderate	A B C	0–10 10–30 30+	A–2 A–2 A–3	SM SP–SM SP	0. 8–2. 5 0. 8–2. 5 5. 0–10	Nonplastic. Nonplastic. Nonplastic.
10–100	Low	A B C	0–20 20–30 30+	A–2 A–3 A–3	SM SP–SM SP	5. 0–10 5. 0–10 5. 0–10	Nonplastic. Nonplastic. Nonplastic.
4–10	High	A C	0–24 24+	A–4 A–4	ML ML–CL	0. 8–2. 5 0. 8–2. 5	Slightly plastic. Slightly plastic.

TABLE 3.—*Brief description of the soils and estimated*

Map symbol	Soil	Brief description of soil and site	Depth to bedrock	Kind of bedrock
			Feet	
JaA JaB JaB2 JaC JaC2 JaC3	Jackson silt loam, 0 to 2 percent slopes. Jackson silt loam, 2 to 6 percent slopes. Jackson silt loam, 2 to 6 percent slopes, moderately eroded. Jackson silt loam, 6 to 12 percent slopes. Jackson silt loam, 6 to 12 percent slopes, moderately eroded. Jackson silt loam, 6 to 12 percent slopes, severely eroded.	Moderately well drained soils on nearly level to sloping stream benches; the surface layer is silt loam, the subsoil is silty clay loam, and the underlying material is silty to a depth of 40 inches or more.	10–100	Sandstone
JuA JuB JuC	Judson silt loam, 0 to 2 percent slopes. Judson silt loam, 2 to 6 percent slopes. Judson silt loam, 6 to 12 percent slopes.	Moderately well drained to well drained, silty soils on nearly level to sloping alluvial fans and on the bottoms of narrow valleys. More than 40 inches thick.	4–10	Sandstone
LsC LsC2 LsD LsD2 LsE LsE2	Lindstrom silt loam, 6 to 12 percent slopes. Lindstrom silt loam, 6 to 12 percent slopes, moderately eroded. Lindstrom silt loam, 12 to 20 percent slopes. Lindstrom silt loam, 12 to 20 percent slopes, moderately eroded. Lindstrom silt loam, 20 to 30 percent slopes. Lindstrom silt loam, 20 to 30 percent slopes, moderately eroded.	Well-drained, sloping to steep soils of valleys; the surface layer is silt loam, the subsoil is light silty clay loam, and the substratum is silty. More than 40 inches thick.	4–10	Sandstone or dolomite.
Lv	Loamy alluvial land.	Moderately well drained to somewhat poorly drained, mixed sandy and silty material on the nearly level flood plains of streams. More than 40 inches thick.	10–100	Sandstone
Lw	Loamy alluvial land, wet.	Mixed sandy and silty material on the nearly level flood plains of streams; has a high water table. More than 40 inches thick.	10–100	Sandstone
Lx	Loamy wet terrace land.	Somewhat poorly drained to poorly drained soil material on nearly level stream benches; underlain at a depth between 2 and 3 feet by loose sand that contains strata of loamy and clayey materials.	10–100	Sandstone
Ly	Loamy very wet terrace land.	Poorly drained to very poorly drained soil material on nearly level stream benches; underlain at a depth between 2 and 3 feet by loose sand that contains strata of loamy and clayey materials.	10–100	Sandstone
MdA MdB	Medary silt loam, 0 to 2 percent slopes.[5] Medary silt loam, 2 to 6 percent slopes.[5]	Moderately well drained to well drained soils on sloping stream benches; the surface layer is silt loam, the subsoil is silty clay loam, and the substratum is clayey.	10–100	Sandstone
MeA MeB MeB2 MeC MeC2 MeC3 MeD2	Meridian fine sandy loam, 0 to 2 percent slopes. Meridian fine sandy loam, 2 to 6 percent slopes. Meridian fine sandy loam, 2 to 6 percent slopes, moderately eroded. Meridian fine sandy loam, 6 to 12 percent slopes. Meridian fine sandy loam, 6 to 12 percent slopes, moderately eroded. Meridian fine sandy loam, 6 to 12 percent slopes, severely eroded. Meridian fine sandy loam, 12 to 20 percent slopes, moderately eroded.	Well-drained soils on nearly level to sloping stream benches; underlain by loose sand at a depth of more than 2 feet.	10–100	Sandstone
Mo	Morocco loamy fine sand.	Somewhat poorly drained soil on nearly level stream benches; the substratum is loose and sandy.	10–100	Sandstone

See footnotes at end of table.

properties significant to engineering—Continued

Depth to water table [1]	Moisture-supplying capacity [2]	Horizon [3]	Depth from surface	Classification		Percolation rate [4]	Wet consistence
				AASHO	Unified		
Feet			*Inches*			*Inches per hour*	
5–100	Moderate to high	A	0–12	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
		B	12–36	A–7	CL	0. 2–0. 8	Plastic.
		C	36+	A–4	CL	0. 2–0. 8	Slightly plastic.
4–100	Moderate to high	A	0–24	A–4	ML	0. 8–2. 5	Slightly plastic.
		C	24+	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
10–100+	Moderate	A	0–12	A–4	ML	0. 8–2. 5	Slightly plastic.
		B	12–40	A–6	ML–CL	0. 8–2. 5	Plastic.
		C	40+	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
3–10	High	A	0–10	A–4	ML	0. 8–2. 5	Slightly plastic.
		C	10+	A–4	ML	0. 8–2. 5	Slightly plastic.
1–3	High	A	0–10	A–4	ML	0. 8–2. 5	Slightly plastic.
		C	10+	A–4	ML	0. 8–2. 5	Slightly plastic.
2–5	Moderate to high	A	0–24	A–2	SM	0. 8–2. 5	Nonplastic.
		C	24+	A–6	SM–SC	0. 2–0. 8	Plastic.
1–3	Moderate to high	A	0–24	A–2	SM	0. 8–2. 5	Nonplastic.
		C	24+	A–6	SM–SC	0. 2–0. 8	Plastic.
10–100	Moderate	A	0–10	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
		B	10–30	A–6, A–7	CL–CH	0. 2–0. 8	Plastic to very plastic.
		C	30+	A–7	CH	. 05–0. 2	Very plastic.
10–100	Low to moderate	A	0–10	A–2	SM	0. 8–2. 5	Nonplastic.
		B	10–30	A–2	SM	0. 8–2. 5	Nonplastic.
		C	30+	A–3	SP	5. 0–10	Nonplastic.
4–10	Moderate	A	0–8	A–2	SM	5. 0–10	Nonplastic.
		C	8+	A–3	SP	10+	Nonplastic.

TABLE 3.—*Brief description of the soils and estimated*

Map symbol	Soil	Brief description of soil and site	Depth to bedrock	Kind of bedrock
			Feet	
NfB2	Norden fine sandy loam, 2 to 6 percent slopes, moderately eroded.	Well-drained soils on the sloping to steep sides of valleys; underlain by fine-grained sandstone at a depth of more than 2 feet.	2–4	Sandstone____
NfC	Norden fine sandy loam, 6 to 12 percent slopes.			
NfC2	Norden fine sandy loam, 6 to 12 percent slopes, moderately eroded.			
NfC3	Norden fine sandy loam, 6 to 12 percent slopes, severely eroded.			
NfD	Norden fine sandy loam, 12 to 20 percent slopes.			
NfD2	Norden fine sandy loam, 12 to 20 percent slopes, moderately eroded.			
NfD3	Norden fine sandy loam, 12 to 20 percent slopes, severely eroded.			
NfE	Norden fine sandy loam, 20 to 30 percent slopes.			
NfE2	Norden fine sandy loam, 20 to 30 percent slopes, moderately eroded.			
NgB2	Norden fine sandy loam, dark surface variant, 2 to 6 percent slopes, moderately eroded.	Well-drained soils on the sloping to steep sides of valleys; underlain by fine-grained sandstone at a depth of more than 2 feet.	2–4	Sandstone____
NgC2	Norden fine sandy loam, dark surface variant, 6 to 12 percent slopes, moderately eroded.			
NoD2	Norden loam, 12 to 20 percent slopes, moderately eroded.[6]	Well-drained soils on the sloping to steep sides of valleys; the surface layer is loam, the subsoil is heavy loam, and the substratum is fine-grained sandstone; the substratum is at a depth of more than 2 feet.	2–4	Sandstone____
NoE	Norden loam, 20 to 30 percent slopes.[5]			
NoE2	Norden loam, 20 to 30 percent slopes, moderately eroded.[6]			
NrB	Norden silt loam, 2 to 6 percent slopes.	Well-drained soils on the sloping to steep sides of valleys; the surface layer is silt loam, the subsoil is silty clay, and the substratum is fine-grained sandstone; the substratum is at a depth of more than 2 feet.	2–4	Sandstone____
NrB2	Norden silt loam, 2 to 6 percent slopes, moderately eroded.			
NrC	Norden silt loam, 6 to 12 percent slopes.			
NrC2	Norden silt loam, 6 to 12 percent slopes, moderately eroded.			
NrC3	Norden silt loam, 6 to 12 percent slopes, severely eroded.			
NrD	Norden silt loam, 12 to 20 percent slopes.			
NrD2	Norden silt loam, 12 to 20 percent slopes, moderately eroded.			
NrD3	Norden silt loam, 12 to 20 percent slopes, severely eroded.			
NrE	Norden silt loam, 20 to 30 percent slopes.			
NrE2	Norden silt loam, 20 to 30 percent slopes, moderately eroded.			
NrE3	Norden silt loam, 20 to 30 percent slopes, severely eroded.			
NsF	Norden silt loam and loam, 30 to 40 percent slopes.			
NsF2	Norden silt loam and loam, 30 to 40 percent slopes, moderately eroded.			
NvB	Northfield very fine sandy loam, 2 to 6 percent slopes.	Well-drained soils on sloping to steep ridges in the uplands; the surface layer is sandy loam; the subsoil is loam and is underlain by hard sandstone bedrock at a depth of less than 2 feet.	1–2	Sandstone____
NvB2	Northfield very fine sandy loam, 2 to 6 percent slopes, moderately eroded.			
	Orion silt loam.	Somewhat poorly drained, silty soil on the nearly level flood plains of streams. More than 40 inches thick.	10–100	Sandstone____
OsB	Otterholt silt loam, loamy substratum, 2 to 6 percent slopes.	Well-drained soils on sloping ridges in the uplands; the surface layer and subsoil are silt loam and the substratum is clay loam.	4–10	Sandstone or dolomite.
OsB2	Otterholt silt loam, loamy substratum, 2 to 6 percent slopes, moderately eroded.			
OsC2	Otterholt silt loam, loamy substatum, 6 to 12 percent slopes, moderately eroded.			

See footnotes at end of table.

properties significant to engineering—Continued

Depth to water table [1]	Moisture-supplying capacity [2]	Horizon [3]	Depth from surface	Classification		Percolation rate [4]	Wet consistence
				AASHO	Unified		
Feet			*Inches*			*Inches per hour*	
100+	Moderate	A	0–10	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
		B	10–36	A–6	CL	0. 8–2. 5	Plastic.
		C	36+	A–6	ML	<0. 8	Plastic.
100+	Moderate	A	0–10	A–2	ML	0. 8–2. 5	Slightly plastic.
		B	10–30	A–2	ML–CL	0. 8–2. 5	Slightly plastic.
		C	30+	A–2	SM	<0. 8	Slightly plastic.
100+	Moderate	A	0–10	A–4	SC	2. 5–5. 0	Slightly plastic.
		B	10–36	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
		C	36+	A–2	SM	5. 0–10	Slightly plastic.
100+	Moderate	A	0–10	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
		B	10–36	A–6, A–7	CL	0. 8–2. 5	Plastic.
		C	36+	A–2	SM	5. 0–10	Slightly plastic.
100+	Low	A	0–10	A–2	SM	0. 8–2. 5	Slightly plastic.
		B	10–20	A–4	SM-SC	0. 8–2. 5	Slightly plastic.
		C	20+	A–3	SP	5. 0–10	Nonplastic.
3–10	High	A	0–10	A–4	ML	0. 8–2. 5	Slightly plastic.
		C	10+	A–4	ML–CL	0. 8–2. 5	Slightly plastic.
100+	Moderate	A	0–10	A–4	ML	0. 8–2. 5	Slightly plastic.
		B	10–40	A–6	ML–CL	0. 8–2. 5	Plastic.
		C	40+	A–7	CL	0. 8–2. 5	Plastic.

TABLE 3.—*Brief description of the soils and estimated*

Map symbol	Soil	Brief description of soil and site	Depth to bedrock	Kind of bedrock
			Feet	
Pa	Peat and muck, deep.	Partly decayed organic material in depressions on the flood plains of streams; high water table. More than 40 inches thick.	10–100	Sandstone____
Pb	Peat and muck, shallow.	Partly decayed organic material in depressions on the flood plains of streams; high water table; 18 to 40 inches thick.	10–100	Sandstone____
PfA PfB PfB2 PfC PfC2 PfD PfD2	Plainfield loamy fine sand, 0 to 2 percent slopes. Plainfield loamy fine sand, 2 to 6 percent slopes. Plainfield loamy fine sand, 2 to 6 percent slopes, eroded. Plainfield loamy fine sand, 6 to 12 percent slopes. Plainfield loamy fine sand, 6 to 12 percent slopes, eroded. Plainfield loamy fine sand, 12 to 20 percent slopes. Plainfield loamy fine sand, 12 to 20 percent slopes, eroded.	Excessively drained, sandy soils on nearly level to sloping stream benches; the subsoil and substratum are loose and sandy.	10–100	Sandstone____
PmA	Plainfield loamy fine sand, mottled subsoil variant, 0 to 2 percent slopes.	Moderately well drained, sandy soil on nearly level to gently sloping stream benches; the substratum is loose and sandy.	10–100	Sandstone____
RcA RcB	Richwood silt loam, 0 to 2 percent slopes. Richwood silt loam, 2 to 6 percent slopes.	Well-drained soils on nearly level to sloping stream benches; the surface layer is silt loam, and the subsoil is silty clay loam; underlain by silty material at a depth of 40 inches.	10–100	Sandstone____
Re	Riverwash.	Excessively drained, mixed sandy and silty material on the nearly level flood plains of streams.	10–100	Sandstone____
Ro	Rowley silt loam.	Somewhat poorly drained soil on nearly level stream benches; the surface layer is silt loam, and the subsoil is silty clay loam; underlain by silty material at a depth of 40 inches.	10–100	Sandstone____
Sa	Sandy alluvial land.	Excessively drained, sandy material on the nearly level flood plains of streams. More than 40 inches thick.	10–100	Sandstone____
SeB SeB2 SeC SeC2 SeC3 SeD SeD2 SeD3 SeE SeE2 SeE3	Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes. Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes, moderately eroded. Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes. Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, moderately eroded. Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, severely eroded. Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes. Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, moderately eroded. Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, severely eroded. Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes. Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, moderately eroded. Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, severely eroded.	Well-drained soils, more than 40 inches thick, on sloping to steep ridges in the uplands; the surface layer is silt loam; the Seaton soils have a subsoil of silt loam to heavy silt loam and a substratum of coarse silt; the Fayette soils have a subsoil of silty clay loam and a substratum of silt.	4–10	Seaton, sandstone or dolomite; Fayette, dolomite.

See footnotes at end of table.

properties significant to engineering—Continued

Depth to water table [1]	Moisture-supplying capacity [2]	Horizon [3]	Depth from surface	Classification		Percolation rate [4]	Wet consistence
				AASHO	Unified		
Feet			*Inches*			*Inches per hour*	
0–1	High	A	0–8	(6)	Pt	0. 5+	Nonplastic.
		C	8+	(6)	Pt	2. 5–5. 0	Nonplastic.
0–1	High	A	0–18	(6)	Pt	0. 5+	Nonplastic.
		C	18+	(6)	SP	10+	Nonplastic.
10–100	Low	A	0–8	A–2	SM	5. 0–10	Nonplastic.
		C	8+	A–3	SP	10+	Nonplastic.
5–20	Low	A	0–8	A–2	SM	5. 0–10	Nonplastic.
		C	8+	A–3	SP	10+	Nonplastic.
5–100	Moderate	A	0–12	A–7	ML	0. 8–2. 5	Slightly plastic.
		B	12–40	A–7	ML–CL	0. 8–2. 5	Plastic.
		C	40+	A–7	ML–CL	0. 8–2. 5	Plastic.
3–10	Very low	C	0–40+	A–1 to A–2	GP, GM	10+	Nonplastic.
3–100	High	A	0–12	A–7	ML	0. 8–2. 5	Slightly plastic.
		B	12–36	A–7	ML–CL	0. 2–0. 8	Plastic.
		C	36+	A–7	ML–CL	0. 2–0. 8	Plastic.
4–10	Low	A	0–5	A–2	SM	2. 5–5. 0	Nonplastic.
		C	5+	A–3	SP	10+	Nonplastic.
100+	Moderate	A	0–12	A–4	Seaton, ML; Fayette, CL.	0. 8–2. 5	Slightly plastic.
		B	12–40	Seaton, A–4; Fayette, A–6.	CL	0. 8–2. 5	Seaton, slightly plastic; Fayette, plastic.
		C	40+	Seaton, A–4; Fayette, A–6.	CL	0. 8–2. 5	Seaton, slightly plastic; Fayette, plastic.

TABLE 3.—*Brief description of the soils and estimated*

Map symbol	Soil	Brief description of soil and site	Depth to bedrock	Kind of bedrock
			Feet	
SfB	Seaton and Fayette silt loams, valleys, 2 to 6 percent slopes.	Well-drained soils, more than 40 inches thick, in sloping to steep valleys; the surface layer is silt loam; the Seaton soils have a subsoil of silt loam to heavy silt loam and a substratum of coarse silt; the Fayette soils have a subsoil of light silty clay loam and a substratum of silt.	4–10	Sandstone or dolomite.
SfC	Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes.			
SfC2	Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes, moderately eroded.			
SfD	Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes.			
SfD2	Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, moderately eroded.			
SfD3	Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, severely eroded.			
SfE	Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes.			
SfE2	Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, moderately eroded.			
SfE3	Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, severely eroded.			
Sh	Sparta fine sand and Dune land.	Excessively drained, sandy soils on nearly level to sloping stream benches; underlain by loose, sandy material.	10–100	Sandstone----
SpA SpB SpB2 SpC SpC2 SpD2	Sparta loamy fine sand, 0 to 2 percent slopes. Sparta loamy fine sand, 2 to 6 percent slopes. Sparta loamy fine sand, 2 to 6 percent slopes, eroded. Sparta loamy fine sand, 6 to 12 percent slopes. Sparta loamy fine sand, 6 to 12 percent slopes, eroded. Sparta loamy fine sand, 12 to 20 percent slopes, eroded.	Excessively drained, sandy soils on nearly level to sloping stream benches; underlain by loose, sandy material.	10–100	Sandstone----
St	Steep stony and rocky land.	Well-drained, mixed sandy and silty material on steep valley slopes; many scattered rocks and outcrops of bedrock.	(6)	Sandstone or dolomite.
Tm	Terrace escarpments, loamy.	Well-drained soil material on steep stream benches; generally underlain by loose sand at a depth of more than 2 feet.	10–100	Sandstone----
Tn	Terrace escarpments, sandy.	Excessively drained, sandy material on steep stream benches; generally underlain by loose sand at a depth between 1 and 2 feet.	10–100	Sandstone----
ToA	Toddville silt loam, 0 to 2 percent slopes.	Moderately well drained soils on nearly level to sloping stream benches; the surface layer is silty, the subsoil is silty clay loam, and the substratum is silty to a depth of 40 inches or more.	10–100	Sandstone----
ToB	Toddville silt loam, 2 to 6 percent slopes.			
UfF UfF2	Urne fine sandy loam, 30 to 45 percent slopes. Urne fine sandy loam, 30 to 45 percent slopes, moderately eroded.	Well-drained fine sandy loams on the sloping to steep sides of valleys; underlain by fine-grained sandstone.	1–3	Sandstone----
UfF3	Urne fine sandy loam, 30 to 45 percent slopes, severely eroded.			
UnB2	Urne and Norden fine sandy loams, 2 to 6 percent slopes, moderately eroded.	See descriptions of Norden fine sandy loam and Urne fine sandy loam.		
UnC2	Urne and Norden fine sandy loams, 6 to 12 percent slopes, moderately eroded.			
UnC3	Urne and Norden fine sandy loams, 6 to 12 percent slopes, severely eroded.			
UnD	Urne and Norden fine sandy loams, 12 to 20 percent slopes.			
UnD2	Urne and Norden fine sandy loams, 12 to 20 percent slopes, moderately eroded.			
UnD3	Urne and Norden fine sandy loams, 12 to 20 percent slopes, severely eroded.			

See footnotes at end of table.

properties significant to engineering—Continued

Depth to water table [1]	Moisture-supplying capacity [2]	Horizon [3]	Depth from surface	Classification		Percolation rate [4]	Wet consistence
				AASHO	Unified		
Feet			*Inches*			*Inches per hour*	
Seaton, 100+; Fayette, 10 to 100+.	Moderate	A	0–12	Seaton, A–4; Fayette, A–6.	ML	0. 8–2. 5	Seaton, slightly plastic; Fayette, plastic.
		B	12–40	A–6	CL	0. 8–2. 5	Seaton, plastic; Fayette, plastic.
		C	40+	A–6	Seaton, CL; Fayette, ML–CL.	0. 8–2. 5	Seaton, plastic; Fayette, plastic.
10–100	Very low	A	0–10	A–3	SP	5. 0–10	Nonplastic.
		C	40+	A–3	SP	10+	Nonplastic.
10–100	Low	A	0–18	A–2	SM	5. 0–10	Nonplastic.
		C	18+	A–3	SP	10+	Nonplastic.
100+	(6)	(6)	(6)	(6)	(6)	(6)	(6).
10–100	Moderate	(6)	(6)	(6)	(6)	(6)	(6)
10–100	Low	(6)	(6)	(6)	(6)	(6)	Nonplastic.
1–3	Moderate to high	A	0–12	A–7	ML–CL	0. 8–2. 5	Slightly plastic.
		B	12–40	A–7	CL	0. 2–0. 8	Plastic.
		C	40+	A–7	CL	0. 8–2. 5	Plastic.
100+	Moderate	A	0–10	A–2	SM	2. 5–5. 0	Slightly plastic.
		C	10+	A–2	SM	0. 8–2. 5	Slightly plastic.

TABLE 3.—*Brief description of the soils and estimated*

Map symbol	Soil	Brief description of soil and site	Depth to bedrock	Kind of bedrock
			Feet	
UnE	Urne and Norden fine sandy loams, 20 to 30 percent slopes.			
UnE2	Urne and Norden fine sandy loams, 20 to 30 percent slopes, moderately eroded.			
UnE3	Urne and Norden fine sandy loams, 20 to 30 percent slopes, severely eroded.			
Wa	Wallkill silt loam.	Poorly drained, silty soil, 1 to 3 feet thick, on the nearly level flood plains of streams; underlain by organic material; high water table.	10–100	Sandstone----
Wf	Watseka loamy fine sand.	Moderately well drained, sandy soil on nearly level stream benches; underlain by loose sand at a depth of more than 1 foot.	10–100	Sandstone----
WkA WkB WkB2 WkC2	Waukegan silt loam, 0 to 2 percent slopes. Waukegan silt loam, 2 to 6 percent slopes. Waukegan silt loam, 2 to 6 percent slopes, moderately eroded. Waukegan silt loam, 6 to 12 percent slopes, moderately eroded.	Well-drained soils on nearly level to sloping stream benches; the surface layer is silty, and the subsoil is silty clay loam; underlain by loose sand at a depth of more than 2 feet.	10–100	Sandstone----
Zg	Zwingle silt loam. [5]	Somewhat poorly drained soil on nearly level stream benches; the surface layer is silt loam, the subsoil is silty clay loam, and the substratum is clayey.	10–100	Sandstone----
Zw	Zwingle silt loam, poorly drained variant.	Poorly drained soil on nearly level stream benches; the surface layer is silt loam, the subsoil is silty clay loam, and the substratum is clayey.	10–100	Sandstone----

[1] Refers to seasonal and fairly stable high water tables; in some soils depth to the water table is fairly constant throughout the year, but in others it varies according to seasonal precipitation.

[2] Refers to the ability of the soils to hold and release moisture for the growth of plants. It is the water available for plants, in excess of the wilting coefficient held in a soil against the force of gravity.

[3] A refers to the surface layer, or plow layer; B refers to the subsoil; C refers to the parent material, or the underlying material.

properties significant to engineering—Continued

Depth to water table [1]	Moisture-supplying capacity [2]	Horizon [3]	Depth from surface	Classification		Percolation rate [4]	Wet consistence
				AASHO	Unified		
Feet			*Inches*			*Inches per hour*	
3–10	Moderate to high	A	0–30	A-4	ML	0.8–2.5	Slightly plastic.
		C	30+	(6)	Pt	0.8–2.5	Nonplastic.
4–20	Low	A	0–12	A-2	SM	5.0–10	Nonplastic.
		C	12+	A-3	SP	10+	Nonplastic.
10–100	Moderate	A	0–12	A-7	ML	0.8–2.5	Slightly plastic.
		B	12–36	A-7	CL	0.8–2.5	Plastic.
		C	36+	A-3	SP	10+	Nonplastic.
5–100	High	A	0–10	A-4	ML–CL	0.8–2.5	Slightly plastic.
		B	10–30	A-6	CL	0.8–2.5	Plastic.
		C	30+	A-7	CH, CL	0.2–0.8	Very plastic.
5–100	High	A	0–10	A-7	ML	0.8–2.5	Plastic.
		B	10–36	A-7	CL	0.8–2.5	Plastic.
		C	36+	A-7	CH	0.05–0.2	Very plastic.

[4] The rate given for the surface layer is that of infiltration into the uneroded surface soil; for eroded soils the rate is about one-third less; for horizons beneath the surface layer, the rate in inches per hour expresses the permeability of the horizon.

[5] To include test data shown in table 5.

[6] Does not apply or is variable.

Engineering interpretations

In table 4 the soils of the county are rated according to their suitability for engineering construction. The ratings given include a rating for susceptibility to frost heaving and erosion; for suitability of the soil material as a source of topsoil and of sand, gravel, and stone; and for suitability for subgrade material for pavements and for use in various kinds of construction; and for suitability for use for private sewage disposal systems, pond sites, terraces, diversions, and irrigation. The kind of drainage or the need for drainage also is shown.

TABLE 4.—*Suitability and characteristics of the soils*

Soil series, miscellaneous land types, and soil symbols	Susceptibility to—		Suitability as a source of—		
	Frost heaving [1]	Erosion [2]	Topsoil [2]	Sand, gravel, and stone [3]	Subgrade material for pavements [1]
Almena (AmB2)	Moderate to very high.	Slight to moderate.	Good	Not suitable	Subsoil poor, large volume change; substratum good, small volume change and good stability.
Arenzville (Ar)	Moderate to very high.	Slight	Good	Not suitable	Poor; unstable at all moisture contents and has low bearing capacity when wet.
Bertrand (BeA, BeB, BeB2, BeC, BeC2, BeC3, BeD2, BeD3).	Moderate to very high.	Slight to moderate.	Good	Questionable below a depth of 3½ to 4 feet.	Subsoil poor and has high volume change; elastic; substratum poor; unstable at all moisture contents.
Boone (BnB, BnB2, BnC, BnC2, BnD2, BsD3, BsF).	Slight to none	Severe	Not suitable	Suitable for sand.	Excellent to good for all types of pavement when confined.
Burkhardt (BuA, BuB, BuB2, BuC3).	Slight to high in the B horizon, and slight to none in the C horizon.	Slight to moderate.	Fair	Suitable for sand.	Subsoil fair, stable when dry; substratum excellent, highly stable at all moisture contents.
Chaseburg (CaA, CaB)	Moderate to very high.	Moderate	Good	Not suitable	Poor; relatively unstable at all moisture contents; low stability and low bearing capacity when wet.
Curran (Cu)	Moderate to high	Slight to moderate.	Good	Questionable below a depth of 3½ to 4 feet.	Subsoil poor, has high volume change and is elastic; substratum poor because it is generally unstable at all moisture contents.
Dakota (DaA, DaB, DaB2, DbA, DbB, DbB2, DbC2).	Slight to high in the B horizon of the fine sandy loams, and moderate to high in the B horizon of the loams; slight to none in the C horizon of all the soils.	Slight to moderate.	Fair to good for the fine sandy loams; good for the loams.	Suitable for sand.	Subsoil good, small volume change and good stability; substratum good; has no volume change and is suitable for all types of pavement when confined.
Dillon (Dc)	Slight to moderate	Slight	Fair to good	Suitable for sand.	Substratum good, has no volume change and is suitable for all types of pavement when confined.

See footnotes at end of table.

Specific features or characteristics of soils that may affect the selection, design, or application of treatment measures, and suitability ratings for specific purposes are considered in table 4. For example, soils that erode easily or that are poorly drained present special problems in engineering. Therefore, in determining the suitability of the soils for highways, the kind of material and drainage must be considered carefully. Also to be considered are the depth to bedrock and the kind of bedrock, which determine the ease or difficulty of construction work.

of Pepin County, Wis., for engineering construction

Suitability of the soil material for—					Kind of drainage or need for [9]	Remarks
Foundations for low buildings [4]	Private sewage disposal systems [5]	Pond sites [6]	Terraces and diversions [7]	Irrigation [8]		
Good; high bearing value, low compressibility, and moderately high shear strength.	Questionable; fluctuating water table and variable bulk density.	Suitable; semipervious substratum has high stability and small volume change.	Suitable	Good	Not needed	Somewhat poorly drained.
Fair; subject to frost heaving and loss of strength on thawing.	Questionable; overflow may flood filter field.	Fair; bottom of reservoir should be compacted.	Suitable	Very good	Not needed	Subject to overflow.
Fair; subject to frost heaving and liquefaction, but has fair shear strength.	Suitable; care is needed to prevent infiltration of silt into drain fields.	Fair; seal blanket required over sandy substratum.	Suitable	Very good	Not needed	Subject to overflow.
Good; sand has good shear strength and no volume change when wet.	Suitable; rapidly permeable.	Not suitable; very pervious and too porous to hold water.	Not suitable	Not suitable	Not needed	Very droughty.
Good; has good shear strength, negligible compressibility, and no volume change.	Suitable; free draining at a depth of more than 20 inches.	Not suitable; very pervious.	Not suitable	Good	Not needed	Droughty.
Fair; in places liquefies easily if saturated; subject to frost heaving and loss of bearing strength on thawing.	Questionable; overflow may flood filter field.	Fair; bottom should be scarified and compacted.	Suitable	Very good	Not needed	Subject to overflow.
Fair; subject to frost heaving and loss of bearing strength, but has fair shear strength.	Questionable; fluctuating water table.	Good; semipervious; seal blanket needed over sandy substratum.	Suitable	Good	Subsurface	Somewhat poorly drained.
Good; has low compressibility, no volume change, and good shear strength.	Suitable; free flowing at a depth below 3 feet.	Poor; very pervious; needs seal blanket.	Suitable	Fair to good for the fine sandy loams; good for the loams.	Not needed	The fine sandy loams are droughty.
Good; low compressibility, no volume change, good shear strength, and high water table.	Not suitable; high water table.	Suitable for dug ponds; very pervious.	Not suitable	Fair	Open ditch	High water table.

TABLE 4.—*Suitability and characteristics of the soils of*

Soil series, miscellaneous land types, and soil symbols	Susceptibility to—		Suitability as a source of—		
	Frost heaving [1]	Erosion [2]	Topsoil [2]	Sand, gravel, and stone [3]	Subgrade material for pavements [1]
Downs (DdB, DdB2, DdC2, DeB2, DeC2, DeD, DeD2, DeD3, DeE2).	Moderate to very high.	Moderate to severe.	Good	Not suitable	Poor; large volume change and loss of bearing capacity when wet.
Dubuque (DfB2, DfC, DfC2, DfD, DfD2, DfE, DfE2, DfF, DpB, DpB2, DpC, DpC2, DpD, DpD2, DpE, DpE2, DsC3, DtD3, DtE2).	Moderate to very high.	Moderate to severe in the silt loams and deep silt loams, but severe in the mapping unit named Dubuque soils.	Good, but fair in the mapping unit named Dubuque soils.	Not suitable	Subsoil poor, has high volume change and is highly plastic; substratum excellent (limestone bedrock).
Ettrick (Ec)	Moderate to very high	Slight	Good	Not suitable	Poor; high volume change, highly plastic, and elastic when wet.
Fayette (mapped only with Seaton).	Moderate to high for upland soils; moderate to high for the B horizon and moderate to very high for the C horizon of the valley soils.	Moderate to severe.	Good	Not suitable	Subsoil poor, large volume change and loss in bearing capacity when wet; substratum poor, moderate volume change.
Gale (GaC, GaC2, GaD, GaD2, GaD3, GaE, GaE2, GaE3, GaF).	Moderate to high in the B horizon, and slight to none in the C horizon.	Moderate to severe.	Good	Suitable for sand.	Subsoil poor, high volume change and low bearing capacity when wet; substratum good, no volume change but needs to be confined in places.
Gotham (GoA, GoB, GoB2, GoC, GoC2).	Slight to high in the B horizon, and slight to none in the C horizon.	Severe	Poor	Suitable for sand.	Good; small volume change and good stability, but needs to be confined in places.
Hixton (HfB2, HfC, HfC2, HfD, HfD2, HfE, HfE2, HfE3, HfF, HfF2 HfF3).	Slight to high in the B horizon, and slight to none in the C horizon.	Moderate to severe.	Fair to good	Suitable for sand.	Subsoil fair, small volume change; substratum good, highly stable under wheel loads regardless of moisture content.
Hubbard (HmA)	Slight to high in the B horizon, but slight to none in the C horizon.	Severe	Not suitable	Suitable for sand.	Good, small volume change and good stability.
Huntsville (Hv)	Moderate to very high.	Slight	Good	Not suitable	Poor; relatively unstable at all moisture contents; low bearing capacity when wet.

See footnotes at end of table.

Pepin County, Wis., for engineering construction—Continued

Suitability of the soil material for—					Kind of drainage or need for [9]	Remarks
Foundations for low buildings [4]	Private sewage disposal systems [5]	Pond sites [6]	Terraces and diversions [7]	Irrigation [8]		
Fair; susceptible to frost heaving and loss of strength on thawing.	Suitable; moderately permeable.	Good; pervious; surface should be compacted.	Suitable	Very good	Not needed	
Good if over limestone bedrock; poor if over thick clay residuum; clay has high volume change, poor shear strength, and high compressibility.	Suitable where clay is sufficiently thick to permit egress of effluents.	Fair; pervious; requires a seal blanket over the limestone.	Not suitable on the silt loams, suitable on the deep silt loams, and questionable on the mapping units named Dubuque soils.	Good for the silt loams, and very good for the deep silt loams; for the mapping units named Dubuque soils, see footnote 10.	Not needed	
Poor; high compressibility, fair shear strength, and high water table.	Not suitable; high water table.	Suitable; semipervious; high water table; suitable for dug ponds.	Suitable	Good	Subsurface	Subject to overflow.
Fair to poor; subject to frost heaving and loss of bearing capacity on thawing; has moderate compressibility and shear strength.	Suitable; moderately permeable.	Suitable; pervious; reservoir bottom needs to be compacted in places.	Suitable	Very good	Not needed	
Good; very low compressibility and no volume change.	Suitable; very permeable at a depth below 3 feet.	Fair; pervious; seal blanket needed over sandy substratum.	Suitable	Good	Not needed	
Good; low compressibility and no volume change.	Suitable; free draining throughout.	Not suitable; very pervious; susceptible to piping.	Not suitable	Fair to good	Not needed	Droughty.
Good; small compressibility; no volume change when wet, and good shear strength.	Suitable; free draining at a depth below 3 feet.	Fair; pervious; needs a seal blanket over sandy substratum.	Questionable	Fair to good	Not needed	Droughty.
Good; no volume change when wet, low compressibility, and good shear strength.	Suitable; free draining throughout.	Not suitable; very pervious; requires a seal blanket.	Not suitable	Fair to good	Not needed	Droughty.
Fair to poor; subject to frost heaving and loss of bearing capacity on thawing; fair shear strength and moderate compressibility.	Questionable; overflow from streams may flood filter field.	Fair; pervious; medium volume change; bottom should be compacted.	Suitable	Very good	Not needed	Subject to overflow.

TABLE 4.—*Suitability and characteristics of the soils of*

Soil series, miscellaneous land types, and soil symbols	Susceptibility to—		Suitability as a source of—		
	Frost heaving [1]	Erosion [2]	Topsoil [2]	Sand, gravel, and stone [3]	Subgrade material for pavements [1]
Jackson (JaA, JaB, JaB2, JaC, JaC2, JaC3).	Moderate to high	Slight to moderate.	Good	Not suitable	Subsoil poor, high volume change and low bearing capacity; substratum poor, relatively unstable at all moisture contents.
Judson (JuA, JuB, JuC)	Moderate to very high.	Slight	Good	Not suitable	Poor; relatively unstable at all moisture contents; low bearing capacity when wet.
Lindstrom (LsC, LsC2, LsD, LsD2, LsE, LsE2).	Moderate to very high.	Moderate to severe.	Good	Not suitable	Subsoil poor, large volume change and loss of bearing capacity when wet; substratum poor, large volume change when wet.
Loamy alluvial land (Lv)	Moderate to very high.	Slight	Fair to good	Not suitable	Poor; large volume change and low bearing capacity when wet.
Loamy alluvial land, wet (Lw).	Moderate to very high.	Slight	Fair to good	Not suitable	Poor; large volume change and low bearing capacity when wet; subject to high water table.
Loamy wet terrace land (Lx)	Moderate to high	Slight	Fair to good	Questionable	Poor; large volume change and low bearing capacity when wet.
Loamy very wet terrace land (Ly).	Moderate to high	Slight	Fair to good	Questionable	Poor; large volume change and low bearing capacity when wet; high water table.
Medary (MdA, MdB)	Moderate to high in the B horizon, but moderate in the C horizon.	Slight to moderate.	Good	Not suitable	Poor; highly plastic and subject to high volume change; elastic.
Meridian (MeA, MeB, MeB2, MeC, MeC2, MeC3, MeD2).	Slight to high in the B horizon, but slight to none in the C horizon.	Moderate to severe.	Fair to good	Suitable for sand.	Subsoil fair, small volume change and good stability; substratum good, no volume change; suitable for all types of pavement when confined.
Morocco (Mo)	Slight to none	Slight to moderate.	Not suitable	Suitable for sand.	Good; no volume change; lacks loads when wet; suitable for all types of pavement when wet.

See footnotes at end of table.

Pepin County, Wis., for engineering construction—Continued

Suitability of the soil material for—					Kind of drainage or need for [9]	Remarks
Foundations for low buildings [4]	Private sewage disposal systems [5]	Pond sites [6]	Terraces and diversions [7]	Irrigation [8]		
Fair; subject to frost heaving, has fair shear strength and liquefies in places.	Suitable; may be questionable in wet sites.	Good; semipervious; reservoir bottom needs to be compacted in places.	Suitable	Good	Not needed	
Fair; subject to frost heaving and loss of bearing capacity on thawing; fair shear strength.	Questionable; overflow from streams may flood filter field.	Fair; pervious; reservoir bottom needs to be compacted in places.	Suitable	Very good	Not needed	Subject to overflow.
Fair; subject to frost heaving and loss of bearing capacity on thawing; moderate compressibility.	Suitable; moderately permeable.	Fair; pervious; reservoir bottom should be compacted.	Suitable	Very good	Not needed	
Poor; subject to frost heaving and loss of bearing capacity on thawing.	Questionable, in many places overflow from streams floods filter field.	Fair; pervious; suitable for dug ponds.	Suitable	Fair	Surface	Subject to overflow.
Poor; subject to frost heaving and loss of bearing capacity on thawing.	Not suitable; high water table.	Fair; pervious; very good for dug ponds.	Suitable	Not suitable	Surface	Subject to overflow.
Poor; subject to frost heaving; has low bearing capacity and high volume change.	Questionable; fluctuating water table and variable bulk density.	Fair; pervious; reservoir bottom needs to be compacted in places; good for dug ponds.	Suitable	Not needed	Surface	Moderately high water table.
Poor; subject to frost heaving; has low bearing capacity and high volume change.	Not suitable; high water table.	Fair; pervious; resservoir bottom needs to be compacted in places; good for dug ponds.	Suitable	Not needed	Surface	High water table.
Poor; high compressibility and poor shear strength; expands when wet.	Questionable; slowly permeable; requires investigation at the site.	Good; semipervious; bottom needs to be compacted in places.	Suitable	Good	Not needed	
Good; high shear strength; no volume change when wet; low compressibility.	Suitable; free draining at a depth below 3 feet.	Fair; pervious; reservoir bottom should be scarified and compacted; a seal blanket is needed over the sandy substratum.	Suitable	Fair to good	Not needed	Droughty.
Good; low compressibility; no volume change when wet; high shear strength; in places below the water table the sand tends to flow.	Questionable; fluctuating water table.	Not suitable; very pervious; suitable for dug ponds in places where water table is high.	Not suitable	Fair	Open ditch	Moderately high water table.

TABLE 4.—*Suitability and characteristics of the soils of*

Soil series, miscellaneous land types, and soil symbols	Susceptibility to—		Suitability as a source of—		
	Frost heaving [1]	Erosion [2]	Topsoil [2]	Sand, gravel, and stone [3]	Subgrade material for pavements [1]
Norden (NfB2, NfC, NfC2, NfC3, NfD, NfD2, NfD3, NfE, NfE2, NgB2, NgC2, NoD2, NoE, NoE2, NrB, NrB2, NrC, NrC2, NrC3, NrD, NrD2, NrD3, NrE, NrE2, NrE3, NsF, NsF2).	Moderate to very high, but for the dark surface variant, moderate to very high in the B horizon and slight to high in the C horizon.	Moderate to severe.	Fair to good, but good for the silt loams.	Questionable at a depth below 3 feet.	Subsoil poor, moderate volume change and low bearing capacity when wet; substratum good, sandstone bedrock.
Northfield (NvB, NvB2)	Slight to high in the B horizon, but slight to none in the C horizon.	Moderate to severe.	Fair	Suitable for sandstone.	Subsoil fair, small volume change and moderate stability; subtratum good, sandstone bedrock.
Orion (Or)	Moderate to very high.	Slight	Good	Not suitable	Poor; relatively unstable at all moisture contents; low stability and bearing capacity when wet.
Otterholt (OsB, OsB2, OsC2)	Moderate to very high.	Moderate to severe.	Good	Not suitable	Subsoil poor, relatively unstable at all moisture contents; substratum good, little volume change and good stability.
Peat and muck (Pa, Pb)	Slight in the deep phase, but slight to none in the C horizon of the shallow phase.	Moderate	Fair	Not suitable	Not suitable in the deep phase, but good in the C horizon of the shallow phase.
Plainfield (PfA, PfB, PfB2, PfC, PfC2, PfD, PfD2, PmA).	Slight to none	Severe, but moderate in the mottled subsoil variant.	Not suitable	Suitable for sand.	Good, no volume change; suitable for all types of pavement when confined.
Richwood (RcA, RcB)	Moderate to very high.	Slight to moderate.	Good	Questionable at a depth below 3½ to 4 feet.	Subsoil poor, high volume change and low bearing capacity when wet; substratum poor; relatively unstable at all moisture contents.
Riverwash (Re)	Slight to none	Severe	Not suitable	Suitable for gravel and sand.	Good; no volume change; high bearing capacity.
Rowley (Ro)	Moderate to very high.	Slight	Good	Questionable in places at a depth below 3½ to 4 feet.	Subsoil poor, high volume change and low bearing capacity when wet; substratum poor; relatively unstable at all moisture contents.
Sandy alluvial land (Sa)	Slight to none	Severe	Not suitable	Suitable	Good; small volume change; good stability; high water table.

See footnotes at end of table.

Pepin County, Wis., for engineering construction—Continued

Suitability of the soil material for—					Kind of drainage or need for [9]	Remarks
Foundations for low buildings [4]	Private sewage disposal systems [5]	Pond sites [6]	Terraces and diversions [7]	Irrigation [8]		
Good; sandstone bedrock.	Good; permeable; sandstone at a depth below 3 feet.	Fair; pervious; reservoir bottom needs a seal blanket over the sandstone.	Suitable	Good, but for the silt loams, very good.	Not needed	
Good; sandstone bedrock.	Questionable; indurated sandstone varies in permeability; requires investigation at the site.	Poor; pervious; needs a seal blanket over the sandstone.	Not suitable	Fair	Not needed	Shallow to bedrock.
Fair; liquefies readily in places; very subject to frost heaving and loss of bearing capacity on thawing.	Questionable; subject to stream overflow that floods the filter field in places.	Fair; pervious; reservoir bottom should be compacted; needs a seal blanket over the sandy layers.	Suitable	Not suitable	Surface	Subject to overflow.
Good; has low compressibility and is easy to compact; fair shear strength.	Fair; moderately permeable.	Good; pervious; bottom needs to be compacted in places.	Suitable	Good	Not needed	
Not suitable in the deep phase but fair in the shallow phase.	Not suitable; high water table.	Poor; high water table; suitable for dug ponds.	[10]	Good	Subsurface in the deep, and open ditch in the shallow.	High water table.
Good; low compressibility; no volume change; good shear strength.	Good; free drainage throughout; questionable in the mottled subsoil variant.	Not suitable; very pervious; needs a seal blanket on the reservoir bottom.	Not suitable	Fair	Not needed	Very droughty, but droughty in the mottled subsoil variant
Fair; subject to frost heaving and loss of bearing capacity on thawing.	Suitable; care is needed to prevent infiltration of silt into the filter field.	Fair; pervious; reservoir bottom needs to be compacted in places; needs a seal blanket over the sandy substratum.	Suitable	Very good	Not needed	
Good; low compressibility; no volume change; subject to flooding.	Not suitable; subject to stream overflow; high water table.	Not suitable; very pervious; where water table is high, may be suitable for dug ponds.	Not suitable	Not suitable	Not needed	Very droughty.
Fair; subject to frost heaving and loss of bearing capacity on thawing.	Questionable; subject to fluctuating water table.	Good; pervious; reservoir bottom needs to be compacted in places.	Suitable	Good	Subsurface	
Good; high bearing capacity, low compressibility and low shear strength.	Questionable; in places overflow from streams floods filter field.	Not suitable; very pervious.	Not suitable	Not suitable	Not needed	Subject to overflow; very droughty.

TABLE 4.—*Suitability and characteristics of the soils of*

Soil series, miscellaneous land types, and soil symbols	Susceptibility to—		Suitability as a source of—		
	Frost heaving [1]	Erosion [2]	Topsoil [2]	Sand, gravel, and stone [3]	Subgrade material for pavements [1]
Seaton (SeB, SeB2, SeC, SeC2, SeC3, SeD, SeD2, SeD3, SeE, SeE2, SeE3, SfB, SfC, SfC2, SfD, SfD2, SfD3, SfE, SfE2, SfE3).	Moderate to high in the B horizon; moderate to very high in the C horizon of the valley soils.	Moderate to severe.	Good	Not suitable	Poor; relatively unstable at all moisture contents; low stability and bearing capacity when wet.
Sparta (Sh, SpA, SpB, SpB2, SpC, SpC2, SpD2).	Slight to none	Severe	Not suitable	Suitable for sand.	Good; no volume change; stable under wheel loads when moist; suitable for all types of pavement when confined.
Steep stony and rocky land (St).	([10])	Slight to moderate.	Fair to not suitable.	Questionable	([10])
Terrace escarpments (Tm, Tn).	Slight to high for the loamy unit, but slight to none for the sandy unit.	Severe	Fair to good for the loamy unit, but not suitable for the sandy unit.	Questionable for the loamy unit, but the sandy unit is suitable for sand.	Substratum good and has small volume change; good stability, good bearing capacity at all moisture contents.
Toddville (ToA, ToB)	Moderate to very high.	Slight	Good	Questionable	Subsoil poor, high volume change and low bearing capacity when wet; substratum poor, relatively unstable at all moisture contents.
Urne (UfF, UfF2, UfF3, UnB2, UnC2, UnC3, UnD, UnD2, UnD3, UnE, UnE2, UnE3).	Slight to high	Moderate to severe.	Fair to good	Questionable	Subsoil fair, small volume change and good stability when wet; substratum good, sandstone bedrock.
Wallkill (Wa)	Slight in the C horizon.	Slight	Fair	Not suitable	Not suitable in C horizon
Watseka (Wf)	Slight to none	Moderate to severe.	Not suitable	Suitable for sand.	Good; no volume change; stable under wheel loads; suitable for all types of pavement when confined.
Waukegan (WkA, WkB, WkB2, WkC2).	Moderate to high in the B horizon, but slight to none in the C horizon.	Slight	Good	Suitable for sand.	Subsoil fair, moderately low volume change and bearing capacity when wet; substratum good; high stability at all moisture contents.
Zwingle (Zg, Zw)	Moderate to high	Slight	Good	Not suitable	Subsoil poor, has high volume change, low bearing capacity; elastic; substratum poor; has high volume change and is highly plastic.

[1] Refers to the disturbed subsoil and underlying material, unless a particular horizon is specified.
[2] Refers to the plow layer or surface soil.
[3] Refers principally to the underlying material; does not indicate the deposits that are suitable for use in concrete. Includes aggregates that have diameters of 0.05 to 2.0 millimeters for sand, and 2.0 millimeters to 3 inches for gravel.
[4] Refers to compacted fill of underlying or compacted material; the suitability ratings apply only to those soils that are protected from overflow.
[5] Suitability is based on percolation rate, as follows: More than 1 inch per hour is suitable, less than 1 inch in 1½ hours is questionable, and less than 1 inch in more than 1½ hours is unsuitable. Alluvial soils that are rated unsuitable may be suitable if they are protected from overflow. Slopes of more than 10 percent may

Pepin County, Wis., for engineering construction—Continued

Suitability of the soil material for—					Kind of drainage or need for [9]	Remarks
Foundations for low buildings [4]	Private sewage disposal systems [5]	Pond sites [6]	Terraces and diversions [7]	Irrigation [8]		
Poor; high compressibility and fair shear strength.	Good; moderately permeable.	Fair; pervious; reservoir bottom should be compacted.	Suitable	Very good	Not needed	
Good; low compressibility; good shear strength; no volume change.	Good; free drainage throughout.	Not suitable; very pervious.	Not suitable	Fair on the loamy fine sands, but not suitable on the fine sand and Dune land.	Not needed	Very droughty.
(10)	Questionable; soil has steep slopes and is variable.	Not suitable; soil has steep slopes and is variable.	Not suitable	Not suitable	Not needed	Very stony and rocky.
Good; low compressibility and no volume change; good shear strength.	Questionable; steep slopes; investigation needed at the site.	Not suitable; very pervious.	Not suitable	Not suitable	Not needed	Very droughty for the sandy unit.
Fair; subject to frost heaving and loss of bearing capacity on thawing.	Fair; permeable; questionable where drainage is somewhat poor.	Fair; pervious; bottom needs to be compacted in places; seal blanket needed over sandy substratum.	Suitable	Good	Not needed	
Good; sandstone bedrock.	Questionable; because of layers of siltstone, investigation is needed at the site.	Fair; pervious; reservoir bottom needs compaction and seal blanket.	Questionable	Good	Not needed	
Not suitable	Not suitable	Not suitable; in places suitable for dug ponds.	(10)	Good	Subsurface	Moderately high water table.
Good; low compressibility; no volume change; good bearing capacity.	Questionable; investigation is needed at the site to determine depth to water table.	Not suitable; very pervious; in some places where water table is high, suitable for dug ponds.	Not suitable	Fair	Not needed	Droughty.
Good; low compressibility and good shear strength; no volume change.	Suitable; free draining at a depth below 3 feet.	Fair; pervious; reservoir bottom needs to be compacted; seal blanket needed over sandy substratum.	Suitable	Very good	Not needed	
Poor; high compressibility, low bearing strength and high volume change.	Not suitable; slow permeability and temporary high water table.	Good; slow permeability; suitable for dug ponds.	Suitable	Fair	Surface	The silty loam is somewhat poorly drained, and the variant is poorly drained.

cause serious problems in construction and maintaining filter beds.

[6] Refers to the suitability of the soil material for permanent storage of water; compactibility of the soil material and porosity of the underlying material were both considered in making the ratings.

[7] Terracing is generally not practical on slopes of more than 14 percent.

[8] Based chiefly on moisture-holding capacity and infiltration rate; does not consider if it is economically feasible to provide water for irrigation. Sprinkler irrigation is generally used and is suitable for sloping areas on which crops normally are grown.

[9] On soils where subsurface drainage is suggested, deep ditching may be as satisfactory as tiles.

[10] Is extremely variable or does not apply.

Soil material that contains much silt and very fine sand is very susceptible to frost heaving. Where the soil material contains much silt and very fine sand, a thick layer of material that is not susceptible to heaving should be used in the highway subgrade. In a soil that is not susceptible to frost heaving, no more than 10 percent of the material passes a No. 200 sieve.

Among the characteristics considered in determining the erodibility of the soils, are the permeability, or imperviousness, of the surface layer and the subsoil, the vegetative cover, and the content of organic matter.

The suitability of the soils as a source of topsoil refers specifically to the use of soil material, preferably rich in organic matter, as a topdressing for roadbanks, parks, gardens, and lawns. The ratings used are based on the texture of the soil and on its content of organic matter. For example, a soil that is medium textured and high in organic matter has a suitability rating of good as a source of topsoil. On the other hand, a soil that is fine or coarse textured and low in organic matter is regarded as poor or unsuitable.

The suitability of the soils as a source of sand, gravel, and stone refers to possible sources of sand, gravel, and stone that are no more than 5 feet from the surface. The suitability of a soil as a source of coarse-grained material for road construction, concrete structures, and other structures is determined for the subsoil, or substratum, whichever is applicable. No separation is made in this column between material that is dominantly coarse grained and material that is coarse grained but that contains small amounts of finer material. Individual test pits and laboratory analyses will be needed to make these determinations.

Ratings of the suitability of the soils as a source of subgrade material for pavements consider qualities of the soil that enable it to support base courses, including curbs and gutters for highways. A soil that is given a rating of poor, for example, contains little coarse material, and it has a high liquid limit and a high plasticity index.

The soils are also rated as to their suitability for foundations of buildings that are no higher than three stories. The suitability of a natural, undisturbed soil as a base for low buildings depends primarily on the bearing value and expansion potential of that particular soil. Slope and erosion are local factors and are not taken into account in determining ratings. If feasible, the base of every part of the foundation should be placed below the depth to which the soil is subject to seasonal volume change caused by alternate wetting and drying. It should also be below the depth to which the soil structure would be weakened by root holes and animal burrows. The depths to which frost heaving is perceptible, which may be as much as 5 feet, is also considered. Therefore, the substratum provides the base for building foundations in most places.

The suitability of the soils for absorption of effluent from septic tanks depends upon the rate of percolation of water into the soil. The ratings given in table 4 are necessarily broad. Installation of filter fields and seepage beds for the disposal of effluent from septic tanks is considered in the ratings, as well as the building of seepage pits. For example, if the soil is coarse textured, deep, and free draining, a shallow seepage pit may prove satisfactory. However, in soils that have unsuitable permeability in the upper few feet but that have a rapidly permeable substratum, a deep pit may be needed. Seepage pits should not be used in areas where the supply of water for domestic use comes from a shallow well, or in areas where the limestone formation connects to underground channels through which polluted water can travel and reach the source of water supply.

How well a sewage disposal system functions depends largely on the rate at which the effluent from the septic tank moves into and through the soil. The permeability of the soil should be moderate to rapid, and the soil should have a percolation rate of at least 1 inch per hour. The percolation rate is influenced by such factors as the relative amount of gravel, sand, silt, and clay in the soil, the kind of clay, the degree of structural development, and the bulk density. For a specific location, it is necessary to make an absorption test, or to determine the rate of percolation. If percolation is so slow that more than 60 minutes is needed for water to move 1 inch through the soil, the use of a seepage pit, alone or with a tile absorption system, should be considered (*11*).

Other characteristics that affect the suitability of a soil for a sewage disposal system are structural stability, the ground-water level, depth of the soil, the kind of underlying material, the susceptibility of the soil to stream overflow, slope of the ground surface, and the proximity of the site to wells, streams, and lakes.

To determine the safe distance between a well and a subsurface disposal system, learn the depth of the well, the kind of construction used, the vertical zone of influence, and data concerning geologic formations in the area and the porosity of the subsoil strata. Also, the hazard of flooding in the disposal system should be considered, particularly on soils of the bottom lands. Regulations of the local Board of Health and the Wisconsin State Board of Health should be consulted for more specific information.

A soil that has blocky structure and that is stable when wet provides a suitable field for a sewage disposal system. If the structure of the soil is unstable, the soil is likely to slake down when wet. Then, permeability and infiltration are slowed and silt filters into the tile pipes or gravel bed of the filter field.

A water table that rises to the height of the subsurface tile and remains there or a high water table that recurs only periodically, prevents the sewage disposal system from operating properly. A high water table forces the sewage effluent upward to the surface of the soil and makes an ill-smelling, unhealthy bog in the filter field. There should be 4 feet of soil material between the ground-water level or indurated rock formation and the bottom of the trench or filter bed for the filtration and purification of septic-tank effluent.

Slopes of less than 10 percent generally do not create a serious problem in either the construction or maintenance of the filter fields. On steeper slopes, however, filter fields are more difficult to lay out and construct and seepage beds are impractical.

In determining a rating of the suitability of a soil for a farm pond, the entire soil profile is considered for the reservoir area and for the embankment material unless otherwise specified. Features that influence the suitability of the soils for reservoirs and embankments are the ground-water level, permeability, stoniness, or depth to bedrock, strength and stability, shrink-swell potential, and the content of organic matter.

Ratings are also given in table 4 for the suitability of the soil material for terraces and diversions. They are based mainly on the stability, texture, and thickness of the soil material; on the stones and rocks in the soil; on the kind of vegetation that can be grown on the soil; and on the topography. If terraces are properly installed and maintained, they are effective for controlling erosion and are also effective for draining some soils. Because of the difficulty of constructing and operating them, terraces are not suitable on slopes of more than 12 percent. Diversions are similar to terraces but are not spaced the same, and they can be used effectively on a wider range of slope. Diversions also reduce the length of the slope, protect gullied areas, and divert surface water away from low-lying areas, buildings, and roads.

The suitability of the soil material for irrigation is based mainly on the depth of the soil, its water-holding capacity, permeability, natural drainage, rate of water intake, stoniness, and topography. Features not considered, because of the wide variability among different areas of identical soil types, are the availability, quality, and source of water for use in irrigation, the stones or rocks in the soil, and its relief. Where sprinkler irrigation is considered, the relief, or lay of the land, is not so critical a factor as it would be in a gravitational system.

Supplemental irrigation would benefit crops grown on some of the loamy soils of the county. A limited amount of water is available for this purpose from rivers and other streams. Because of the cost of pumping water from the deep valleys to the uplands, however, irrigation would probably be limited to the terraces and bottom lands.

Soils that are suited to irrigation should have a topography that will permit use of flooding for irrigation or the use of an overhead irrigation system. The soils should also be permeable throughout, have good water-supplying capacity, be well aerated, permit roots to penetrate easily, be free of harmful salts, and be resistant to erosion.

In planning a drainage system, the permeability of the soil should be considered. If the soil is slowly or very slowly permeable, it would be better to use open ditches to provide drainage than to use tile drains. In areas where the water table is high and the soil is permeable, open ditches can be used to provide drainage, and they will also lower the water table.

Water flowing through open ditches that are used for drainage in sandy soils may cause the walls of the ditches to cave in. Erosion and deposition may choke ditches used for drainage in soils consisting of coarse silt and fine sand and may clog tile drains. Soils that have a substratum of fine sand or coarse silt should be checked carefully before determining the kind of drainage system that is suitable.

Some of the factors considered in determining the kind of drainage or need for drainage are the rate of water movement into and through the soil, depth to a restricting layer or to bedrock, depth to the water table, and the position of the soil on the landscape. The permeability of the soil is that of the least permeable horizon in the solum or in the part of the substratum immediately below the subsoil.

The need for both surface and subsurface drainage was considered. Surface drainage can be accomplished by using ditches that are less than 30 inches deep on most mineral soils, ditches that are 36 inches deep on organic soils, and ditches that are 48 inches deep on sandy soils. Surface drains can also be used to remove surplus water from cultivated areas. Deep ditches, tile drains, or a combination of the two will provide subsurface drainage, remove excess water from the surface and subsoil, and intercept or lower the ground-water level.

High ground water and an intermittent perched water table are two causes of poor drainage in the soils of this county. Some soils have one or more layers that restrict the movement of water through the soil, and, as a result, they have an intermittent high water table during seasons of heavy rainfall. A way should be provided to remove the free water that is held periodically above the restricting layer in the solum of such soils.

In soils that are poorly drained, seepage along the back slope of cuts may cause slumping or sliding of the overlying material. A perched water table beneath a pavement is likely to result in freezing and thawing in the saturated foundation material. This, in turn, may cause differential volume change and a reduction in bearing capacity. Before beginning construction, therefore, it is important to know the location of poorly drained areas. The poorly drained areas should be inspected in greater detail than other areas to determine the need for interceptor drains and underdrains.

There are only a few small areas of poorly drained soils on the uplands and terraces of the county, but there are extensive areas of poorly drained soils on the bottoms along the streams. Deposits of organic materials that have accumulated in the depressions are not suitable for use in engineering structures. They should be removed from roadway sections or from foundations of structures and placed where they will not be detrimental to the construction.

Some parts of the bottom lands are flooded each year. Therefore, care should be taken to protect structures on these low lands from scouring and other harmful effects of running water. Also, roads should be built on embankments so that the surface of the pavement is at least 4 feet above the water table. By constructing drainage ditches before earthwork is begun, the soils that have a high water table can be made more suitable as a source of borrow material, as well as for excavation of roads.

Soil test data

To help evaluate the soils for engineering purposes, soil samples from the principal soil types of each of several extensive soil series were tested in accordance with established procedures (*1*). The test data are given in table 5. Actual laboratory data were not available for all the soils in the county. Therefore, for some of the soils, data from similar soils in other counties were used.

The engineering classifications in table 5 are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods. Percentages of silt and clay determined by the hydrometer method should not be used in naming textural classes for soil classification. The information, however, is useful in determining general engineering properties of the soils.

The tests to show liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The *plastic limit* is the moisture content at which the soil material passes from a semisolid to a plastic state. The *liquid limit* is the moisture content at which the material passes from a plastic to a liquid state. The *plasticity index* is the numerical difference between the liquid limit and the plastic limit. It indicates the range of

TABLE 5.—*Engineering test data of representative*

[Absence of figure indicates information

Soil type, parent material, location, and laboratory number	Horizon	Depth	Moisture-density	
			Maximum dry density	Optimum moisture content
Almena silt loam (parent material is loess over acid, reddish-brown till of sandy clay loam):		*Inches*	*Lb. per cu. ft.*	*Percent*
Taylor County—				
SW¼SW¼ sec. 1, T. 33 N., R. 4 W.	B2	19–25	140. 2	6. 9
	D1	41–53	111. 0	16. 9
SE¼SE¼ sec. 31, T. 33 N., R. 4 W.	B2	22–30		
	D1	36–48		
Arenzville silt loam (parent material is silty alluvium):				
Trempealeau County—				
NE¼SW¼ sec. 24, T. 23 N., R. 9 W.	C1	7–24	103. 6	18. 9
	C2	30–36	89. 0	27. 6
Bertrand silt loam (parent material is deep silt over sand):				
Buffalo County—				
NE¼ sec. 35, T. 23 N., R. 12 W.	C	42–60		
Dakota loam (parent material is loamy outwash or alluvium):				
St. Croix County—				
SW¼ sec. 31, T. 28 N., R. 18 W.	B2	17–25		
Ettrick silt loam (parent material is silty alluvium):				
Monroe County—				
SW¼NW¼ sec. 27, T. 16 N., R. 4 W.	B	12–18	101. 7	21. 2
	C	26–42	112. 7	15. 8
NE¼NW¼SW¼ sec. 10, T. 15 N., R. 2 W.	B	13–20		
	C	20–60		
SE¼SW¼NW¼ sec. 32, T. 18 N., R. 1 W.	B	22–28		
	C	28–60		
Jackson silt loam (parent material is deep silt over sand):				
Pepin County—				
NE¼ sec. 15, T. 25 N., R. 14 W.	C	37–44		
Medary silt loam (parent material is loess over lacustrine silt and clay):				
Buffalo County—				
NW¼NE¼ sec. 26, T. 22 N., R. 13 W., 88 (HC).	B2	11–30		
Meridian fine sandy loam (parent material is loam over sand):				
Buffalo County—				
SE¼ sec. 9, T. 24 N., R. 11 W.	B2	11–25		
Norden fine sandy loam (parent material is loess and material from fine-grained sandstone):				
Dunn County—				
W½SW¼NW¼ sec. 33, T. 27 N., R. 13 W.				
S33995	A2	4–10	109	15
S33996	B21	14–28	107	17
S33997	B3	34–40	115	15

See footnotes at end of table.

moisture content within which a soil material is in a plastic condition.

Table 5 also gives compaction (moisture density) values for the tested soils. If soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material will increase until the optimum moisture content is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed maximum dry density. Moisture-density data are important in earthwork, for, as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

soil samples, Pepin County, Wis.[1]

was not available or was not obtained]

Mechanical analyses [2]											Liquid limit	Plasticity index	Classification	
Percent passing sieve [3]—							Percentage smaller than [3]—						AASHO [4]	Unified [5]
1 inch	¾ inch	⅜ inch	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
[6] 94	90	84	80	75	65	41	38	28	14	9	16	6	A-4(1)	SM-SC.
------	------	------	------	100	99	98	97	66	36	30	45	24	A-7-6(15)	CL.
------	------	------	------	100	97	92	88	55	31	26	37	16	A-6(10)	CL.
97	94	90	87	81	65	31	27	16	9	6	16	3	A-2-4	SM.
------	------	------	------	------	100	96	88	50	17	9	32	10	A-4(8)	ML-CL.
------	------	------	------	------	98	96	89	53	17	10	47	12	A-7-5(10)	ML.
------	------	------	------	100	99	80	64	20	16	13	24	5	A-4(8)	ML-CL.
------	------	------	------	100	90	45	42	30	16	13	19	6	A-4(2)	SM-SC.
------	------	------	------	------	100	94	94	84	44	35	55	32	A-7-6(19)	H.
------	------	------	------	------	------	100	97	75	32	26	41	20	A-7-6(12)	ML.
------	------	------	------	------	100	98	97	61	26	21	41	16	A-7-6(10)	CL.
------	------	------	------	------	100	98	96	66	29	24	34	14	A-6(10)	CL.
------	------	------	------	100	99	90	89	79	52	39	52	23	A-7-6(16)	MH.
99	98	95	93	93	83	13	10	7	4	3	(7)	(7)	A-2-4(0)	SM.
------	------	------	------	------	100	98	87	48	23	19	29	10	A-4(8)	CL.
------	------	------	------	------	100	96	------	------	66	------	65	41	A-7-6(20)	CH.
------	------	------	------	100	89	51	47	34	20	15	20	5	A-4(3)	ML-CL.
------	------	------	------	------	100	98	93	56	21	16	24	4	A-4(8)	ML-CL.
------	------	------	------	------	100	99	95	60	30	26	35	14	A-6(10)	CL.
------	------	------	------	100	99	80	72	46	27	22	30	12	A-6(9)	ML.

TABLE 5.—*Engineering test data of representative*

[Absence of figure indicates information

Soil type, parent material, location, and laboratory number	Horizon	Depth	Moisture-density: Maximum dry density	Moisture-density: Optimum moisture content
Norden silt loam (parent material is loess and material from fine-grained sandstone):				
Pepin County—				
NE½SE¼ sec. 26, T. 25 N., R. 11 W.		*Inches*	*Lb. per cu. ft.*	*Percent*
S34002	A1	0–2	93	23
S34003	A2	2–9	105	16
S34004	B22	16–28	105	18
S34005	D2	38+	115	12
Dunn County—				
W½SW¼SW¼ sec. 32, T. 8 N., R. 13 W.				
S33992	A2	3–9	108	14
S33993	B22	18–23	110	15
S33994	B3	23–28	114	16
Orion silt loam (parent material is silty alluvium):				
Pepin County—				
NE¼ sec. 8 T. 25 N., R. 14 W.	A12	18–32		
Waukegan silt loam (parent material is silty material over sandy outwash):				
St. Croix County—				
SW¼ sec. 32, T. 28 N., R, 19 W.	B2	14–24		
Zwingle silt loam (parent material is loess over lacustrine silt and clay):				
Pepin County—				
SW¼SE¼ sec. 18, T. 23 N., R. 14 W., 89 (HC).	C	38–44		

[1] Except for the Norden soils, which were tested by the Bureau of Public Roads, the soils were tested by the State Highway Commission of Wisconsin under a cooperative agreement with the U.S. Department of Commerce, Bureau of Public Roads. Standard procedures of the American Association of State Highway Officials (AASHO) were used in performing the tests (*1*).

[2] Mechanical analyses are according to AASHO Designation: T 88. Results by this procedure may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechani-

soil samples, *Pepin County*, *Wis.*[1]—Continued

was not available or was not obtained]

Mechanical analyses [2]											Liquid limit	Plasticity index	Classification	
Percent passing sieve [3]—							Percentage smaller than [3]—						AASHO [4]	Unified [5]
1 inch	¾ inch	⅜ inch	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
------	------	------	--------	100	100	95	88	51	18	13	38	8	A-4(8)-----	ML.
------	------	------	--------	100	100	96	90	48	16	10	24	3	A-4(8)-----	ML.
------	------	------	--------	100	100	97	92	60	32	28	42	20	A-7-6(12)--	CL.
[8] 87	83	79	76	73	73	15	12	11	7	7	([7])	([7])	A-2-4(0)---	SM.
------	------	------	--------	100	99	92	82	48	23	15	24	4	A-4(8)-----	ML-CL.
------	------	------	--------	100	99	91	82	50	28	21	27	8	A-4(8)-----	CL.
------	------	------	--------	100	99	59	52	40	32	27	34	17	A-6(8)-----	CL.
------	------	------	--------	100	99	97	91	57	19	12	33	7	A-4(8)-----	ML-CL.
------	------	------	--------	100	90	77	------	------	25	--------	32	10	A-4(8)-----	ML-CL.
100	100	100	100	100	99	98	------	------	52	--------	45	20	A-7-6(13)--	ML-CL.

cal analyses used in this table are not suitable for use in naming textural classes of soils.

[3] Based on total material. Laboratory test data corrected for amount discarded in field sampling.

[4] Based on the Standard Specifications for Highway Materials and Methods of Sampling and Testing (pt. 1, ed. 7). The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation: M 145-49.

[5] Based on the Unified Soil Classification System, Tech. Memo. No. 3-357, v. 1, Waterways Expt. Sta., Corps of Engin. March 1953.

[6] The percentage of material passing the 2-inch sieve was 100 percent.

[7] Nonplastic.

[8] The percentage of material passing the 3-inch sieve was 100 percent and that of passing the 2-inch sieve was 94 percent.

684-153—64——5

Descriptions of the Soils

This section is provided for those who want detailed information about the soils in the county. It describes each soil series, a typical profile of each soil type, and then each mapping unit; that is, the areas on the detailed soil map that are bounded by lines and identified by a symbol. The soils are described approximately in alphabetical order.

All of the soils of one series that have the same kind of texture in the surface layer are grouped together, and a brief description of a profile, generally like that of the first soil of the group, is given. The descriptions of the other soils that are in each soil type generally tell how their profile differs from the one described, or differences are indicated in the soil name.

Most of the names of the soils are made up of the series name, the type name, and the phase name; for example, Bertrand (series) silt loam (type), 6 to 12 percent slopes (phase). A few soils have names made up only of the series and type names, since they have no variations in slope, erosion, or other properties normally designated at the level of the soil phase. Curran silt loam is an example.

In this report the classes of erosion are as follows:

Moderately eroded—Soils that have lost from one-third to two-thirds of their original surface layer through erosion.

Severely eroded—Soils that have lost more than two-thirds of their original surface layer through erosion.

Eroded—Soils that have two classes of erosion combined into one soil phase.

For more general information about the soils, the reader can refer to the section "General Soil Map" in which the broad patterns of soils are described. The approximate acreage and proportionate extent of each soil mapped in the county are given in table 6, and their location is shown on the soil map at the back of the report. Terms used to describe the soil are given in the Glossary. Technical descriptions of each series are provided in the section "Detailed Descriptions of Soil Series."

TABLE 6.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Almena silt loam, 2 to 6 percent slopes, moderately eroded	39	(1)
Arenzville silt loam	1, 216	0. 8
Bertrand silt loam, 0 to 2 percent slopes	352	. 2
Bertrand silt loam, 2 to 6 percent slopes	787	. 5
Bertrand silt loam, 2 to 6 percent slopes, moderately eroded	4, 354	2. 9
Bertrand silt loam, 6 to 12 percent slopes	46	(1)
Bertrand silt loam, 6 to 12 percent slopes, moderately eroded	651	. 4
Bertrand silt loam, 6 to 12 percent slopes, severely eroded	51	(1)
Bertrand silt loam, 12 to 20 percent slopes, moderately eroded	55	(1)
Bertrand silt loam, 12 to 20 percent slopes, severely eroded	81	. 1
Boone loamy fine sand, 2 to 6 percent slopes	53	(1)
Boone loamy fine sand, 2 to 6 percent slopes, eroded	254	. 2
Boone loamy fine sand, 6 to 12 percent slopes	185	. 1
Boone loamy fine sand, 6 to 12 percent slopes, eroded	607	. 4
Boone loamy fine sand, 12 to 30 percent slopes, eroded	895	. 6
Boone soils, 12 to 30 percent slopes, severely eroded	93	. 1
Boone soils, 30 to 60 percent slopes	2, 911	1. 9
Burkhardt sandy loam, 0 to 2 percent slopes	2, 273	1. 5
Burkhardt sandy loam, 2 to 6 percent slopes	1, 500	1. 0
Burkhardt sandy loam, 2 to 6 percent slopes, moderately eroded	429	. 3
Burkhardt sandy loam, 6 to 12 percent slopes, severely eroded	54	(1)
Chaseburg silt loam, 0 to 2 percent slopes	755	. 5
Chaseburg silt loam, 2 to 6 percent slopes	1, 297	. 9
Curran silt loam	476	. 3
Dakota fine sandy loam, 0 to 2 percent slopes	264	. 2
Dakota fine sandy loam, 2 to 6 percent slopes	75	(1)
Dakota fine sandy loam, 2 to 6 percent slopes, moderately eroded	192	. 1
Dakota loam, 0 to 2 percent slopes	332	. 2
Dakota loam, 2 to 6 percent slopes	497	. 3
Dakota loam, 2 to 6 percent slopes, moderately eroded	239	. 2
Dakota loam, 6 to 12 percent slopes, moderately eroded	64	(1)
Dillon fine sandy loam	401	. 3
Downs silt loam, 2 to 6 percent slopes	212	. 1
Downs silt loam, 2 to 6 percent slopes, moderately eroded	1, 540	1. 0
Downs silt loam, 6 to 12 percent slopes, moderately eroded	527	. 3
Downs silt loam, benches, 2 to 6 percent slopes, moderately eroded	124	. 1
Downs silt loam, benches, 6 to 12 percent slopes, moderately eroded	158	-
Downs silt loam, benches, 12 to 20 percent slopes	81	1
Downs silt loam, benches, 12 to 20 percent slopes, moderately eroded	462	. 3
Downs silt loam, benches, 12 to 20 percent slopes, severely eroded	76	(1)
Downs silt loam, benches, 20 to 30 percent slopes, moderately eroded	136	. 1
Dubuque silt loam, 2 to 6 percent slopes, moderately eroded	57	(1)
Dubuque silt loam, 6 to 12 percent slopes	242	. 2
Dubuque silt loam, 6 to 12 percent slopes, moderately eroded	117	. 1
Dubuque silt loam, 12 to 20 percent slopes	293	. 2
Dubuque silt loam, 12 to 20 percent slopes, moderately eroded	354	. 2
Dubuque silt loam, 20 to 30 percent slopes	549	. 4
Dubuque silt loam, 20 to 30 percent slopes, moderately eroded	321	. 2
Dubuque silt loam, 30 to 45 percent slopes	223	. 1
Dubuque silt loam, deep, 2 to 6 percent slopes	64	(1)
Dubuque silt loam, deep, 2 to 6 percent slopes, moderately eroded	225	. 1
Dubuque silt loam, deep, 6 to 12 percent slopes	301	. 2
Dubuque silt loam, deep, 6 to 12 percent slopes, moderately eroded	1, 486	1. 0
Dubuque silt loam, deep, 12 to 20 percent slopes	939	. 6
Dubuque silt loam, deep, 12 to 20 percent slopes, moderately eroded	1, 761	1. 2

See footnote at end of table.

TABLE 6.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Area	Extent
	Acres	*Percent*
Dubuque silt loam, deep, 20 to 30 percent slopes	488	. 3
Dubuque silt loam, deep, 20 to 30 percent slopes, moderately eroded	56	(1)
Dubuque soils, 6 to 12 percent slopes, severely eroded	141	. 1
Dubuque soils, deep, 12 to 20 percent slopes, severely eroded	591	. 4
Dubuque soils, deep, 20 to 30 percent slopes, severely eroded	242	. 2
Ettrick silt loam, coarse silt substratum	384	. 3
Gale silt loam, 6 to 12 percent slopes	100	. 1
Gale silt loam, 6 to 12 percent slopes, moderately eroded	50	(1)
Gale silt loam, 12 to 20 percent slopes	63	(1)
Gale silt loam, 12 to 20 percent slopes, moderately eroded	174	. 1
Gale silt loam, 12 to 20 percent slopes, severely eroded	61	(1)
Gale silt loam, 20 to 30 percent slopes	278	. 2
Gale silt loam, 20 to 30 percent slopes, moderately eroded	403	. 3
Gale silt loam, 20 to 30 percent slopes, severely eroded	269	. 2
Gale silt loam, 30 to 40 percent slopes	208	. 1
Gotham loamy fine sand, 0 to 2 percent slopes	634	. 4
Gotham loamy fine sand, 2 to 6 percent slopes	247	. 2
Gotham loamy fine sand, 2 to 6 percent slopes, moderately eroded	1, 824	1. 2
Gotham loamy fine sand, 6 to 12 percent slopes	63	(1)
Gotham loamy fine sand, 6 to 12 percent slopes, moderately eroded	158	. 1
Hixton fine sandy loam, 2 to 6 percent slopes, moderately eroded	187	. 1
Hixton fine sandy loam, 6 to 12 percent slopes	66	(1)
Hixton fine sandy loam, 6 to 12 percent slopes, moderately eroded	289	. 2
Hixton fine sandy loam, 12 to 20 percent slopes	45	(1)
Hixton fine sandy loam, 12 to 20 percent slopes, moderately eroded	229	. 2
Hixton fine sandy loam, 20 to 30 percent slopes	197	. 1
Hixton fine sandy loam, 20 to 30 percent slopes, moderately eroded	269	. 2
Hixton fine sandy loam, 20 to 30 percent slopes, severely eroded	213	. 1
Hixton fine sandy loam, 30 to 45 percent slopes	846	. 6
Hixton fine sandy loam, 30 to 45 percent slopes, moderately eroded	66	(1)
Hixton fine sandy loam, 30 to 45 percent slopes, severely eroded	86	. 1
Hubbard loamy fine sand, 0 to 3 percent slopes	1, 776	1. 2
Huntsville silt loam	174	. 1
Jackson silt loam, 0 to 2 percent slopes	1, 514	1. 0
Jackson silt loam, 2 to 6 percent slopes	1, 564	1. 0
Jackson silt loam, 2 to 6 percent slopes, moderately eroded	683	. 4
Jackson silt loam, 6 to 12 percent slopes	44	(1)
Jackson silt loam, 6 to 12 percent slopes, moderately eroded	116	. 1
Jackson silt loam, 6 to 12 percent slopes, severely eroded	64	(1)
Judson silt loam, 0 to 2 percent slopes	308	. 2
Judson silt loam, 2 to 6 percent slopes	463	. 3
Judson silt loam, 6 to 12 percent slopes	76	(1)
Lindstrom silt loam, 6 to 12 percent slopes	60	(1)
Lindstrom silt loam, 6 to 12 percent slopes, moderately eroded	136	. 1
Lindstrom silt loam, 12 to 20 percent slopes	39	(1)
Lindstrom silt loam, 12 to 20 percent slopes, moderately eroded	65	(1)
Lindstrom silt loam, 20 to 30 percent slopes	37	(1)
Lindstrom silt loam, 20 to 30 percent slopes, moderately eroded	48	(1)
Loamy alluvial land	2, 822	1. 9
Loamy alluvial land, wet	6, 611	4. 4
Loamy wet terrace land	751	. 5
Loamy very wet terrace land	578	. 4
Medary silt loam, 0 to 2 percent slopes	74	(1)
Medary silt loam, 2 to 6 percent slopes	25	(1)
Meridian fine sandy loam, 0 to 2 percent slopes	345	. 2
Meridian fine sandy loam, 2 to 6 percent slopes	178	. 1
Meridian fine sandy loam, 2 to 6 percent slopes, moderately eroded	396	. 3
Meridian fine sandy loam, 6 to 12 percent slopes	44	(1)
Meridian fine sandy loam, 6 to 12 percent slopes, moderately eroded	227	. 1
Meridian fine sandy loam, 6 to 12 percent slopes, severely eroded	58	(1)
Meridian fine sandy loam, 12 to 20 percent slopes, moderately eroded	61	(1)
Morocco loamy fine sand	723	. 5
Norden fine sandy loam, 2 to 6 percent slopes, moderately eroded	143	. 1
Norden fine sandy loam, 6 to 12 percent slopes	122	. 1
Norden fine sandy loam, 6 to 12 percent slopes, moderately eroded	1, 593	1. 0
Norden fine sandy loam, 6 to 12 percent slopes, severely eroded	167	. 1
Norden fine sandy loam, 12 to 20 percent slopes	486	. 3
Norden fine sandy loam, 12 to 20 percent slopes, moderately eroded	1, 032	. 7
Norden fine sandy loam, 12 to 20 percent slopes, severely eroded	713	. 5
Norden fine sandy loam, 20 to 30 percent slopes	185	. 1
Norden fine sandy loam, 20 to 30 percent slopes, moderately eroded	467	. 3
Norden fine sandy loam, dark surface variant, 2 to 6 percent slopes, moderately eroded	469	. 3
Norden fine sandy loam, dark surface variant, 6 to 12 percent slopes, moderately eroded	182	. 1
Norden loam, 12 to 20 percent slopes, moderately eroded	67	(1)
Norden loam, 20 to 30 percent slopes	133	. 1
Norden loam, 20 to 30 percent slopes, moderately eroded	80	. 1
Norden silt loam, 2 to 6 percent slopes	86	. 1
Norden silt loam, 2 to 6 percent slopes, moderately eroded	97	. 1
Norden silt loam, 6 to 12 percent slopes	102	. 1
Norden silt loam, 6 to 12 percent slopes, moderately eroded	208	. 1
Norden silt loam, 6 to 12 percent slopes, severely eroded	57	(1)
Norden silt loam, 12 to 20 percent slopes	151	. 1
Norden silt loam, 12 to 20 percent slopes, moderately eroded	293	. 2
Norden silt loam, 12 to 20 percent slopes, severely eroded	159	. 1
Norden silt loam, 20 to 30 percent slopes	902	. 6
Norden silt loam, 20 to 30 percent slopes, moderately eroded	790	. 5
Norden silt loam, 20 to 30 percent slopes, severely eroded	132	. 1
Norden silt loam and loam, 30 to 40 percent slopes	410	. 3
Norden silt loam and loam, 30 to 40 percent slopes, moderately eroded	134	. 1
Northfield very fine sandy loam, 2 to 6 percent slopes	155	. 1
Northfield very fine sandy loam, 2 to 6 percent slopes, moderately eroded	766	. 5
Orion silt loam	987	. 6

See footnote at end of table.

TABLE 6.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Area	Extent
	Acres	*Percent*
Otterholt silt loam, loamy substratum, 2 to 6 percent slopes	141	. 1
Otterholt silt loam, loamy substratum, 2 to 6 percent slopes, moderately eroded	1, 643	1. 1
Otterholt silt loam, loamy substratum, 6 to 12 percent slopes, moderately eroded	208	. 1
Peat and muck, deep	1, 777	1. 2
Peat and muck, shallow	1, 888	1. 2
Plainfield loamy fine sand, 0 to 2 percent slopes	862	. 6
Plainfield loamy fine sand, 2 to 6 percent slopes	945	. 6
Plainfield loamy fine sand, 2 to 6 percent slopes, eroded	2, 198	1. 4
Plainfield loamy fine sand, 6 to 12 percent slopes	582	. 4
Plainfield loamy fine sand, 6 to 12 percent slopes, eroded	1, 929	1. 3
Plainfield loamy fine sand, 12 to 20 percent slopes	167	. 1
Plainfield loamy fine sand, 12 to 20 percent slopes eroded	149	. 1
Plainfield loamy fine sand, mottled subsoil variant, 0 to 2 percent slopes	743	. 5
Richwood silt loam, 0 to 2 percent slopes	35	(1)
Richwood silt loam, 2 to 6 percent slopes	64	(1)
Riverwash	343	. 2
Rowley silt loam	607	. 4
Sandy alluvial land	3, 308	2. 2
Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes	330	. 2
Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes, moderately eroded	3, 165	2. 1
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes	828	. 5
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, moderately eroded	7, 482	4. 9
Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, severely eroded	661	. 4
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes	1, 252	. 8
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, moderately eroded	4, 839	3. 2
Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, severely eroded	1, 706	1. 1
Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes	490	. 3
Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, moderately eroded	719	. 5
Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, severely eroded	344	. 2
Seaton and Fayette silt loams, valleys, 2 to 6 percent slopes	53	(1)
Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes	128	. 1
Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes, moderately eroded	752	. 5
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes	853	. 6
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, moderately eroded	2, 347	1. 5
Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, severely eroded	128	. 1
Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes	2, 224	1. 5
Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, moderately eroded	2, 146	1. 4
Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, severely eroded	205	. 1
Sparta fine sand and Dune land	401	. 3
Sparta loamy fine sand, 0 to 2 percent slopes	1, 797	1. 2
Sparta loamy fine sand, 2 to 6 percent slopes	1, 320	. 9
Sparta loamy fine sand, 2 to 6 percent slopes, eroded	3, 282	2. 2
Sparta loamy fine sand, 6 to 12 percent slopes	236	. 2
Sparta loamy fine sand, 6 to 12 percent slopes, eroded	1, 255	. 8
Sparta loamy fine sand, 12 to 20 percent slopes, eroded	67	(1)
Steep stony and rocky land	12, 558	8. 3
Terrace escarpments, loamy	2, 345	1. 5
Terrace escarpments, sandy	1, 601	1. 1
Toddville silt loam, 0 to 2 percent slopes	224	. 1
Toddville silt loam, 2 to 6 percent slopes	96	. 1
Urne fine sandy loam, 30 to 45 percent slopes	1, 723	1. 1
Urne fine sandy loam, 30 to 45 percent slopes, moderately eroded	214	. 1
Urne fine sandy loam, 30 to 45 percent slopes, severely eroded	195	. 1
Urne and Norden fine sandy loams, 2 to 6 percent slopes, moderately eroded	89	. 1
Urne and Norden fine sandy loams, 6 to 12 percent slopes, moderately eroded	144	. 1
Urne and Norden fine sandy loams, 6 to 12 percent slopes, severely eroded	39	(1)
Urne and Norden fine sandy loams, 12 to 20 percent slopes	110	. 1
Urne and Norden fine sandy loams, 12 to 20 percent slopes, moderately eroded	212	. 1
Urne and Norden fine sandy loams, 12 to 20 percent slopes, severely eroded	150	. 1
Urne and Norden fine sandy loams, 20 to 30 percent slopes	418	. 3
Urne and Norden fine sandy loams, 20 to 30 percent slopes, moderately eroded	162	. 1
Urne and Norden fine sandy loams, 20 to 30 percent slopes, severely eroded	603	. 4
Wallkill silt loam	249	. 2
Watseka loamy fine sand	1, 002	. 7
Waukegan silt loam, 0 to 2 percent slopes	471	. 3
Waukegan silt loam, 2 to 6 percent slopes	127	. 1
Waukegan silt loam, 2 to 6 percent slopes, moderately eroded	134	. 1
Waukegan silt loam, 6 to 12 percent slopes, moderately eroded	63	(1)
Zwingle silt loam	78	. 1
Zwingle silt loam, poorly drained variant	93	. 1
Total	151, 680	100. 0

[1] Less than 0.1 percent.

Almena Series

The Almena series is made up of light-colored soils that are somewhat poorly drained. These nearly level to gently sloping soils are generally on ridgetops within areas of other soils that are undulating to gently sloping. They formed under a forest of hardwoods in a mantle of silt, 42 to 60 inches thick, that overlies strongly acid glacial till.

A representative profile of an Almena silt loam in a cultivated field follows:

0 to 8 inches, very dark grayish-brown to grayish-brown, friable silt loam.
8 to 12 inches, grayish-brown, friable silt loam; a few mottles of dark yellowish brown.
12 to 14 inches, grayish-brown, friable to firm silt loam; bleached silt coats and mottles of dark yellowish brown.
14 to 25 inches, dark-brown, firm heavy silt loam; thick, bleached silt coats; mottles of low contrast.
25 to 45 inches, dark-brown to dark yellowish-brown, firm heavy silt loam; thick, bleached silt coats; a few mottles of low contrast.
45 inches +, grayish-brown to brown, massive silt loam; mottles of strong brown.

In cultivated areas the surface layer is very dark grayish brown to grayish brown. In undisturbed areas the surface layer is thinner than that in areas that are cultivated and is black to very dark grayish brown. The surface layer and subsoil combined are 30 to 45 inches thick. The mantle of loess in which the soils formed ranges from 42 to 60 inches in thickness. The underlying glacial till ranges from loam to clay loam in texture.

These soils have high moisture-supplying capacity. Runoff is medium to slow. Permeability of the solum is moderate, but internal drainage is slow because the underlying glacial till is slowly permeable. The soils are strongly acid and are moderately high in natural fertility. The root zone extends deep into the lower subsoil. There is a slight hazard of erosion in areas that are gently sloping. Crops on these soils respond well if lime, commercial fertilizer, and manure are added.

These soils are fairly easy to cultivate and to manage. Yields are good to excellent if the soils are well managed.

Almena silt loam, 2 to 6 percent slopes, moderately eroded (AmB2).—This is the only Almena soil mapped in the county.

Mapped with this soil are some areas of a soil that has slightly better internal drainage than this soil.

All of Almena silt loam, 2 to 6 percent slopes, moderately eroded, is used for crops. Practices are required that help to control erosion. (Capability unit IIe-3; woodland group 8)

Arenzville Series

The Arenzville series is made up of deep, light-colored, well drained to moderately well drained soils. These nearly level soils are on stream bottoms, where they formed in thin layers of silty materials. The materials were washed in by streams and were deposited over the darker original soil. The native vegetation was made up of deciduous trees.

A representative profile of Arenzville silt loam follows:

0 to 8 inches, dark grayish-brown, friable silt loam.
8 to 13 inches, brown, friable silt loam.
13 to 22 inches, dark-gray, friable silt loam.
22 to 40 inches, black, friable silt loam that becomes very dark gray at a depth of 34 inches; a few mottles of dark reddish brown in the upper part of this horizon.
40 inches +, dark grayish-brown, friable silt loam.

Depth to the buried, darker soil ranges from 18 to 48 inches. The color, arrangement, and thickness of the layers of older underlying material vary somewhat because of water sorting when the material was deposited.

The Arenzville soils are moderately permeable. They are high in moisture-supplying capacity and in fertility. They are nearly neutral throughout the profile.

Arenzville silt loam (Ar).—This is the only Arenzville soil mapped in the county. Its profile is like the one described as representative for the series. In some places, however, the darker, buried soil is at a depth of more than 48 inches.

Generally, little or no lime is required for field crops grown on this soil. Crops respond well, however, if a complete fertilizer is added.

Streambank cutting and occasional flooding for short periods in spring limit the use of this soil for crops. Nevertheless, the soil is well suited to corn, small grains, hay, and pasture. If floods do not damage the crops, good yields are obtained. (Capability unit IIw-2; woodland group 1)

Bertrand Series

In the Bertrand series are deep, light-colored soils that are well drained. These nearly level to moderately steep soils formed on high stream terraces in silty material that was more than 42 inches thick. The native vegetation was mainly maple, oak, and hickory, but it included other hardwoods.

A representative profile of a Bertrand silt loam in a cultivated field follows:

0 to 8 inches, very dark grayish-brown to dark grayish-brown, very friable silt loam.
8 to 10 inches, dark grayish-brown, very friable silt loam.
10 to 13 inches, dark-brown, friable silt loam.
13 to 36 inches, dark-brown, firm silty clay loam.
36 to 42 inches, dark yellowish-brown, friable light silty clay loam.
42 inches +, dark yellowish-brown, friable silt loam.

In areas that have been plowed, the surface layer is 6 to 9 inches thick and is very dark grayish brown to dark grayish brown. In areas that have not been cultivated, the surface layer is darker colored than that of the profile described, and it is lighter colored in areas that are eroded. The color of the lower three layers in the profile described is yellowish brown in places. Fine sand or silt that contains thin layers of fine sand is at a depth below 42 inches.

These soils have high moisture-holding capacity and moderate permeability. They are moderately high in natural fertility and are slightly acid.

Bertrand silt loam, 0 to 2 percent slopes (BeA).—The profile of this soil is like the representative profile described. This soil is in broad, level, cultivated areas and is subject to little erosion.

This soil is suited to all the crops commonly grown in the county, but corn, oats, and hay of alfalfa and bromegrass are the principal crops. If a suitable cropping system is used and practices are applied to maintain a good supply of plant nutrients, this soil can be cropped intensively and yields will remain high. No special practices are needed to control erosion.

In many places organic matter and nitrogen are lacking. Nevertheless, crops on this soil respond well if a complete fertilizer is applied. Lime is required for high yields. Enough lime should be added to raise the pH to 6.5 or 7.0 (Capability unit I-1; woodland group 1)

Bertrand silt loam, 2 to 6 percent slopes (BeB).—The profile of this soil is similar to the representative profile described. It is on broad, gently sloping stream terraces. Nearly all of the original surface layer has been retained. As a result, water is absorbed readily and runoff is not a serious hazard.

Most of this soil is used for crops, but a few areas that are not accessible to tillage equipment remain in woodland. This soil is well suited to corn, oats, and hay. If practices are used to control erosion and to keep the supplies of organic matter and plant nutrients high, this soil can be used intensively and will give high yields. (Capability unit IIe-1; woodland group 1)

Bertrand silt loam, 2 to 6 percent slopes, moderately eroded (BeB2).—The surface layer of this soil is lighter colored than that in the representative profile described. In most places from one-third to two-thirds of the original surface layer has been removed through water erosion. In some places more than two-thirds of the original surface layer is gone. The present surface layer is 5 to 8 inches thick.

This soil lacks organic matter and nitrogen. If practices are applied to control further erosion and if a suitable cropping system is used and a good supply of plant nutrients is maintained, the soil can be used intensively. Crops on this soil respond well if a complete fertilizer and manure are added. Lime is needed. (Capability unit IIe-1; woodland group 1)

Bertrand silt loam, 6 to 12 percent slopes (BeC).—The surface layer of this soil is slightly lighter colored and thinner than that in the representative profile described. The areas are mostly in narrow bands along the edges of stream benches and are used for pasture or have been kept in trees.

This soil requires careful management to protect it from erosion. If it is used for crops, the supply of plant nutrients needs to be maintained. Row crops can be grown less frequently than on the less sloping soils of the series.

Crops on this soil respond well if a complete fertilizer is applied. Turning under green-manure crops and adding barnyard manure will help to increase the content of organic matter and nitrogen. Lime is needed if the soil is cultivated. (Capability unit IIIe-1; woodland group 1)

Bertrand silt loam, 6 to 12 percent slopes, moderately eroded (BeC2).—This soil has a thinner, lighter colored surface layer than that in the profile described. From one-third to two-thirds of the original surface layer has been lost through erosion. The present surface layer is 5 to 8 inches thick. In areas that are plowed, dark-brown or dark yellowish-brown material from the subsoil has been turned up in about half of the acreage. A few small areas are severely eroded.

This soil requires careful management if further erosion is to be controlled. If the soil is used for crops, the supply of plant nutrients will need to be maintained. Row crops can be grown less frequently on this soil than on the less sloping Bertrand soils.

Crops on this soil respond well if a complete fertilizer is applied. Turning under green-manure crops and adding barnyard manure help to increase the content of organic matter and nitrogen. Lime is needed if the soil is cultivated. (Capability unit IIIe-1; woodland group 1)

Bertrand silt loam, 6 to 12 percent slopes, severely eroded (BeC3).—This soil occupies only a small acreage and has lost all or nearly all of its original surface layer through water erosion. The areas are in narrow bands along the edges of stream benches and drainageways. Here, brownish material from the former subsoil is exposed in most places.

This soil cannot be used so intensively as Bertrand silt loam, 6 to 12 percent slopes. If it is used for crops, a suitable cropping system is required. For high yields, the cropping system needs to be supported by practices to prevent further erosion. Large amounts of a complete fertilizer and manure are also needed. (Capability unit IVe-1; woodland group 1)

Bertrand silt loam, 12 to 20 percent slopes, moderately eroded (BeD2).—This soil lies in narrow bands along the edges of draws and terraces. Its surface layer is only 4 to 6 inches thick. In some small areas the soil is slightly eroded, and in other areas it is severely eroded. If this soil is plowed, dark-brown or dark yellowish-brown material from the former subsoil is turned up in about half of the acreage.

This soil is not well suited to row crops, because of the position and narrowness of the areas. Therefore, it is generally used for hay crops or pasture. If this soil is used for cultivated crops, practices are needed to control erosion. To help maintain productivity, choose a cropping system in which close-growing crops, rather than clean-tilled crops, are grown most of the time. Crops on this soil respond well if a complete fertilizer is applied and manure is added. Lime is needed in areas that are cultivated. (Capability unit IVe-1; woodland group 2)

Bertrand silt loam, 12 to 20 percent slopes, severely eroded (BeD3).—This soil occupies narrow bands along the edges of draws and terraces. Most of its original surface layer has been lost through erosion, and in some places part of the subsoil is gone. As a result, the present surface layer is generally dark brown to dark yellowish brown.

Because of the strong slopes, severe erosion, and susceptibility to further erosion, this soil is not suited to row crops. It is best suited to permanent pasture or to hay crops. If the pastures are renovated, yields of forage crops are fairly high. Yields are even better if a supplemental nitrogen fertilizer is added and sufficient lime is applied. (Capability unit VIe-1; woodland group 2)

Boone Series

The Boone series consists of light-colored, gently sloping to very steep, droughty upland soils formed in residuum from sandstone. Depth to bedrock ranges from a few inches to several feet. The shallower soils commonly occupy the steeper slopes. The native vegetation consisted of scrub oak and other drought-tolerant hardwoods, interspersed with areas that had a sparse cover of grass. Some areas previously cleared and cultivated have been planted to pines. All but a few acres of the Boone soils in the county are in the eastern half.

A representative profile of a Boone loamy fine sand follows:

0 to 7 inches, dark grayish-brown, very friable loamy fine sand.
7 to 36 inches, yellowish-brown or light yellowish-brown, very friable or loose loamy sand.
36 inches +, yellow sandstone.

The thickness of the surface layer ranges from 4 to 7 inches in cultivated fields. Undisturbed areas have a thinner and darker surface layer.

The soils that have a slope of less than 12 percent commonly contain varying amounts of fine sand. The sand washed or rolled from the finer grained Franconia sandstone above. The fine sand gives these soils a slightly more favorable moisture-supplying capacity than is normal for the Boone soils. The steep Boone soils are more variable in depth to sandstone than the less sloping ones, and their surface soil is somewhat coarser textured. In some of the steep areas, the proportions of sand and loamy sand in the surface soil are about equal, and the mapping unit is called Boone soils.

Boone soils have rapid permeability and low moisture-supplying capacity for plants. They are subject to wind and water erosion. Low natural fertility and low moisture-supplying capacity somewhat limit the selection of cover plants for erosion control. Unless limed, Boone soils are strongly to very strongly acid throughout.

Boone loamy fine sand, 2 to 6 percent slopes (BnB).—The profile of this soil is similar to the representative profile described, but the surface layer is darker colored. Most of this soil has been protected from erosion by a cover of trees or grass. The surface soil therefore contains more organic matter than is present in Boone soils that have been cultivated or eroded.

This soil dries out rapidly and, if not protected, is highly susceptible to wind erosion. It is low in natural fertility and in capacity to supply moisture for plants.

Some areas are used for crops, mainly for soybeans, corn, rye, oats, clover, and alfalfa. Grasses are included in some of the hay mixtures. Some areas have been planted to pine trees, and some fields have been abandoned and are now idle. (Capability unit IVs–1; woodland group 5)

Boone loamy fine sand, 2 to 6 percent slopes, eroded (BnB2).—The profile of this soil is similar to the representative profile described. The soil has lost from one-third to more than two-thirds of the original surface layer through wind and water erosion and will lose more if not protected. This soil dries out rapidly, has a low natural supply of plant nutrients, and is low in moisture-supplying capacity. The major crops are soybeans, corn, rye, oats, clover, and alfalfa. Some areas have been planted to pine trees. Some fields have been abandoned and now remain idle. (Capability unit IVs–1; woodland group 5)

Boone loamy fine sand, 6 to 12 percent slopes (BnC).—The surface layer of this soil is darker than that in the representative profile described. The soil has not been eroded or is only slightly eroded, because it was protected by a cover of trees or grass. The surface soil retains most of the original organic matter.

This soil has low moisture-supplying capacity and is too droughty and too susceptible to wind and water erosion to be used for row crops. It will, however, produce moderate yields of hay or pasture if well managed. The soil also is well suited to conifers and to plants that provide food and cover for wildlife. (Capability unit VIs–1; woodland group 5)

Boone loamy fine sand, 6 to 12 percent slopes, eroded (BnC2).—The profile of this soil is like the representative profile described. This soil has lost from one-third to more than two-thirds of its original surface layer, which contained more organic matter than the present surface soil.

Nearly all of this soil has been cultivated. Because of the low returns when used for crops, many fields were converted to pastures or to pine plantations, and the conversion is still going on. The low moisture-supplying capacity, the damage already done by erosion, and the susceptibility to further wind and water erosion make this soil unsuited to row crops. Crops on this soil produce moderate yields of hay and alfalfa if well managed. The soil is well suited to conifers and to plants that provide food and cover for wildlife. (Capability unit VIs–1; woodland group 5)

Boone loamy fine sand, 12 to 30 percent slopes, eroded (BnD2).—The profile of this soil is generally shallower than the one described as representative for the series. The soil varies in the color and thickness of the surface layer and in the depth to bedrock. Depth to sandstone bedrock ranges from less than 1 foot to several feet, and in places the sandstone is exposed.

This soil is susceptible to wind and water erosion. If gullies form, they are likely to become large and deep before they can be controlled.

Many areas of this soil are in forest and are only slightly eroded. Areas that formerly were in crops now have a cover of grass, are used for pasture, or are idle. This soil is better suited to pasture and trees than to row crops. However, its use for pasture is limited. Trees can be grown for timber or for sale as Christmas trees. (Capability unit VIIs–1; woodland group 6)

Boone soils, 12 to 30 percent slopes, severely eroded (BsD3).—This mapping unit is made up of loose, droughty, sandy soils that have lost more than two-thirds of their original surface layer through erosion. The texture of the present surface layer ranges from loamy fine sand to sand. The surface layer is generally lighter colored than that in the representative profile described, and the solum is thinner to bedrock. Depth to unweathered sandstone ranges from about 12 to 24 inches.

This soil formerly was used for crops. It now has a sparse cover of grass or is being planted to pine trees. (Capability unit VIIs–1; woodland group 6)

Boone soils, 30 to 60 percent slopes (BsF).—In these soils the profile is shallower to bedrock and is more droughty than the representative profile described. The soils are steep and variable in relief. They occupy a large acreage.

Mapped with these soils are areas of Hixton soils that are too small to be mapped separately.

Boone soils, 30 to 60 percent slopes, consists of sand to loamy fine sand. In thickness it ranges from a few inches to about 2 feet. Much of the acreage supports poor stands of oak trees. The soils have a thin mat of partly decomposed leaf litter on the surface and dark organic matter in the surface layer that help to absorb rainfall and to protect the soil from erosion. Trees on these soils yield some timber. The areas are also of value for wildlife. (Capability unit VIIs-1; woodland group 6)

Burkhardt Series

In the Burkhardt series are somewhat droughty, dark-colored sandy loams. These level to gently undulating soils are on stream terraces. They formed under prairie in sandy materials derived mainly from sandstone residuum or from well-sorted glacial outwash. They are underlain by coarse sandy outwash and fine gravel at a depth between 18 and 24 inches.

A representative profile of a Burkhardt sandy loam follows:

0 to 12 inches, black, very friable sandy loam.
12 to 18 inches, very dark brown, friable sandy loam.
18 to 24 inches, dark-brown, very friable loamy sand.
24 to 30 inches +, dark-brown, loose sand and gravel that becomes brown with increasing depth.

The color of the surface layer ranges from black to very dark brown. Otherwise, the profile varies mainly in the thickness of the solum and in the amount of sand and gravel in the underlying material. Depth to the underlying sandy and gravelly outwash ranges from 18 to 24 inches.

The soils have low moisture-supplying capacity, and they are only moderately productive. Runoff is medium to slow, depending on the steepness of the slope. Permeability and internal drainage are somewhat rapid. The root zone extends to a depth between 16 and 24 inches. The content of organic matter originally was fairly high, but it has been depleted by intensive use for cultivated crops.

In this county most of the acreage of Burkhardt soils is on the terraces and outwash plains along the Mississippi and Chippewa Rivers. Because of their fairly gentle relief, these soils are used mainly for crops.

Burkhardt sandy loam, 0 to 2 percent slopes (BuA).—This soil is in broad, nearly level areas on stream terraces and outwash plains. Its profile is like the representative profile described.

This soil has low moisture-supplying capacity and is droughty. Wind erosion is a problem on broad, open areas, and practices are required to help control erosion.

Most areas of this soil are in crops, mainly corn, small grains, and crops grown for forage. Yields are low. (Capability unit IIIs-1; woodland group 3)

Burkhardt sandy loam, 2 to 6 percent slopes (BuB).—This soil is on slightly undulating, broad stream benches. Depth to loose sand and gravel is slightly less than in the representative profile described.

This soil can be used and managed about the same as Burkhardt sandy loam, 0 to 2 percent slopes. (Capability unit IIIs-1; woodland group 3)

Burkhardt sandy loam, 2 to 6 percent slopes, moderately eroded (BuB2).—This soil occupies undulating stream terraces. Its surface layer is thinner and slightly lighter colored than that in the representative profile described. From one-third to two-thirds of the original surface layer has been removed through erosion. In places plowing has mixed material from the former subsoil with the remaining surface soil, and, as a result, the present surface layer is brownish in color. Depth to the underlying material generally is less in this soil than in the less eroded Burkhardt soils.

This soil is subject to wind and water erosion. It is suited to the same crops as Burkhardt sandy loam, 0 to 2 percent slopes. (Capability unit IIIs-1; woodland group 3)

Burkhardt sandy loam, 6 to 12 percent slopes, severely eroded (BuC3).—Most areas of this soil are in small acreages on breaks along draws or along the edges of terraces. The layers that make up the profile are thinner than those in the representative profile described. Consequently, this soil contains less organic matter and has lower moisture-supplying capacity. More than two-thirds of the original surface layer has been removed through erosion. The present surface layer is brownish, and in many places material from the underlying sand and gravel is mixed in it.

This soil is subject to sheet and gully erosion. It is not suited to row crops, and most of the acreage is used for hay. (Capability unit VIs-1; woodland group 3)

Chaseburg Series

The Chaseburg series is made up of deep, moderately light colored soils that are well drained to moderately well drained. The soils formed in silty sediments, more than 42 inches thick, moved from nearby uplands and terraces by water and soil creep. They are at the heads of draws, along intermittent streams that flow out of small drainage basins, and along the base of steep slopes. Most of the areas are small and are widely distributed throughout the county. Generally, the slope ranges from 0 to 6 percent, but in a small acreage it is steeper.

A representative profile of a Chaseburg silt loam follows:

0 to 24 inches, very dark grayish-brown, very friable silt loam.
24 to 32 inches, dark grayish-brown, friable silt loam.
32 to 42 inches, dark-brown, friable silt loam.
42 inches +, yellowish-brown, friable silt loam.

Differences in the source of sediments cause minor variations in color throughout the profile. In a few small areas, stones, sand, or gravelly overwash are on the surface. There are thin, sandy strata throughout the profile in places. The Chaseburg soils are dominantly well drained.

The Chaseburg soils are moderate in permeability and high in moisture-supplying capacity. Runoff is medium. The solum is neutral to medium acid. These soils are friable and have a deep rooting zone. They are fairly low in organic matter, but they are high in natural fertility.

Chaseburg silt loam, 0 to 2 percent slopes (CaA).—This nearly level soil is along intermittent drainageways. Its profile is like the representative profile described. This soil is subject to overflow. Consequently, a few areas have an overwash of sandy loam or loam on the surface.

This soil is well suited to all of the crops commonly grown in the county. If the supply of plant nutrients is kept high and a suitable cropping system is used, this soil can be cropped intensively. The crops respond well to good management. There is only a slight risk of erosion. No special practices are required to protect the soil, except where flooding occurs. Here, dikes can be used to prevent overflow by floodwaters. Otherwise, the areas should be kept in pasture or trees.

Crops on this soil respond well if a commercial fertilizer is applied. In places yields of corn are low because the soil needs nitrogen. In many places lime is needed for high yields of legumes. (Capability unit I-1; woodland group 1)

Chaseburg silt loam, 2 to 6 percent slopes (CaB).—This soil is in gently sloping drainageways in the uplands, on bottoms along intermittent streams, and in alluvial fans on terraces and high bottoms. Its surface layer generally is slightly thinner than that in the representative profile described. Also, in places, especially at the heads of draws, there are a few stones on the surface or throughout the profile.

Mapped with this soil are a few acres of a Chaseburg soil that has a slope of more than 6 percent.

The hazard of erosion is slightly greater on this soil than on Chaseburg silt loam, 0 to 2 percent slopes. Consequently, more careful management is required to control erosion. Practices are also needed to prevent further damage because of soil material washed onto this soil from higher lying areas. About the same crops can be grown on this soil as are grown on Chaseburg silt loam, 0 to 2 percent slopes. (Capability unit IIe-1; woodland group 1)

Curran Series

The Curran series is made up of deep, light-colored, silty soils on high stream terraces. These nearly level soils are somewhat poorly drained. Most of the acreage is within the valleys of Little and Big Arkansaw Creeks in the northwestern part of the county. The areas are small, but the soils are locally important to agriculture.

A representative profile of Curran silt loam follows:

0 to 7 inches, very dark grayish-brown, friable silt loam.
7 to 8 inches, gray to grayish-brown, friable silt loam; mottles of dark yellowish brown.
8 to 12 inches, grayish-brown, firm silt loam; mottles of dark yellowish brown; bleached silt coats.
12 to 25 inches, dark grayish-brown, firm silty clay loam that grades to silt loam in the lower part of the layer; mottles of dark yellowish brown.
25 to 34 inches, grayish-brown, friable silt loam; mottles of yellowish brown.

The structure of the surface layer is granular in many places. In a few areas the dominant color of the middle layers is brown, rather than grayish brown. There is sand below a depth of 3½ feet in places.

These soils have slow internal drainage and high moisture-supplying capacity. Natural fertility is moderately high. The soils are slightly acid to strongly acid.

Curran silt loam (Cu).—This is the only Curran soil mapped in the county. It generally has a slope of 0 to 2 percent, but in places the slope is as much as 5 percent. Its profile is the representative profile described.

Drainage of this soil needs to be improved. Alfalfa, in particular, is hard to establish unless adequate drainage is provided. Slow internal drainage also delays tillage in spring. If the soil is drained and is well managed otherwise, yields of corn, oats, and hay are high. Corn and small grains respond well if nitrogen fertilizer is added, especially if the fertilizer is applied early in spring. In most places lime is needed for high yields of legumes. In some places there is a slight risk of erosion. (Capability unit IIw-1; woodland group 8)

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Dakota Series

The Dakota series consists of moderately deep, dark-colored soils on stream terraces. The soils are well drained, are nearly level to sloping, and have formed under prairie in outwash of loam and sandy loam. They are underlain by loose sand at a depth between 24 and 36 inches.

A representative profile of Dakota fine sandy loam in a cultivated field follows:

0 to 8 inches, very dark brown, very friable fine sandy loam.
8 to 13 inches, very dark grayish-brown, very friable fine sandy loam.
13 to 25 inches, dark-brown, friable loam that grades to fine sandy loam in the lower part of this layer.
25 to 31 inches, dark-brown, very friable loamy sand.
31 inches +, strong-brown, loose sand that contains a few pebbles.

In undisturbed areas the surface layer of Dakota fine sandy loam is 8 to 13 inches thick and is black to very dark brown. The solum ranges from 24 to 36 inches in thickness, but it is generally about 38 inches thick. The underlying material ranges from fine sand to coarse sand, and in many places it contains a small amount of gravel.

A representative profile of a Dakota loam follows:

0 to 10 inches, very dark brown to black, very friable loam.
10 to 14 inches, dark-brown, firm heavy loam.
14 to 23 inches, dark-brown, firm heavy loam.
23 to 28 inches, dark-brown, friable light loam.
28 to 42 inches +, strong-brown, loose sand that is yellowish brown in the lower part of this layer.

In undisturbed areas the surface layer of the Dakota loams is generally black. In cultivated but uneroded areas, the surface layer is very dark brown. Where the soil is eroded, the surface layer is grayish brown. Variations in the Dakota loams are chiefly in the size of the particles of the underlying sand and in the thickness of the solum.

All the Dakota soils are moderate to moderately rapid in permeability. They are medium to moderately low in moisture-supplying capacity and are moderate in natural fertility. These soils are strongly acid to neutral unless they have been limed.

Dakota fine sandy loam, 0 to 2 percent slopes (DaA).—This soil is on stream terraces. Its profile is like the representative profile of the Dakota fine sandy loam described.

This soil is well suited to all of the crops commonly grown in the county. If a suitable cropping system is used and the supply of plant nutrients and organic matter is maintained, this soil can be cropped intensively. There is a slight risk of wind erosion, but no special practices are needed to prevent erosion if the soil is otherwise well managed. Generally, yields are moderately high. During dry periods, however, lack of moisture causes crops to make lower yields in many places. The capacity of this soil for storing moisture is so low that in dry years corn, hay, and other crops planted late in the season are damaged by drought. Crops grown on this soil respond well if lime and fertilizer are applied. (Capability unit IIIs–1; woodland group 3)

Dakota fine sandy loam, 2 to 6 percent slopes (DaB).—The solum of this soil is thinner than that of the Dakota fine sandy loam for which a representative profile is described. Also, the risk of erosion is somewhat greater. Therefore, careful management is required to control erosion. Otherwise, this soil can be used and managed about the same as Dakota fine sandy loam, 0 to 2 percent slopes. (Capability unit IIIs–1; woodland group 3)

Dakota fine sandy loam, 2 to 6 percent slopes, moderately eroded (DaB2).—The surface layer of this soil is thinner and slightly lighter colored than that in the profile described for the Dakota fine sandy loams. From 4 to 8 inches of the original surface layer has been lost through wind and water erosion. Plowing has mixed material from the subsoil with the remaining surface layer.

The hazard of erosion is greater on this soil than on Dakota fine sandy loam, 0 to 2 percent slopes. Therefore, greater care is needed to control erosion. If fairly simple practices are used to prevent erosion, and if plant nutrients and lime are added, this soil can be cropped fairly intensively. (Capability unit IIIs–1; woodland group 3)

Dakota loam, 0 to 2 percent slopes (DbA).—The profile of this soil is similar to the one described for the Dakota loams, except that depth to the underlying sand is 28 to 36 inches.

The nearly level relief and thick, friable surface layer make this soil easy to till. All of this soil is in crops. It is well suited to row crops, small grains, and hay, and to green beans, peas, and other special crops. Yields are high if the soil is well managed. Because this soil is slightly droughty, the content of organic matter needs to be kept high and lime and fertilizer should be applied. Apply the lime and fertilizer according to the needs indicated by soil tests. (Capability unit IIs–1; woodland group 9)

Dakota loam, 2 to 6 percent slopes (DbB).—The profile of this soil is like the representative profile described for the Dakota loams.

This soil is well suited to all the crops commonly grown in the county. It is moderately susceptible to erosion and is slightly droughty. Nevertheless, if fairly simple practices are used to control erosion and fertilizer and lime are applied, this soil can be cropped fairly intensively. (Capability unit IIe–2; woodland group 9)

Dakota loam, 2 to 6 percent slopes, moderately eroded (DbB2).—The surface layer of this soil is lighter colored than that in the representative profile described for the Dakota loams, and the content of organic matter is lower. From 4 to 8 inches of the original surface layer has been removed through erosion, and in places plowing has mixed dark-brown material from the subsoil with the remaining surface soil. Runoff is greater on this soil than on the less eroded Dakota loams.

This soil is well suited to row crops, small grains, and hay, and all of it is used for crops. If practices are applied to help control erosion, and if crop residues are plowed under and manure is added, the moisture-supplying capacity and tilth will be improved. Crops grown on this soil respond well if lime and fertilizer are applied according to the needs indicated by soil tests. (Capability unit IIe–2; woodland group 9)

Dakota loam, 6 to 12 percent slopes, moderately eroded (DbC2).—The surface layer of this soil is lighter colored and thinner than that in the representative profile described for the Dakota loams. All but 4 to 6 inches of the original surface layer has been removed through erosion, and plowing has mixed material from the former subsoil with the remaining surface soil. As a result, the present surface layer is a lighter brown than the original one.

This soil is suited to corn, small grains, and hay. It is mainly in narrow bands along the edges of stream terraces and drainageways, however, where it is subject to gully erosion. Practices are required to help control erosion and to supply organic matter. Lime and fertilizer are also needed. (Capability unit IIIe–3; woodland group 9)

Dillon Series

The Dillon series consists of deep, dark-colored, sandy soils on stream terraces. The soils are very poorly drained. They are in level areas and in slight depressions in the eastern part of the county. These soils formed under a luxuriant growth of grasses, sedges, reeds, and other plants that tolerate wetness. They have a thick, black surface layer.

A representative profile of Dillon fine sandy loam in a cultivated field follows:

0 to 11 inches, black, very friable fine sandy loam.
11 to 14 inches, very dark gray to grayish-brown, very friable loamy fine sand.
14 to 26 inches, light brownish-gray, loose fine sand; mottles of yellowish brown.
26 to 46 inches, grayish-brown, loose fine sand.
46 inches +, brown, loose sand.

The surface layer is 10 to 15 inches thick. In uncultivated areas there are a few inches of peat or muck overlying the surface layer in places.

Dillon soils are rapid in permeability. Runoff is slow. These soils have an intermittent high water table. The water table fluctuates from about 1 foot below the surface in spring, or following periods of extended rainfall, to a depth of more than 4 feet in summer. Generally, these soils have high moisture-supplying capacity, but in places, during the latter part of the growing season, yields are somewhat limited by lack of moisture. Unless they have been limed, these soils are medium acid to strongly acid.

Dillon fine sandy loam (Dc).—This is the only Dillon soil mapped in the county. Its profile is like the representative profile described.

The drainage of this soil needs to be improved if crops are to grow well. Also, a fertilizer that contains phosphate and potash is generally needed to raise the level of plant nutrients.

If alfalfa is grown on this soil, potash and lime are needed. If corn and small grains are grown, nitrogen ought to be applied and crop residues should be returned to the soil for high yields. (Capability unit IVw–1; woodland group 7)

Downs Series

In the Downs series are moderately dark colored, deep, well-drained soils. These soils formed in a mantle of windblown silt, or loess, 42 or more inches thick. Some of the soils are near the Fayette soils on broad ridges underlain by limestone. Others are on benches—low ridges and hills—that are believed to be the remnants of old stream terraces dissected by erosion. These Downs soils on benches are underlain by greenish glauconitic sandstone. In this county they are in positions about halfway between those of the soils on upland ridges and those of the soils on stream terraces.

Most of the Downs soils have convex slopes of 2 to 12 percent, but some of them on benches have slopes of as much as 30 percent. The Downs soils on ridges occupy a larger acreage than those on benches. They are in the far western part of the county and are mostly within Stockholm Township. The acreage on benches is in the broad valley of Bear Creek in the eastern part of the county.

A representative profile of a Downs silt loam in a cultivated field follows:

0 to 9 inches, very dark brown, very friable silt loam.
9 to 12 inches, brown, very friable silt loam.
12 to 16 inches, dark-brown, friable silt loam.
16 to 23 inches, dark-brown, firm silty clay loam.
23 to 38 inches, dark yellowish-brown, firm silty clay loam.
38 inches +, dark yellowish-brown, friable silt loam.

In undisturbed areas or in slightly eroded areas, the surface layer of the Downs silt loams is black to very dark brown. In cultivated areas and in eroded areas, the surface layer is very dark grayish brown to brown. In places the layer of firm silty clay loam extends to a depth of as much as 42 inches, but in other places it is at a depth of less than 38 inches. Depth of the silty material over limerock ranges from 42 inches to several feet.

A representative profile of a Downs silt loam, benches, in an undisturbed area follows:

0 to 8 inches, black, very friable silt loam.
8 to 13 inches, very dark grayish-brown to dark grayish-brown, very friable silt loam.
13 to 17 inches, dark grayish-brown, friable silt loam.
17 to 36 inches, dark-brown, friable to firm light silty clay loam.
36 inches +, dark-brown and pale-brown, friable silt loam.

The surface layer of the Downs soils on benches is brown to very dark grayish brown or black. The thickness of the solum ranges from 32 to 42 inches.

All of the Downs soils are moderate in permeability and high in moisture-supplying capacity. Roots can penetrate deep into them. In undisturbed areas the soils are nearly neutral and are high in fertility.

Downs silt loam, 2 to 6 percent slopes (DdB).—This soil is slightly eroded, but its profile is otherwise like the profile of the Downs silt loam described. In a few small areas, this soil is not cultivated and the surface layer is black or very dark brown. This soil is on the gently sloping tops of broad ridges. Because of its gentle slope and its position on the landscape, runoff is not excessive.

This soil is well suited to row crops, small grains, and hay. Practices are required to help to control erosion. (Capability unit IIe–1; woodland group 1)

Downs silt loam, 2 to 6 percent slopes, moderately eroded (DdB2).—The surface layer of this soil is slightly thinner than that of the Downs silt loam described. It is 6 to 8 inches thick. This soil is on the tops of broad ridges and occupies the gently sloping parts of the ridges.

This soil is well suited to row crops, small grains, and hay. It is highly productive if well managed, but it is susceptible to further erosion if it is used for crops and not protected. Terracing, contour stripcropping, and returning crop residues to the soil will reduce runoff and erosion. The crops grown respond well if lime and fertilizer are applied. (Capability unit IIe–1; woodland group 1)

Downs silt loam, 6 to 12 percent slopes, moderately eroded (DdC2).—This soil has lost from one-third to two-thirds of its original surface layer through erosion. About 4 to 8 inches of the original surface layer remains.

In some areas this soil covers the entire top of the ridge. In other places it occupies only the outer edge of the top of the ridge and lies just below less sloping Downs soils.

If this soil is well managed, it is well suited to row crops, small grains, and hay. Nearly all of it is used for crops. Practices are needed to control erosion. If a cropping system is used in which crops are grown that keep the content of organic matter high, tilth is improved. The ability of the soil to absorb rainfall is also improved and runoff is reduced. This soil is highly productive if adequate fertilizer and lime are supplied. (Capability unit IIIe–1; woodland group 1)

Downs silt loam, benches, 2 to 6 percent slopes, moderately eroded (DeB2).—The surface layer of this soil is slightly lighter colored than that in the profile described for Downs silt loam, benches. Erosion and mixing by plowing have made the surface layer very dark brown rather than black.

This soil is on fairly narrow, gently sloping tops of ridges that make up the dissected benches. Because it lies above other soils and the surface layer generally has favorable structure, runoff is not a serious problem.

This soil is highly productive. If it is well managed, it is well suited to corn and oats, to alfalfa and bromegrass grown together, and to special crops: This soil can be cropped intensively if fairly simple practices are used to control erosion and if fertility is kept high. (Capability unit IIe–1; woodland group 1)

Downs silt loam, benches, 6 to 12 percent slopes, moderately eroded (DeC2).—This soil has lost from one-third to two-thirds of its original surface layer through erosion. The present surface layer is very dark grayish brown. The subsoil is slightly thinner than that in the profile described for Downs silt loam, benches.

This soil is on the tops of ridges that make up the dissected benches, or is in long, narrow strips just below the crest of the ridges. Because of its slope and the low content of organic matter in the surface layer, much rainfall runs off and causes further erosion.

This soil is suited to corn, grain, hay, and other crops commonly grown in the county. If practices are used to reduce runoff and other good management is used, high yields are obtained. (Capability unit IIIe–1; woodland group 1)

Downs silt loam, benches, 12 to 20 percent slopes (DeD).—The subsoil of this soil is slightly thinner than that in the representative profile described for Downs silt loam, benches. This soil is in small areas at the heads of valleys or on the ends of ridges that make up the dissected benches. The areas are mostly in trees or pasture.

If this soil is carefully managed to control erosion, it is suited to field crops. High yields of legumes and grasses grown for pasture can be obtained if lime and fertilizer are applied according to the needs indicated by soil tests. (Capability unit IVe–1; woodland group 2)

Downs silt loam, benches, 12 to 20 percent slopes, moderately eroded (DeD2).—The profile of this soil is thinner than the one described as representative of Downs silt loam, benches, and the surface layer is lighter colored. Only 4 to 6 inches of the original surface layer remains. Plowing has mixed material from the subsoil with the remaining surface soil. As a result, the present surface layer is very dark grayish brown. The subsoil extends to a depth of about 36 inches.

Most of this soil is on the sides of long, narrow ridges that make up the dissected benches. It is in a lower position than the other Downs soils on benches and receives runoff from them.

This soil is used mostly for field crops. The main crops in the cropping system are those grown for hay or pasture. Careful management is required. Stripcropping, diversions, and practices to maintain fertility are needed to control erosion and to maintain high yields. (Capability unit IVe–1; woodland group 2)

Downs silt loam, benches, 12 to 20 percent slopes, severely eroded (DeD3).—This soil has lost more than two-thirds of its original surface layer through erosion. The surface layer and the subsoil are thinner than those in the profile described for Downs silt loam, benches. Also, plowing has mixed material from the lighter colored subsoil with the remaining surface soil. As a result, the present surface layer is dark brown and the subsoil is less friable. The soil is also more difficult to till and is more susceptible to erosion. This soil receives runoff from higher areas. It therefore is susceptible to further erosion. In a small acreage the slope is as steep as 30 percent. This soil is suited mainly to hay and pasture. (Capability unit VIe–1; woodland group 2)

Downs silt loam, benches, 20 to 30 percent slopes, moderately eroded (DeE2).—The surface layer of this soil is thinner and lighter colored than that in the profile of Downs silt loam, benches, described, and the subsoil is thinner. The surface layer is 4 to 6 inches thick and is very dark grayish brown. The subsoil extends to a depth of about 36 inches.

Mapped with this soil are a few small areas of a steep Downs soil that is less eroded than this soil.

Downs silt loam, benches, 20 to 30 percent slopes, moderately eroded, occupies long, narrow areas on the sides of hills below less sloping Downs soils. It is too steep for row crops and is better suited to hay and pasture. If fertilizer is applied and the soil is otherwise well managed, yields are high. (Capability unit VIe–1; woodland group 2)

Dubuque Series

The Dubuque series consists of moderately deep to deep, light-colored, silty soils that are well drained. These soils formed on uplands in a mantle of windblown silt, or loess, and partly in reddish clay that weathered from and lies over dolomitic limestone. The silt ranges from 1 to 3½ feet in thickness and overlies clayey material that weathered from limestone. The clayey material is a few inches to several feet thick. The native vegetation was a hardwood forest made up chiefly of oak, hickory, and hard maple.

The soils of this series differ in depth to clayey material. In the soils not named as deep, the clayey material is at a depth of 12 to 20 inches. In contrast, in the deep Dubuque soils it is at a depth of 20 to 42 inches.

Most of the Dubuque soils are on ridges throughout the western part of the county. Typically, they are on the tops of narrow ridges or are along the more sloping edges of the broader ridges. The steep areas are used mainly as pastures or as woodland. The less sloping areas are used mainly for crops.

These soils are productive if well managed. They are important to the economy of the county.

The following describes a representative profile of a Dubuque silt loam not named as deep, in a cultivated field:

0 to 6 inches, dark grayish-brown, friable silt loam.
6 to 13 inches, dark yellowish-brown, very friable silt loam.
13 to 18 inches, yellowish-brown, friable silt loam.
18 to 28 inches, strong-brown clay; sticky and plastic when wet, and hard when dry.
28 to 36 inches, reddish-brown clay; sticky and plastic when wet, and hard when dry.
36 inches +, limestone.

In the Dubuque soils not named as deep, the depth to clay ranges from 12 to 20 inches. The thickness of the clay over the underlying limestone ranges from a few inches to several feet. The size and amount of chert fragments in the soil vary considerably. In wooded areas the surface layer is darker than in areas that are cultivated.

The following describes a representative profile of a Dubuque silt loam, deep, in an undisturbed area:

0 to 1 inch, black, very friable silt loam.
1 to 9 inches, dark grayish-brown to brown, very friable silt loam.
9 to 12 inches, dark-brown, friable silt loam.
12 to 32 inches, dark-brown, firm silty clay loam.
32 to 42 inches, reddish-brown clay; sticky and plastic when wet, and hard when dry.
42 inches +, limestone.

In the deep Dubuque silt loams, the surface layer of the soils that have been tilled is dark grayish brown to very dark grayish brown. Depth to the reddish clay ranges from 20 to 42 inches. The thickness of the red clay over limestone ranges from a few inches to several feet. In places there are chert fragments on the surface and throughout the profile.

All of the Dubuque soils are moderate in permeability and are moderate to high in moisture-supplying capacity. Runoff is medium on the gently sloping soils and rapid on the steep ones. Unless they have been limed, these soils are acid throughout the profile.

Dubuque silt loam, 2 to 6 percent slopes, moderately eroded (DfB2).—The profile of this soil is similar to the representative profile described for the Dubuque silt loams not named as deep. This soil has lost from one-third to two-thirds of its original surface layer through erosion.

Mapped with this soil are a few small areas of a less eroded soil. Areas of this included soil are too small to be mapped separately.

Nearly all of Dubuque silt loam, 2 to 6 percent slopes, moderately eroded, is used for crops. If fairly simple practices are used to protect it and other good management is used, this soil is suited to corn, oats, and alfalfa and bromegrass grown together for hay. Yields are good.

Practices are required to control erosion. If a cropping system is used that provides a supply of organic matter, tilth is improved and the capacity of the soil to absorb rainfall is also improved. Crops on this soil respond well if fertilizer and lime are added according to the needs indicated by soil tests. (Capability unit IIe-2; woodland group 1)

Dubuque silt loam, 6 to 12 percent slopes (DfC).—The surface layer of this soil is darker than that in the profile described for the Dubuque silt loams not named as deep, because it contains more organic matter. The organic matter is from decomposed leaf litter and makes the surface layer dark grayish brown to black.

This soil is mainly on narrow ridges or on the tops of ridges. The size and shape of the areas make them difficult to cultivate or inaccessible to farm equipment. Therefore, nearly all of the areas are in trees, and the soil is only slightly eroded. (Capability unit IIIe-3; woodland group 1)

Dubuque silt loam, 6 to 12 percent slopes, moderately eroded (DfC2).—From one-third to two-thirds of the original surface layer of this soil has been removed through erosion. Brownish to reddish subsoil is exposed in places because of erosion or because of plowing.

This soil is on the crests and slopes of ridges, and nearly all the areas are cultivated. It is suited to row crops, small grains, and hay if erosion is controlled and other good management is used. (Capability unit IIIe-3; woodland group 1)

Dubuque silt loam, 12 to 20 percent slopes (DfD).—The surface layer of this soil is darker than that in the profile described for the Dubuque silt loams not named as deep, because it contains more organic matter. The organic matter is from partly decomposed leaf litter, and it makes the surface layer very dark grayish brown to very dark brown.

This soil generally is on the tops or ends of narrow ridges, or it is in other areas that are not well suited to farming or that are not easily accessible. Therefore, most areas are in trees, and the soil has a mat of leaf litter on the surface that protects it from erosion and helps absorb water.

If this soil is cultivated, careful management is required to prevent severe erosion. The soil is not suited to intensive tillage. High yields of hay and pasture can be obtained if lime and fertilizer are applied. Good timber management is required to obtain the best yields of timber. (Capability unit IVe-2; woodland group 2)

Dubuque silt loam, 12 to 20 percent slopes, moderately eroded (DfD2).—From one-third to two-thirds of the original surface layer of this soil has been lost through erosion, and in a small acreage more than two-thirds is gone. Depth to the plastic clay subsoil is only 12 to 15 inches in some places. In a few places brown material from the subsoil is exposed. Fragments of chert are on the surface and in the profile in some places.

This soil is on the sides of ridges below areas of less sloping Dubuque soils, and it receives runoff from them. It is moderately productive if well managed, but it is not suited to intensive use for cultivated crops. If this soil were to become more eroded, it would be more difficult to till and its productivity would decrease. Therefore, the cropping system should consist mainly of crops grown for hay or pasture. (Capability unit IVe-2; woodland group 2)

Dubuque silt loam, 20 to 30 percent slopes (DfE).—This soil has a cover of trees and is not eroded or is only slightly eroded. The surface layer is darker than that in the profile described for the Dubuque silt loams not named as deep. Also, the silty upper part of the profile is generally thinner over clay. It ranges from 12 to 15 inches in thickness.

Because of strong slopes and susceptibility to erosion, this soil is better suited to pasture or trees than to cultivated crops. (Capability unit VIe-1; woodland group 2)

Dubuque silt loam, 20 to 30 percent slopes, moderately eroded (DfE2).—The profile of this soil is thinner than the one described for Dubuque soils not named as deep. The brown to reddish-brown, cherty subsoil is also thinner. The present surface layer is 4 to 6 inches thick. The silty upper part of the profile is only about 12 inches thick.

In places depth to limestone bedrock is 18 inches or less. Fragments of chert are on the surface and throughout the profile in most places. In some places there are shallow gullies and the clayey subsoil is exposed.

On most areas of this soil, tillage is limited to preparing the areas for seeding of grasses and legumes for pasture. Some of the less accessible areas are in pastures of bluegrass. A few areas are reverting to trees. (Capability unit VIe-1; woodland group 2)

Dubuque silt loam, 30 to 45 percent slopes (DfF).—Most of this soil has a cover of trees. Therefore, it is not eroded or is only slightly eroded. Organic matter from partly decomposed leaf litter makes the surface layer darker than that in the profile described for Dubuque silt loams not named as deep. Depth to the reddish-brown, cherty subsoil is 12 to 18 inches. There are outcrops of limestone in places.

Included with this soil are a few small areas of a soil that is moderately eroded or is severely eroded. Also included is a small acreage of a soil that has a thicker profile than this soil.

Dubuque silt loam, 30 to 45 percent slopes, is high in organic matter. The organic matter helps absorb and hold water, thereby reducing runoff on areas that lie below higher lying soils. (Capability unit VIIe-1; woodland group 2)

Dubuque silt loam, deep, 2 to 6 percent slopes (DpB).—Areas of this soil are mainly on the tops or ends of narrow ridges or in other areas that are not well suited to farming or that are not easily accessible. Therefore, nearly all the areas are in trees that provide a mat of leaf litter that helps protect this soil from erosion.

If this soil is used for cultivated crops, lime and fertilizer are required for high yields. Apply the lime and fertilizer according to the needs indicated by soil tests. The areas in trees require protection from fire and grazing and other good management to maintain yields of timber. (Capability unit IIe-1; woodland group 1)

Dubuque silt loam, deep, 2 to 6 percent slopes, moderately eroded (DpB2).—The surface layer of this soil is lighter colored than that in the profile described for the deep Dubuque silt loams. From one-third to two-thirds of the original surface layer has been removed through erosion. The present surface layer is 4 to 8 inches thick. Mixing by plowing has made its color dark grayish brown to very dark grayish brown.

This soil is on the tops of rounded ridges, and nearly all areas are cultivated. If well managed, this soil is well suited to row crops, small grains, and hay. Yields are high. Runoff is not excessive, but some practices are needed to help control erosion. Crops on this soil respond well if lime and fertilizer are added according to the needs indicated by soil tests. (Capability unit IIe–1; woodland group 1)

Dubuque silt loam, deep, 6 to 12 percent slopes (DpC).—Most areas of this soil are in trees. Therefore, they are not eroded or are only slightly eroded. The areas are mainly on the tops or ends of narrow ridges and generally are not well suited to tillage. If this soil is cultivated, careful management is required to prevent erosion. (Capability unit IIIe–2; woodland group 1)

Dubuque silt loam, deep, 6 to 12 percent slopes, moderately eroded (DpC2).—The surface layer of this soil is lighter colored than that in the profile described for the deep Dubuque silt loams. As much as two-thirds of the original surface layer is gone in places. The present surface layer is 4 to 8 inches thick. Because of mixing by plowing, the color is dark grayish brown.

This soil is on ridge slopes, and nearly all areas are used for cultivated crops. The main crops are corn, oats, and alfalfa and bromegrass grown together. If the soil is protected from erosion and lime and fertilizer are applied, high yields can be obtained. (Capability unit IIIe–2; woodland group 1)

Dubuque silt loam, deep, 12 to 20 percent slopes (DpD).—This soil has slightly thinner layers than those in the profile described for the deep Dubuque silt loams. Depth to the reddish-brown, clayey material ranges from 24 to 28 inches.

This soil is in trees. It, therefore, is not eroded or is only slightly eroded. Because of the moderately strong slopes and the severe hazard of erosion, careful management is required if this soil is used for crops. The trees require protection from fire and grazing and need other good management that helps to maintain yields. (Capability unit IVe–1; woodland group 2)

Dubuque silt loam, deep, 12 to 20 percent slopes, moderately eroded (DpD2).—This soil has lost from one-third to two-thirds of its original surface layer through erosion. Depth to reddish-brown, clayey material is less than in the profile described for the deep Dubuque silt loams. Also, the thin, dark A1 layer is lacking because of plowing. The present surface layer is about 4 to 6 inches thick and is dark grayish brown. Depth to clay ranges from about 24 to 28 inches.

This soil is not suited to intensive use for cultivated crops. Nevertheless, moderately high yields of row crops, small grains, and hay can be made if the soil is protected from erosion and is otherwise well managed. Use a cropping system made up mainly of hay crops. Add lime and fertilizer according to the needs indicated by soil tests. (Capability unit IVe–1; woodland group 2)

Dubuque silt loam, deep, 20 to 30 percent slopes (DpE).—This soil has slightly thinner layers than those in the profile described for the deep Dubuque silt loams. Also, in many places the layer of clay is thinner and the limestone bedrock is at a depth between 24 and 32 inches. Generally, depth to the reddish-brown clay is about 24 inches.

Nearly all of this soil has a cover of trees. Therefore, the soil is not eroded or is only slightly eroded. (Capability unit VIe–1; woodland group 2)

Dubuque silt loam, deep, 20 to 30 percent slopes, moderately eroded (DpE2).—This soil has a lighter colored surface layer and slightly thinner subsoil layers than those in the profile described for the Dubuque silt loams. From one-third to two-thirds of the original surface layer has been removed through erosion. The present surface layer is 4 to 6 inches thick and is dark grayish brown. Depth to the reddish-brown, clayey subsoil is about 24 inches.

At one time this soil was used mainly for crops, but now nearly all the areas are in pasture. Because this soil is steep and susceptible to erosion, it is not suited to intensive cultivation. High yields of forage can be obtained if pastures are renovated. Generally, large amounts of a fertilizer containing phosphate and potash are needed for high yields of alfalfa and bromegrass. (Capability unit VIe–1; woodland group 2)

Dubuque soils, 6 to 12 percent slopes, severely eroded (DsC3).—This mapping unit is made up of Dubuque silt loams that have lost more than two-thirds of their original surface layer through erosion. Plowing has mixed brown to reddish-brown, clayey material from the subsoil with the remaining surface soil. As a result, in many places the present surface layer is finer textured than that in the profile described for the Dubuque silt loams not named as deep. Fragments of chert are scattered on the surface in most places.

Poor tilth makes these soils difficult to cultivate. Most areas are therefore used mainly for hay or pasture. Careful management is required if the soils are used for cultivated crops. If large amounts of lime and fertilizer are added and practices are used to supply organic matter, good yields can be obtained. (Capability unit IVe–2; woodland group 1)

Dubuque soils, deep, 12 to 20 percent slopes, severely eroded (DtD3).—This mapping unit is made up of deep Dubuque silt loams that have lost more than two-thirds of their original surface layer through erosion. The surface layer is thinner and depth to the reddish-brown clay is less than in the profile described for the deep Dubuque silt loams. Depth to clay is about 24 inches. In much of the acreage, brownish material formerly in the subsoil has been exposed by plowing. As a result, the soils have a lower infiltration rate, are lower in organic matter, and are more difficult to keep in good tilth. The areas where the subsoil material has been exposed erode more easily than where the surface layer is not eroded.

These soils formerly were used chiefly for crops. Many areas are now used for hay or have been converted to pasture. The soils are better suited to renovated pasture or to sod-forming crops than to row crops. (Capability unit VIe–1; woodland group 2)

Dubuque soils, deep, 20 to 30 percent slopes, severely eroded (DtE3).—This mapping unit is made up of deep Dubuque silt loams that have lost more than two-thirds of their original surface layer through erosion. Their profile is thinner over red clay than that described for the deep Dubuque silt loams. Depth to the clay is generally about 20 to 24 inches. In most places brownish material from the subsoil is exposed. As a result, these soils are less friable, have a lower infiltration rate, and are lower in organic matter than the original ones. Consequently, they are hard to keep in good tilth. In areas where the subsoil is not exposed, the surface layer is dark grayish brown.

At one time these soils were used for cultivated crops. Now, nearly all the areas are used for pastures of bluegrass or for improved pastures. Some of the less accessible areas and areas that are gullied are idle and are reverting to trees.

These soils are hard to cultivate. It is best to keep them in sod-forming crops. If lime and fertilizer are added, moderate yields of alfalfa and bromegrass grown for pasture, and of other mixtures of legumes and grasses, can be obtained. (Capability unit VIIe-1; woodland group 2)

Ettrick Series

The Ettrick series is made up of deep, dark-colored, silty soils on stream bottoms. These soils are very poorly drained. They are on flats and in slight depressions along streams that overflow during periods of high water. Most of the areas are in the eastern half of the county. These soils formed in silty materials washed in by streams. In places the silty materials contain thin layers of fine sand. The soils formed under a luxuriant growth of marshgrass, reeds, and water-tolerant trees. They have a thick, black surface layer.

Following is a representative profile of Ettrick silt loam, coarse silt substratum, in a cultivated field:

0 to 8 inches, black, friable silt loam.
8 to 15 inches, black, friable silty clay loam.
15 to 36 inches, gray, firm silty clay loam.
36 inches +, gray, friable coarse silt; massive.

The surface and subsurface layers combined range from 10 to 15 inches in thickness. In some places the surface layer has a thin cover of peat or of silty material that was deposited recently. Depth to the massive layer of silt is 20 to 36 inches. In some places, thin strata of fine sand occur at a depth between 20 and 36 inches.

These soils have high moisture-supplying capacity. Runoff is slow, and permeability and internal drainage are slow. The soils have an intermittent high water table. The water table fluctuates from about 1 foot below the surface in spring to as much as 3 feet below in midsummer. The soils are neutral to slightly alkaline.

Ettrick silt loam, coarse silt substratum (Ec).—This is the only Ettrick soil mapped in the county. It is highly productive if drainage is improved and the areas are protected from flooding.

This soil can be cropped intensively if fertility is kept high and other good management is used. The variability of the material in the subsoil makes it generally more feasible to use ditches, rather than tile, to provide drainage. Most areas that are not drained are in pasture or are used for wildlife. (Capability unit IIIw-1; woodland group 8)

Fayette Series

In the Fayette series are light-colored, deep, silty soils of undulating to rolling upland ridges and valley slopes. These soils are well drained. They formed in loess, or windblown silt, more than 42 inches thick. In some places the silt is as much as 10 feet thick, and it generally is somewhat more than 5 feet thick. The loess was originally calcareous but has been leached of carbonates to a depth of 5 feet or more. It overlies dolomitic limestone in most places, but in some places it overlies sandstone. The native vegetation was a hardwood forest made up of oak, hickory, and maple trees.

Two topographic phases of Fayette silt loams—uplands and valleys—have been recognized. The Fayette soils on valley slopes have a somewhat coarser textured subsoil and substratum, slightly less structural development in the subsoil, and a few fragments of sandstone and limestone in the solum. Generally, the soils on the ridges have slopes between 2 and 12 percent, and those of the valleys have slopes between 12 and 30 percent.

The Fayette soils are similar to the Seaton soils. They formed from finer textured silt than those soils and have more clay in the subsoil.

A representative profile of a Fayette silt loam in a forested area follows:

0 to 3 inches, very dark grayish-brown, friable silt loam.
3 to 9 inches, dark grayish-brown, friable silt loam.
9 to 40 inches, dark-brown, firm heavy silt loam.
40 to 72 inches +, brown, friable silt loam.

The surface layer is dark gray in areas that have been cultivated. In areas under forest the thin upper part of the surface layer is black in places. The subsoil ranges from silt loam to silty clay loam.

Fayette soils are high in moisture-supplying capacity and moderate in permeability. Runoff is medium on the gently sloping soils and rapid on the steep ones. These soils are generally strongly acid throughout the solum, unless they have been limed.

In this county Fayette soils are mapped only in undifferentiated units with the Seaton soils.

Gale Series

The Gale series is made up of light-colored, silty soils that are well drained. These sloping to steep soils formed on uplands in windblown silt, or loess, that was 24 to 42 inches thick. They are underlain by sand or sandstone. The native vegetation was mainly oak, hickory, and maple, but it included other hardwoods.

A representative profile of a Gale silt loam in a cultivated field follows:

0 to 7 inches, dark grayish-brown, friable silt loam.
7 to 13 inches, brown, friable silt loam.
13 to 31 inches, dark yellowish-brown, firm silty clay loam.
31 inches +, yellow and white, partly weathered sandstone that grades to hard, massive sandstone.

In wooded areas the surface layer is thin and is darker colored than in cultivated areas. Depth to sand or sandstone ranges from 24 to 42 inches but is generally between 30 and 36 inches.

The Gale soils are moderately permeable. They have medium moisture-supplying capacity for plants. Runoff is rapid on the steep soils and medium on the less sloping ones. In undisturbed areas the surface layer may be nearly neutral. In cultivated areas the soils are strongly acid throughout the profile unless they have been limed.

These soils are mostly in the eastern half of the county. The acreage is not large, but the soils are locally important to agriculture. The steep Gale soils are used mainly for forage crops and pasture; the less sloping ones are used for field crops.

Gale silt loam, 6 to 12 percent slopes (GaC).—In most places this soil has a cover of native hardwoods and a mat of leaves on the surface. Therefore, the surface layer is slightly darker than that in the representative profile described, and it contains more humus.

Mapped with this soil are a few areas in which the surface layer is loam, but where sandstone is at about the same depth as that underlying this soil. These included areas are too small to be mapped separately. They can be used and managed the same as the silt loam.

Gale silt loam, 6 to 12 percent slopes, is mainly on the tops or ends of ridges. Because of their size, shape, or location, many areas are not easy to till. In areas that have a cover of forest, runoff is not excessive. If the soil is cultivated, however, practices are needed to protect it from runoff. Good management is required for high yields of timber. (Capability unit IIIe-3; woodland group 1)

Gale silt loam, 6 to 12 percent slopes, moderately eroded (GaC2).—The profile of this soil is like the representative profile described. Nearly all of this soil is in crops, and from one-third to two-thirds of the original surface layer has been lost through erosion.

Mapped with this soil are a few areas of a soil that has a surface layer of loam. These included areas are too small to be mapped separately, but they can be used and managed about the same as this soil.

Gale silt loam, 6 to 12 percent slopes, moderately eroded, is on the tops and sides of ridges. If it is protected from erosion and is otherwise well managed, it is well suited to corn and oats and to alfalfa and bromegrass grown together. Crops on this soil respond well if lime and fertilizer are applied according to the needs indicated by soil tests. (Capability unit IIIe-3; woodland group 1)

Gale silt loam, 12 to 20 percent slopes (GaD).—This soil has a slightly darker surface layer than that in the representative profile described. It has a cover of native hardwoods, and it therefore is little eroded or only slightly eroded. This soil is subject to severe erosion if it is not protected.

Mapped with this soil are a few areas of a soil that has a surface layer of loam and is similar to this soil in depth and slope. Areas of this included soil are too small to be mapped separately, but they can be used and managed in about the same way as this soil.

Gale silt loam, 12 to 20 percent slopes, is on the sides of ridges. It generally lies below less sloping Gale soils or is below other silty soils of the ridgetops. If this soil is cultivated, practices are needed to control erosion. Good management is required to improve stands of timber and to maintain yields. (Capability unit IVe-2; woodland group 2)

Gale silt loam, 12 to 20 percent slopes, moderately eroded (GaD2).—The profile of this soil is similar to the representative profile described. From one-third to two-thirds of the original surface soil has been removed through erosion.

Mapped with this soil are a few areas of a soil that has a surface layer of loam.

Gale silt loam, 12 to 20 percent slopes, moderately eroded, is on the sides of ridges. It generally lies below less sloping Gale soils or other silty soils that are on the ridgetops. Runoff from these higher lying soils adds to the hazard of erosion.

Most areas of this soil are in crops. If this soil is cultivated, practices are needed to control erosion. A cropping system that consists mainly of forage crops helps to control further erosion and to maintain good tilth. Moderately high yields can be obtained if lime and fertilizer are applied. (Capability unit IVe-2; woodland group 2)

Gale silt loam, 12 to 20 percent slopes, severely eroded (GaD3).—The surface layer of this soil is thinner and lighter colored than that in the representative profile described. Also, depth to the underlying sandstone is less. More than two-thirds of the original surface layer has been lost through erosion. Yellowish-brown material from the subsoil is exposed in most places. Depth to the underlying sandstone ranges from about 24 to 30 inches.

Mapped with this soil are a few areas of a soil that has a surface layer of loam but is similar to this soil in depth, slope, and erosion. These included areas can be used and managed the same as this soil.

Gale silt loam, 12 to 20 percent slopes, severely eroded, is on the sides of ridges where it receives runoff from higher lying areas. If this soil is not protected, it erodes rapidly, and then the moisture-supplying capacity for plants is lowered. Also, because much of the more friable original surface layer is gone, this soil has a lower infiltration rate than the less eroded Gale soils and is difficult to keep in good tilth. This soil should be kept in sod-forming crops. If it is used for hay or pasture, the areas should be renovated when reseeding is necessary. Lime and fertilizer are also required. (Capability unit VIe-1; woodland group 2)

Gale silt loam, 20 to 30 percent slopes (GaE).—The profile of this soil is not so deep as the one described. Depth to the underlying sandstone is about 24 to 30 inches. Also, because it has been protected by a cover of trees, this soil is little eroded and has a slightly darker surface layer. A thin mat of leaves covers the surface and helps to absorb water and to reduce runoff.

Areas that are not wooded are suited to hay or pasture if seeding is done only when the areas are renovated, and if other good management is used. The wooded areas should be managed to maintain yields of timber. (Capability unit VIe-1; woodland group 2)

Gale silt loam, 20 to 30 percent slopes, moderately eroded (GaE2).—The profile of this soil is thinner to sandstone than the representative profile described. Depth to the sandstone ranges from 24 to 30 inches. From one-third to two-thirds of the original surface layer has been lost through erosion. In a small acreage the soil has slopes of as much as 40 percent.

This soil is better suited to permanent pasture or to trees than to field crops. Formerly, this soil was used largely for crops, but most areas are now used for pasture. Some areas are in bluegrass pastures. Other areas have been renovated and seeded to domestic grasses and legumes. (Capability unit VIe–1; woodland group 2)

Gale silt loam, 20 to 30 percent slopes, severely eroded (GaE3).—The surface layer of this soil is thinner and lighter colored than that in the representative profile described. Depth to the underlying sandstone is also less. It ranges from 24 to 48 inches. Because much of the surface layer has been removed through erosion, yellowish-brown material from the former subsoil is exposed in most places. In a few areas the slope is as much as 40 percent.

The present surface layer consists of compact material from the former subsoil that has been mixed with the remaining, more friable surface soil. In some places the surface layer is made up entirely of material from the former subsoil. As a result, this soil contains less organic matter than the original one and has a lower infiltration rate. Runoff is also greater, and the soil is therefore susceptible to further erosion.

This soil is difficult to farm and keep in good tilth. It is better suited to permanent pasture or trees than to field crops. Most areas are in pastures of bluegrass or are in pastures that have been renovated. (Capability unit VIIe–1; woodland group 2)

Gale silt loam, 30 to 40 percent slopes (GaF).—The profile of this soil is thinner than the representative profile described. This soil has a cover of trees and a mat of leaf litter on the surface. Consequently, the surface layer is slightly darker colored because of organic matter from the leaf litter. Depth to sandstone is about 24 inches. In some places there are outcrops of sandstone.

Little of this soil was ever cleared and used for agriculture. Therefore, it has not been eroded or is only slightly eroded. The areas are fairly large. Some of them support a growth of merchantable timber. The steep slopes make harvesting difficult, but in places yields of timber are obtained. In other places the trees help protect the watershed. This soil also provides good habitats for wildlife. (Capability unit VIIe–1; woodland group 2)

Gotham Series

The Gotham series is made up of deep, moderately dark colored, sandy soils that are somewhat excessively drained. These nearly level to undulating soils are on high stream terraces, mainly east of the Chippewa River. The native vegetation was a mixture of prairie grasses and oaks.

A representative profile of a Gotham loamy fine sand in a cultivated field follows:

- 0 to 10 inches, very dark grayish-brown, very friable loamy fine sand.
- 10 to 14 inches, dark-brown, very friable loamy fine sand.
- 14 to 22 inches, dark yellowish-brown, very friable loamy fine sand.
- 22 to 30 inches, yellowish-brown, very friable loamy fine sand.
- 30 inches +, yellowish-brown and light yellowish-brown, loose sand.

The surface layer is very dark brown in places. Depth to loose sand ranges from 24 to 36 inches. In places at a depth between 3 and 6 feet, the underlying sand contains thin layers of finer textured material.

These soils are rapidly permeable. They have low moisture-supplying capacity. As a result, yields are likely to be low, especially during seasons when rainfall is limited or is poorly distributed. These soils are subject to wind and water erosion. Unless they have been limed, they are medium acid to strongly acid throughout the profile.

Gotham loamy fine sand, 0 to 2 percent slopes (GoA).—The profile of this soil is like the representative profile described.

Low moisture-storing capacity, sandy texture, and low natural fertility limit the use of this soil for agriculture. This soil needs to be protected from wind erosion. During seasons when rainfall is well distributed, corn, oats, and alfalfa and bromegrass make moderate yields if the soil is well managed. Returning crop residues to the soil and using other practices that maintain organic matter help improve this soil. (Capability unit IVs–1; woodland group 5)

Gotham loamy fine sand, 2 to 6 percent slopes (GoB).—The profile of this soil is similar to the representative profile described. Most areas of this soil are used for cultivated crops, but a few are in oaks of low quality. Row crops, small grains, and hay can be grown if lime and fertilizer are added and the soil is otherwise well managed. This soil is subject to wind and water erosion. (Capability unit IVs–1; woodland group 5)

Gotham loamy fine sand, 2 to 6 percent slopes, moderately eroded (GoB2).—The surface layer of this soil is thinner than that in the representative profile described. Also, depth to the underlying loose sand is less. The surface layer is 8 to 10 inches thick. In places as much as two-thirds of the original surface layer has been lost through wind and water erosion. In other places soil materials from other areas have been deposited on the surface by wind.

This soil is not suited to intensive cropping, but it can be used for row crops, small grains, and hay if carefully managed. Lime, fertilizer, and organic matter are needed. The moisture-supplying capacity of the soil can be improved by plowing under green-manure crops and returning crop residues to the soil. Yields generally are low, but they are even lower during seasons of low rainfall or if the rainfall is poorly distributed. (Capability unit IVs–1; woodland group 5)

Gotham loamy fine sand, 6 to 12 percent slopes (GoC).—The profile of this soil is similar to the representative profile described, but the color of the surface layer is very dark brown in places.

Most areas of this soil have a cover of bluegrass or of oaks of poor quality. If this soil is cultivated, it is subject to serious wind and water erosion. This soil is better suited to sod-forming crops, grown for hay or pasture, or to pine trees than to row crops. (Capability unit VIs–1; woodland group 5)

Gotham loamy fine sand, 6 to 12 percent slopes, moderately eroded (GoC2).—The combined surface layer and subsurface layer of this soil are thinner than those in the profile described. They are about 8 inches thick because wind and water erosion have removed part of the original layers. Depth to loose sand is also slightly less.

This soil is used for crops and pasture. Because of the limited moisture-supplying capacity, yields are fairly low, especially during seasons of low rainfall or if the rainfall is poorly distributed. This soil is subject to serious wind and water erosion if it is not protected. Therefore, it is better suited to hay crops, pasture, or pine trees than to row crops. (Capability unit VIs-1; woodland group 5)

Hixton Series

In the Hixton series are moderately deep, light-colored soils that are well drained. These soils formed on ridges and valley slopes of rolling to hilly uplands, in sandy and loamy materials weathered from sandstone. They are gently sloping to very steep and are extensive throughout the eastern part of the county. The native vegetation was a deciduous forest made up mainly of oaks.

A representative profile of a Hixton fine sandy loam in a cultivated field follows:

0 to 5 inches, dark grayish-brown, very friable fine sandy loam.
5 to 8 inches, dark yellowish-brown, friable fine sandy loam.
8 to 22 inches, dark-brown, friable loam.
22 to 27 inches, strong-brown, very friable fine sandy loam.
27 to 36 inches, yellowish-brown, loose sand.
36 inches +, broken, partly weathered, yellow sandstone.

In forested areas the surface layer is darker colored than in cultivated areas. Depth to loose sand is between 22 and 36 inches, and depth to bedrock is between 2 and 4 feet. In places there are varying amounts of sandstone fragments on the surface and in the profile. The texture of the subsoil is loam or fine sandy loam.

These soils have moderately rapid permeability and moderately low moisture-supplying capacity for plants. Runoff is rapid on most of the steep Hixton soils, but medium on the less sloping ones. Unless limed, these soils are medium acid to strongly acid throughout the solum.

The steep Hixton soils are used mainly for hay and pasture or for timber, and the less sloping ones are used mainly for row crops.

Hixton fine sandy loam, 2 to 6 percent slopes, moderately eroded (HfB2).—The profile of this soil is like the representative profile described. Most of the acreage is on the crests of rolling ridges and hills. Nearly all the areas are used for crops.

This soil is suited to row crops, small grains, and hay if it is well managed. It is somewhat droughty and is subject to water erosion. Practices are required to control erosion and to prevent further reduction in the moisture-supplying capacity. Additional organic matter is also needed, and lime and fertilizer are generally required. During seasons of low rainfall, or if the rain is poorly distributed, yields are likely to be lowered by shortage of moisture. (Capability unit IIIs-1; woodland group 3)

Hixton fine sandy loam, 6 to 12 percent slopes (HfC).—The surface layer of this soil is darker colored than that in the representative profile described. Most of this soil is in trees. There is a thin cover of leaf litter on the surface, and the surface layer contains organic matter from the decaying leaves.

Mapped with this soil are a few areas of a Hixton soil that has slopes of 2 to 6 percent and is less susceptible to erosion than this soil.

Hixton fine sandy loam, 6 to 12 percent slopes, is on the tops of rolling hills. If it is used for crops, it is subject to severe erosion. Areas that are in trees need special management that improves the stands and increases yields. (Capability unit IVe-3; woodland group 3)

Hixton fine sandy loam, 6 to 12 percent slopes, moderately eroded (HfC2).—The profile of this soil is similar to the representative profile described. As much as two-thirds of the original surface layer has been lost through water erosion. Mapped with this soil is a severely eroded Hixton fine sandy loam.

Hixton fine sandy loam, 6 to 12 percent slopes, moderately eroded, is mostly on the tops of rolling hills, but some areas are on valley slopes. Most of the acreage is cultivated. This soil is not suited to intensive tillage. Fair yields of row crops, small grains, and hay are made, however, if the soil is well managed.

Special practices are needed to control erosion. Also, this soil is moderately low in natural fertility. It needs lime and fertilizer and a cropping system consisting mainly of close-growing crops that will supply organic matter. During seasons of low rainfall, or if the rainfall is poorly distributed, yields are lowered. The severely eroded areas should be kept in hay or pasture or should be planted to trees. (Capability unit IVe-3; woodland group 3)

Hixton fine sandy loam, 12 to 20 percent slopes (HfD).—The surface layer of this soil contains more humus and is darker than that in the representative profile described. Most of this soil has a cover of trees and has been only slightly eroded.

This soil is mostly on the ends of ridges or is in other positions not well suited to tillage. If it is cultivated, this soil is subject to severe erosion. This soil is better suited to hay or pasture than to cultivated crops. It is also well suited to pine trees, but areas in trees require special management. (Capability unit VIe-2; woodland group 4)

Hixton fine sandy loam, 12 to 20 percent slopes, moderately eroded (HfD2).—The profile of this soil is similar to the one described. Mapped with this soil is a small acreage of a severely eroded soil.

Most of Hixton fine sandy loam, 12 to 20 percent slopes, moderately eroded, is used in a cropping system that consists mainly of hay crops. Because of the severe hazard of erosion, many areas are used for pasture and are cultivated only when it is necessary to reseed them. (Capability unit VIe-2; woodland group 4)

Hixton fine sandy loam, 20 to 30 percent slopes (HfE).—The surface layer of this soil contains more humus and is darker than that in the representative profile described, and the profile is thinner to bedrock. In most places this soil is 24 to 30 inches thick over consolidated sandstone. Nearly all areas are in trees and have a mat of leaf litter on the surface.

Mapped with this soil are a few areas where the soil has a surface layer of loam.

Hixton fine sandy loam, 20 to 30 percent slopes, generally is on the sides of hills and valleys. The areas are below less sloping Hixton soils. Runoff from the higher lying areas causes gullies if the soil is cultivated. Consequently, this soil is better suited to pasture and trees than to crops that are tilled. (Capability unit VIIe-1; woodland group 4)

Hixton fine sandy loam, 20 to 30 percent slopes, moderately eroded (HfE2).—The profile of this soil is thinner over sandstone bedrock than the representative profile described. From one-third to two-thirds of the original surface layer has been removed through erosion. Depth to bedrock ranges from 24 to 30 inches. In some places there are fragments of sandstone throughout the profile.

Mapped with this soil are a few areas of a soil that has a surface layer of loam.

Most areas of Hixton fine sandy loam, 20 to 30 percent slopes, moderately eroded, are on valley slopes. They lie below less sloping Hixton soils and receive runoff from them. The runoff is likely to cause further erosion, and it makes this soil even more droughty. Much of the acreage is now used for hay and pasture. The hay and pasture provide a protective cover and help to control erosion.

This soil is too steep for tilled crops. It is best suited to permanent pasture or to trees. If this soil is used for pasture, grazing should be controlled to obtain high yields and to halt further erosion. (Capability unit VIIe–1; woodland group 4)

Hixton fine sandy loam, 20 to 30 percent slopes, severely eroded (HfE3).—The surface layer of this soil is thinner and lighter colored than that in the representative profile described. Also, depth to consolidated sandstone is less. Because of erosion and tillage, yellowish-brown material from the former subsoil is exposed in much of the acreage. In most places depth to sandstone is about 24 inches. There are fragments of sandstone throughout the profile. This soil is more droughty than the one described because more than two-thirds of the original surface layer is gone. It is also more erodible and is lower in productivity.

Mapped with this soil is a small acreage of a soil that has a surface layer of loam.

Hixton fine sandy loam, 20 to 30 percent slopes, severely eroded, is used mainly for pasture. Areas that are gullied or that are not easily accessible are idle, and some of them are reverting to trees.

This soil is suited to permanent pasture if it is managed carefully to control further erosion. Areas where it is difficult to establish grass ought to be planted to trees. The trees should be protected from fire and from grazing. (Capability unit VIIe–1; woodland group 4)

Hixton fine sandy loam, 30 to 45 percent slopes (HfF).—The profile of this soil is thinner over sandstone than the representative profile described. It is about 24 inches thick. Also, the surface layer contains more humus and is darker because it contains decomposed leaf litter. This soil has been protected by a cover of hardwood trees. Therefore, it has not been eroded or is only slightly eroded. In a few places there are outcrops of bedrock.

Mapped with this soil are a few areas in which the soil has a surface layer of loam.

Hixton fine sandy loam, 30 to 45 percent slopes, is on the slopes of valleys and on ridges. Runoff from higher lying soils is likely to cause gullies if the areas are disturbed.

This soil should be kept in trees, and open areas should be planted to pine trees. The trees require protection from fire and grazing, and they need other good management for sustained yields. (Capability unit VIIe–1; woodland group 4)

Hixton fine sandy loam, 30 to 45 percent slopes, moderately eroded (HfF2).—In this soil depth to sandstone is 22 to 24 inches. There are outcrops of bedrock in some places. In many places there are fragments of sandstone throughout the profile. Formerly, this soil was tilled or grazed heavily. Consequently, it has lost from one-third to two-thirds of its original surface layer through erosion.

Mapped with this soil are areas of a soil that has a surface layer of loam.

Hixton fine sandy loam, 30 to 45 percent slopes, moderately eroded, is too steep to cultivate. Most areas have a cover of bluegrass and are used for pasture, but some areas are idle. The areas in pasture need careful management. Gullies form unless grazing is controlled. If feasible, this soil should be planted to trees. (Capability unit VIIe–1; woodland group 4)

Hixton fine sandy loam, 30 to 45 percent slopes, severely eroded (HfF3).—The surface layer of this soil is thinner and lighter colored than that in the representative profile described, and depth to sandstone is less. Also, the soil is lower in organic matter, is more droughty, and is less productive. More than two-thirds of the original surface layer has been removed through erosion. Yellowish-brown material from the former subsoil is exposed in much of the acreage. Depth to consolidated sandstone is generally about 22 inches, but in some places the sandstone outcrops. In many places there are fragments of sandstone throughout the profile.

Most areas of this soil support a sparse cover of grass. This soil is used mainly for pasture, but yields are low. Some areas are idle and are reverting to brush and trees. If feasible, this soil should be planted to trees. The trees require protection from fire and grazing. (Capability unit VIIe–1; woodland group 4)

Hubbard Series

In the Hubbard series are deep, dark-colored, sandy soils. These soils formed in sandy materials on high, broad stream terraces. They are nearly level to gently undulating. These soils are of moderate extent. Nearly all of the acreage is on the broad sand flats northeast of the city of Durand in the townships of Durand and Lima.

A representative profile of a Hubbard loamy fine sand in a cultivated field follows:

0 to 8 inches, very dark brown, very friable loamy fine sand.
8 to 15 inches, black to very dark brown, very friable loamy fine sand.
15 to 27 inches, very dark brown to dark brown, very friable loamy fine sand.
27 to 35 inches, dark-brown, very friable loamy fine sand.
35 inches +, yellowish-brown, loose sand.

Depth to loose sand ranges from 24 to 36 inches. These soils have moderately rapid permeability and moderately low moisture-supplying capacity. They are somewhat droughty. During periods of low rainfall or if the rain is poorly distributed, yields are likely to be lowered by lack of moisture. Areas that are not protected are subject to wind erosion. Unless limed, these soils are slightly acid throughout the profile.

Hubbard loamy fine sand, 0 to 3 percent slopes (HmA).—This is the only Hubbard soil mapped in the county. It is nearly level and is easy to till. Nearly all areas are cultivated.

Careful management is needed to prevent this soil from blowing. Plowing under green-manure crops and turning under crop residues help to stabilize the soil and to control erosion. These practices also help improve the tilth and the moisture-supplying capacity of this soil. In places shelterbelts and stripcropping are needed to help control wind erosion. (Capability unit IVs-1; woodland group 5)

Huntsville Series

In the Huntsville series are deep, dark-colored soils that are well drained to moderately well drained. These soils formed in silty sediments washed from dark-colored soils of the uplands. They are on narrow bottoms along small streams and on the flood plains of larger streams.

A representative profile of Huntsville silt loam in a cultivated field follows:

0 to 14 inches, very dark brown, very friable silt loam.
14 to 42 inches, dark-brown, friable silt loam.
42 inches +, dark yellowish-brown, friable silt and very fine sand.

The surface layer varies considerably in thickness. In places there are slight variations in color throughout the profile. There is a thin, sandy overwash on the surface in places. In some places the profile contains thin layers of fine sand.

These soils are moderately permeable. They are subject to overflow, but flooding does not seriously limit the use of the soils for agriculture. The Huntsville soils have high moisture-supplying capacity for plants. They are neutral to slightly alkaline.

Huntsville silt loam (Hv).—This is the only Huntsville soil mapped in the county. Its profile is like the representative profile described.

This soil is high in natural fertility. Because of its nearly level relief and deep, friable surface layer, it is easy to till. This soil can be cropped intensively if lime and fertilizer are added and if it is otherwise well managed. If crops are not damaged by flooding, high yields are obtained. (Capability unit IIw-2; woodland group 9)

Jackson Series

The soils of the Jackson series are deep and are light colored. They are well drained to moderately well drained. These nearly level to sloping soils formed on stream terraces in silty material that was more than 42 inches thick. The native vegetation was a forest made up mainly of oak, hard maple, and hickory, but it included other hardwoods.

A representative profile of a Jackson silt loam in a cultivated field follows:

0 to 8 inches, very dark grayish-brown to dark-gray, very friable silt loam.
8 to 11 inches, dark-gray to dark grayish-brown, very friable silt loam.
11 to 16 inches, dark-brown, friable silt loam.
16 to 32 inches, dark-brown, firm silty clay loam; many, fine mottles of yellowish red and brown.
32 to 37 inches, yellowish-brown, firm silty clay loam; a few, coarse mottles of yellowish red and dark reddish brown.
37 inches +, brown to yellowish-brown, friable silt loam; many mottles of yellow, red, and brown.

Variations in the profile are mainly in the degree and position of mottling. Depth to mottling is between 18 and 30 inches.

These soils have moderate permeability and high moisture-supplying capacity for plants. They are high in natural fertility. Unless these soils have been limed, they are slightly acid to medium acid.

Jackson silt loam, 0 to 2 percent slopes (JaA).—The profile of this soil is like the representative profile described. This soil occupies broad, nearly level areas.

Mapped with this soil are areas of a Curran silt loam, which is somewhat poorly drained and in low-lying areas that are generally less than 1 acre in size.

Runoff is slow on Jackson silt loam, 0 to 2 percent slopes. Therefore, the hazard of erosion is slight. This soil warms slowly in spring. Seepage or runoff from adjoining soils of the uplands causes the areas to be excessively wet in places during spring or following periods of extended rainfall.

This soil is well suited to corn, small grains, and forage crops. Yields are high. If a suitable cropping system is used and an adequate supply of plant nutrients is maintained, this soil can be cropped intensively. Crops on this soil respond well if a complete fertilizer is added. Corn requires supplemental nitrogen. Lime is needed for high yields of legumes. (Capability unit I-1; woodland group 1)

Jackson silt loam, 2 to 6 percent slopes (JaB).—The profile of this soil is similar to the representative profile described. In places, however, the surface layer is slightly thinner.

Runoff is not excessive on this soil. Nevertheless, practices are needed to control erosion. If an adequate supply of plant nutrients is maintained and fairly simple practices are used to control erosion, this soil can be cropped intensively. Crops on this soil respond well if a complete fertilizer is applied and manure is added. Additional nitrogen is needed for high yields of corn, and lime is required for high yields of legumes. The fertilizer and lime should be applied according to the needs indicated by soil tests. (Capability unit IIe-1; woodland group 1)

Jackson silt loam, 2 to 6 percent slopes, moderately eroded (JaB2).—This soil has lost from one-third to two-thirds of its original surface layer through erosion. The present surface layer is slightly lighter colored than that in the profile described because plowing has mixed brownish subsoil in it.

This soil is well suited to corn, small grains, and crops grown for forage if it is protected from further erosion. If adequate lime and fertilizer are applied, high yields can be obtained. In many places yields of corn are low; organic matter and nitrogen are needed for better yields. Returning crop residues to the soil helps to maintain a high content of organic matter and to keep the soil in good tilth. (Capability unit IIe-1; woodland group 1)

Jackson silt loam, 6 to 12 percent slopes (JaC).—The surface layer of this soil is slightly thicker than that in the representative profile described. This soil is mainly in narrow bands along draws or at the edges of stream terraces. Most of the areas are not accessible to farm equipment or are otherwise not well suited to cultivation. Therefore, most of this soil is in trees or pasture and is little eroded.

If this soil is cultivated, careful management is needed to control erosion and to keep gullies from forming. (Capability unit IIIe-1; woodland group 1)

Jackson silt loam, 6 to 12 percent slopes, moderately eroded (JaC2).—This soil has lost from one-third to two-thirds of its original surface layer through erosion. The present surface layer is 4 to 8 inches thick. In many places plowing has mixed material from the former subsoil with the remaining surface soil. As a result, in much of the acreage the present surface layer is lighter colored than the original one.

This soil is suited to corn, small grains, and crops grown for forage if practices are used to control further erosion. In many places runoff from adjacent soils of uplands causes erosion. Crops on this soil respond well if lime and fertilizer are applied. Organic matter and nitrogen are needed for high yields of corn. (Capability unit IIIe-1; woodland group 1)

Jackson silt loam, 6 to 12 percent slopes, severely eroded (JaC3).—This soil has lost more than two-thirds of its original surface layer through erosion. The present surface layer is less than 3 inches thick. In many places brownish material from the subsoil is exposed.

This soil is in narrow bands along draws or at the edges of stream terraces. If it is cultivated, it is highly susceptible to sheet and gully erosion. This soil is not suited to intensive use for crops. A cropping system is needed in which crops are grown that will improve the content of organic matter and also the tilth. Large amounts of lime and a complete fertilizer are needed to maintain productivity. (Capability unit IVe-1; woodland group 1)

Judson Series

The soils in the Judson series are deep and dark colored. They are mainly well drained. These soils formed under prairie in silty materials moved by water or gravity from the steeper slopes above. The Judson soils are nearly level to sloping, but the slope is predominantly less than 6 percent. They occupy small areas that are widely distributed throughout the county. These soils are mainly in narrow valleys. The areas are at the heads of draws, along the bottoms of small intermittent streams, and at the base of steep slopes.

A representative profile of a Judson silt loam in a cultivated field follows:

0 to 16 inches, very dark brown, very friable silt loam.
16 to 27 inches, very dark grayish-brown, friable silt loam.
27 inches +, dark grayish-brown, friable silt loam.

In a few places there is a thin layer of sandy overwash on the surface. There are also a few pebbles and small stones on the surface. In some places there are a few mottles at a depth below 18 inches.

These soils are moderate in permeability and have high moisture-supplying capacity for plants. Runoff is medium. The soils are high in natural fertility and in organic matter. They are nearly neutral. Plant roots can penetrate deep into them. The thick, friable surface layer makes these soils valuable for farming.

Judson silt loam, 0 to 2 percent slopes (JuA).—The profile of this soil is like the representative profile described. This soil is in nearly level areas adjacent to intermittent streams. It is likely to be flooded occasionally. The floodwaters deposit a thin layer of sand and a few small stones on the surface in places.

This soil is well suited to all the crops commonly grown in the county. It is also well suited to growing special crops. If this soil is well managed, it can be cropped intensively and high yields can be obtained. The small areas that have a cover of sandy overwash generally can be used and managed the same as the rest of this soil.

If this soil is used intensively for crops, the supply of plant nutrients is reduced. Therefore, manure and a complete fertilizer are needed. Areas likely to be damaged by floods need to be protected by dikes, diversions, or waterways, or should be kept in hay or pasture. Forage crops on this soil respond well if a complete fertilizer is applied periodically. (Capability unit I-1; woodland group 9)

Judson silt loam, 2 to 6 percent slopes (JuB).—This soil has gentle slopes and a profile similar to the representative profile described. Areas of this soil generally are small. They are in draws, at the heads of draws, or on fans at the lower ends of the draws.

Most of this soil is used for crops. This soil is well suited to row crops, small grains, and forage crops. There is a slight hazard of flooding and erosion. In small areas flooding is likely to deposit small amounts of sand and a few pebbles on the surface. The floodwaters also cause cutting and scouring of the stream channels.

This soil is highly productive if well managed. It can be used intensively for crops. Yields are high if plant nutrients are supplied and erosion and flooding are controlled. Where flooding and erosion cannot be controlled, the areas should be kept in hay or pasture. (Capability unit IIe-1; woodland group 9)

Judson silt loam, 6 to 12 percent slopes (JuC).—The surface layer of this soil is somewhat thinner and lighter colored than that in the representative profile described. Because of its stronger slopes, this soil is less subject to flooding than are the less steep Judson soils. The soil in some areas contains a few stones moved from the uplands by gravity and water. Channel cutting and sheet erosion are serious hazards.

If this soil is protected from erosion, it is suited to row crops, small grains, and forage crops. High yields can be obtained if an adequate supply of plant nutrients is maintained and a suitable cropping system is used. In a few areas channel cutting is difficult to control. These areas should be kept in hay or pasture. (Capability unit IIIe-1; woodland group 9)

Lindstrom Series

The Lindstrom series consists of deep, dark-colored soils that are well drained. These soils formed under tall prairie grasses in silty materials more than 42 inches thick. They are on valley slopes below areas of Steep stony and rocky land. The areas are small. They occur in valleys throughout the western part of the county.

A representative profile of a Lindstrom silt loam in a cultivated field follows:

0 to 12 inches, very dark brown to black, very friable silt loam.
12 to 17 inches, dark-brown, friable silt loam.
17 to 42 inches, dark-brown to dark yellowish-brown, firm silty clay loam.
42 inches +, dark yellowish-brown, friable silt loam.

The surface layer varies somewhat in color and in thickness. In the less eroded areas, the surface layer is as much as 15 inches thick and is black in places. In the steep, more eroded areas the surface layer is as thin as 6 inches and is dark brown. Typically, the two upper layers contain small amounts of grit from coarser materials that washed or rolled from higher lying areas of Steep stony and rocky land.

These soils have moderate permeability and high moisture-supplying capacity for plants. They are subject to gully and sheet erosion. These soils generally are slightly acid to medium acid throughout the profile. Natural fertility is high.

Lindstrom silt loam, 6 to 12 percent slopes (LsC).—The profile of this soil is like the representative profile described. Nearly all areas are in trees or are in permanent pasture. The areas are small, and many of them are in places that are not easily accessible to farm equipment.

If this soil is cultivated, it needs to be protected from erosion. It is suited to all the crops commonly grown in the county. Yields are high if the soil is well managed. (Capability unit IIIe–1; woodland group 9)

Lindstrom silt loam, 6 to 12 percent slopes, moderately eroded (LsC2).—This soil has lost from one-third to two-thirds of its original surface layer through erosion. The present surface layer is 6 to 10 inches thick, but the profile is otherwise similar to the representative profile described.

This soil is well suited to corn, small grains, and forage crops. It occurs in small areas, however, and it is farmed in the same way as adjoining soils. If this soil is cultivated, it is likely to be severely eroded, unless practices are used to control erosion. Runoff from higher lying areas increases the hazard of sheet and gully erosion, and diversion terraces are needed to safely remove excessive runoff in places. If practices are used to prevent erosion and if the fertility is kept high, this soil is highly productive. (Capability unit IIIe–1; woodland group 9)

Lindstrom silt loam, 12 to 20 percent slopes (LsD).—The surface layer of this soil is slightly thinner than that in the representative profile described. Because of its strong slopes, this soil has had a permanent cover of grass and is not eroded or is only slightly eroded. If this soil is cultivated, it is subject to severe erosion by runoff from adjacent higher areas. If it is used for cultivated crops, intensive practices are needed to control erosion. The cropping system should consist mainly of forage crops. High yields can be obtained if fertility is kept high and if other good management is used. (Capability unit IVe–1; woodland group 9)

Lindstrom silt loam, 12 to 20 percent slopes, moderately eroded (LsD2).—The surface layer in this soil is thinner and slightly lighter colored than that in the representative profile described. It is 6 to 10 inches thick and is very dark brown to very dark grayish brown.

Most areas of this soil are used for forage crops, but row crops are grown in some places. This soil is not suited to intensive use for cultivated crops, because of the hazard of severe erosion. Nevertheless, fairly high yields of row crops can be obtained if erosion is controlled and a suitable cropping system is used along with other good management. This soil is well suited to forage crops. Yields are high if adequate lime and fertilizer are applied and the soil is otherwise well managed. (Capability unit IVe–1; woodland group 9)

Lindstrom silt loam, 20 to 30 percent slopes (LsE).—This steep soil is used mainly for permanent pasture, and the cover of grass has protected it from erosion. Except for having a slightly thinner surface layer and subsoil, the profile is similar to the representative profile described.

This soil is too steep for cultivated crops. If erosion is controlled and other good management is used, moderately high yields of permanent pasture can be obtained. (Capability unit VIe–1; woodland group 9)

Lindstrom silt loam, 20 to 30 percent slopes, moderately eroded (LsE2).—This soil has lost from one-third to two-thirds of its original surface layer through erosion. The present surface layer is 6 to 8 inches thick and is very dark grayish brown to dark brown. Also, depth to the underlying yellowish-brown silt loam is slightly less than in the representative profile described.

Most eroded areas in this soil resulted because row crops were grown at some time. Now, the soil is used for hay and pasture, and gully and sheet erosion have been reduced. If adequate fertilizer and lime are applied and seeding is done only when the pastures are renovated, moderately high yields can be obtained. (Capability unit VIe–1; woodland group 9)

Loamy Alluvial Land

Loamy alluvial land consists of miscellaneous land types made up of sandy and silty sediments laid down by water. The soil materials vary in texture and in color. They have been in place long enough for trees and other plants to grow, but the areas are flooded frequently unless they are protected.

Loamy alluvial land (Lv) is a nearly level miscellaneous land type on flood plains. The soil materials consist of variable alluvial sediments. The surface layer ranges from sandy loam to silt loam in texture and from dark to light in color. In some places sand or gravel is on the surface, and in other places there are lenses throughout the soil material. In the higher lying areas, the soil material is moderately well drained, but in level or slightly depressed areas it is somewhat poorly drained in places. The moisture-supplying capacity for plants is high. The soil material is medium acid to nearly neutral.

Included with this land type are areas of Loamy alluvial land, wet, and of Arenzville, Huntsville, and Orion soils. These areas are too small to be mapped separately.

The largest single area of Loamy alluvial land is on the flood plain of the Chippewa River just north of the city of Durand. Most of the acreage, however, is in small areas along the valleys of the many streams in the county. The areas are subject to flooding when the streams overflow and to deposition of sediments.

Areas that are adequately drained and protected from flooding are used for crops. Much of the rest of the acreage is used for grazing, and in many places yields of pasture are high. A small acreage is in trees. The land is also well suited to wildlife. (Capability unit IIIw–3; woodland group 8)

Loamy alluvial land, wet (Lw) is a miscellaneous land type in nearly level or slightly depressed areas on flood plains. It consists of variable alluvial sediments. The surface layer ranges in texture from sandy loam to silt loam and in color from light to dark. The water table is at or near the surface during most of the year.

Most areas of this land type are along the Chippewa and Eau Galle Rivers. Other smaller, narrower areas are along the bottoms of creeks throughout the county. The larger areas along the Chippewa River are in sloughs, oxbows, in abandoned stream channels, and in marsh. All the areas are subject to frequent flooding, and some areas are covered with water for several days following periods of high water. Fresh stream sediments are deposited on the surface in places during floods. In a few places the channels of streams shift to new courses because of the floods.

Most of Loamy alluvial land, wet, has a cover of bluegrass, marsh grasses, willow, river birch, soft maple, and other water-tolerant plants. The land is better suited to permanent pasture, woodland, or wildlife than to cultivated crops. (Capability unit Vw–2; woodland group 8)

Loamy Terrace Land

Loamy terrace land is made up of miscellaneous land types in level to somewhat depressed areas on stream terraces. The areas are made up of variable materials and are wet or very wet. Crops can be grown on some of the areas, but most areas require drainage before crops can be grown.

Loamy wet terrace land (Lx) is a miscellaneous land type in level to somewhat depressed areas on stream terraces. It consists of dark-colored soil materials that are poorly drained. Generally, the surface layer is fine sandy loam. The layers in the substratum are made up of sand interlayered with finer textured materials that restrict internal drainage. Mottling occurs throughout the profile. The areas are saturated with water in some seasons.

The surface layer is very dark grayish brown. The other layers vary in color, thickness, and position in the profile, depending on the kind of parent materials. In some places the finer textured layers are higher in the profile than in other places and have a blocky structure. At a depth below 3 feet, the color of some of the layers is reddish. Unless limed, the profile is acid throughout.

Some areas of this land require drainage before crops can be grown on them. Other areas can be used for crops without drainage. If this land type is adequately drained, it is well suited to row crops, small grains, and hay and can be farmed fairly intensively. (Capability unit IIIw–1; woodland group 7)

Loamy very wet terrace land (Ly) is in slight depressions. Surface and internal drainage are very slow, and water sometimes ponds on the surface in places.

This land type has as much as 12 inches of black peat, muck, or silty overwash on the surface. Because of plowing, the texture of the surface layer varies, but, typically, it is fine sandy loam. The color, thickness, and position in the profile of the other layers are all highly variable, depending upon the kind of parent materials. The layers range from loamy sand to clay in texture, and from less than 1 inch to 8 inches in thickness.

Because of the high water table and poor natural drainage, many areas of this land type are used for pasture or wildlife. This land needs drainage before it can be used for cultivated crops. Some areas require protection from flooding. (Capability unit IVw–1; woodland group 7)

Medary Series

The Medary series consists of deep, silty, light-colored soils that are moderately well drained to well drained. These nearly level to gently sloping soils formed in thick deposits of silt and clay on high stream terraces. The uppermost 12 to 24 inches of the profile consists of silt laid down by wind. The silt is underlain by layers of reddish silt and clay that were deposited in slack water. The original vegetation was hardwood trees. All of the Medary soils in the county are within Hicks Valley.

A representative profile of a Medary silt loam in a cultivated field follows:

0 to 8 inches, very dark grayish-brown to dark-gray, friable silt loam.
8 to 11 inches, dark grayish-brown, friable silt loam.
11 to 13 inches, dark-brown, firm silt loam.
13 to 18 inches, reddish-brown, firm silty clay loam.
18 to 29 inches, reddish-brown and reddish-gray silty clay; hard when dry, and sticky when wet; mottled in the lower part.
29 to 36 inches, dark-brown, firm to sticky silty clay loam; yellow, brown, and olive mottles.
36 inches +, grayish-brown, friable silt.

Mottling is generally slight and in places it is lacking. Depth to red clay ranges from 12 to 24 inches.

The Medary soils have moderately slow permeability. Runoff is slow to medium. Because water moves slowly down through these soils, they dry slowly in spring or following periods of extended rainfall. If the soils are tilled during periods of excessive wetness, the structure of the surface soil is easily damaged. The surface layer then has poor tilth, is hard and cloddy when dry, and puddles when it is wet. These soils have high moisture-supplying capacity for plants. They are naturally nearly neutral, but areas of soils that have been used intensively for crops and have not been limed are likely to be acid.

Medary silt loam, 0 to 2 percent slopes (MdA).—The profile of this soil is like the representative profile described. This nearly level soil has slow runoff. Therefore, it is slow to warm in spring; it is necessary to delay tillage until the soil dries enough to prevent puddling of the surface layer. This soil can be used fairly intensively for cultivated crops, and it is well suited to most crops commonly grown in the county. It has only slight susceptibility to erosion. In places waterways or diversions are needed to remove excess runoff from nearby higher lying soils.

If an adequate supply of plant nutrients and organic matter is maintained, crops make high yields on this soil. Including deep-rooted legumes in the rotation helps to improve aeration and internal drainage. Crops on this soil respond well if lime and a complete fertilizer are applied and manure is added. A nitrogen fertilizer is needed for high yields of corn, and lime is required for legumes. The lime should be applied according to the needs indicated by soil tests. (Capability unit IIe-3; woodland group 1)

Medary silt loam, 2 to 6 percent slopes (MdB).—The surface layer of this soil is thinner than that in the representative profile described.

Areas of this soil are small and are along terrace breaks or at the edges of draws. Mapped with this soil are a few areas that have lost two-thirds or more of their original surface layer. Also included are a few areas that have slopes of as much as 10 percent. These included areas are too small to be mapped separately.

Medary silt loam, 2 to 6 percent slopes, is well suited to corn, small grains, and forage crops. Special care is needed, however, to prevent sheet erosion and to keep gullies from forming. Because areas of this soil are small and in many places lie next to areas of Medary silt loam, 0 to 2 percent slopes, this soil is farmed along with the less sloping soil. The two soils can be used and managed about the same, but this soil requires more careful tillage. Also, larger amounts of lime and fertilizer are needed and more organic matter is required. (Capability unit IIe-3; woodland group 1)

Meridian Series

In the Meridian series are moderately deep, light-colored sandy loams. These well-drained soils are underlain by loose sand at a depth between 24 and 36 inches. They are nearly level to moderately steep, but their slope is mostly less than 6 percent. These soils are in stream valleys and on broad terrace plains throughout the county.

A representative profile of a Meridian fine sandy loam in a cultivated field follows:

0 to 11 inches, dark grayish-brown, very friable fine sandy loam.
11 to 25 inches, dark yellowish-brown, firm loam.
25 to 28 inches, yellowish-brown, very friable fine sandy loam.
28 inches +, yellowish-brown, loose sand.

The texture of the subsoil ranges from loam to sandy loam. In places the underlying sand contains thin layers of finer textured materials.

These soils have moderately rapid permeability and moderately low moisture-supplying capacity. They are moderately productive if well managed and if rainfall is well distributed throughout the growing season. Natural fertility is moderate. Unless limed, these soils are slightly acid to strongly acid. Crops on these soils respond well if lime and fertilizer are added and manure is applied.

Meridian fine sandy loam, 0 to 2 percent slopes (MeA)—The profile of this soil is like the representative profile described. This soil occupies fairly large areas on broad stream terraces.

Moderately low moisture-supplying capacity limits the use of this soil. If suitable practices are applied to conserve moisture, this soil is well suited to the crops commonly grown in the county. Moderately high yields can be obtained if the soil is well managed and if rainfall is well distributed throughout the growing season. Manure and commercial fertilizer are needed for high yields. In many places yields can be improved by adding organic matter and nitrogen. Lime and potash are needed if legumes are grown (Capability unit IIIs-1; woodland group 3)

Meridian fine sandy loam, 2 to 6 percent slopes (MeB).—The profile of this soil is slightly shallower to underlying sand than the representative profile described.

This soil is moderately susceptible to erosion. Nevertheless, if good management is used, the soil is suited to all the crops commonly grown in the county. In dry years, or in years when rainfall is poorly distributed throughout the growing season, yields are lowered by lack of moisture. (Capability unit IIIs-1; woodland group 3)

Meridian fine sandy loam, 2 to 6 percent slopes, moderately eroded (MeB2).—This soil has lost from one-third to two-thirds of its original surface layer through erosion. Its surface layer is lighter colored in places than that of the representative profile described. Also, depth to loose sand is less.

This soil is suited to row crops, small grains, and forage crops if a suitable cropping system is used and other good management is applied. Care is needed to prevent erosion and lowering of the moisture-supplying capacity. Crops on this soil respond well if lime and fertilizer are applied. (Capability unit IIIs-1; woodland group 3)

Meridian fine sandy loam, 6 to 12 percent slopes (MeC).—The profile of this soil is shallower to loose sand than the representative profile described. Most of the acreage is in small areas on breaks along draws or on the edges of terraces. Therefore, most areas have remained in pasture or in trees.

If this soil is cultivated, careful management is needed to control erosion and to keep gullies from forming. Gullies in this soil are difficult to control and generally cut deep into the steep edges of the terraces. (Capability unit IVe-3; woodland group 3)

Meridian fine sandy loam, 6 to 12 percent slopes, moderately eroded (MeC2).—This soil has lost from one-third to two-thirds of its original surface layer through erosion. Therefore, the surface layer is thinner and lighter colored than that in the representative profile described. Also, depth to the underlying sand is less.

If cultivated, this soil is likely to be seriously eroded unless practices are applied to control erosion. Special care is needed to prevent gullies from forming along the edges of the terraces.

This soil is suited to row crops, small grains, and forage crops if suitable cropping systems are used and if adequate amounts of lime and fertilizer are applied. Organic matter is also needed. In many places crops are damaged in midsummer by droughts that last for short periods. (Capability unit IVe-3; woodland group 3)

Meridian fine sandy loam, 6 to 12 percent slopes, severely eroded (MeC3).—The surface layer of this soil is thinner and lighter colored than that in the representative profile described. Because of erosion, less than one-third of the original surface soil remains, and tillage is partly in the yellowish-brown, less friable subsoil. The subsoil is exposed in much of the acreage.

This soil contains less organic matter and is more droughty than the less eroded Meridian soils. Also, it is highly susceptible to gully erosion, especially on the breaks along the edges of the terraces. Most areas of this soil are cultivated, and hay is the main crop. If this soil is well managed, yields of hay and pasture are moderately high. (Capability unit VIe-2; woodland group 3)

Meridian fine sandy loam, 12 to 20 percent slopes, moderately eroded (MeD2).—The surface layer of this soil is thinner and lighter colored than that in the representative profile described. Also, depth to the underlying sand is less. Because of erosion, the present surface layer is only about 4 to 6 inches thick.

This soil is in small areas on breaks along draws or along edges of terraces where there is a severe hazard of gully erosion. The soil also has low moisture-supplying capacity. As a result, most areas are in hay or pasture. Yields are high if the areas are renovated periodically. (Capability unit VIe-2; woodland group 4)

Morocco Series

The Morocco series is made up of somewhat poorly drained, sandy soils. These nearly level soils formed in sandy material under water-tolerant trees. They are in low-lying areas on stream terraces in the eastern part of the county. The sand in which they formed extends to a depth of many feet. These soils have a high water table and are wet most of the year. During extended dry periods, however, the water table recedes and the soil is then somewhat droughty.

A representative profile of Morocco loamy fine sand in a cultivated field follows:

0 to 8 inches, very dark grayish-brown to dark-brown, very friable loamy fine sand.
8 to 23 inches, brown to grayish-brown, very friable loamy fine sand; yellow, brown, and gray mottles.
23 to 36 inches +, pale-brown and light yellowish-brown, loose sand.

Morroco soils have rapid permeability, but, because of the high water table, they have fairly good moisture-supplying capacity during most of the growing season. Natural fertility is low. These soils are medium acid to strongly acid throughout the profile unless they have been limed. The nearly level relief and high water table make these soils so wet that farming is generally delayed in spring unless drainage has been improved.

Morocco loamy fine sand (Mo).—This is the only Morocco soil mapped in the county. Its profile is the representative profile described.

Some areas of this soil require drainage before they can be used for crops. If carefully managed, other areas can be used for crops without supplemental drainage. A drainage system is required that will not overdrain the soil and thus make it droughty or susceptible to wind erosion.

This soil is suited to row crops, small grains, and forage crops. Organic matter, lime, and fertilizer are required regularly. If suitable cropping systems are used and the soil is otherwise well managed, yields are fair. (Capability unit IVw-1; woodland group 7)

Norden Series

The Norden series is made up of moderately deep, light-colored, sandy loams, loams, and silt loams. These soils are well drained. They formed under hardwood trees in the uplands and are underlain by weathered, greenish, fine-grained sandstone at a depth between 24 and 42 inches. The green color is from glauconite, a potash-bearing mineral that occurs in varying amounts throughout layers of the Franconia sandstone formation. In most places, part or all of the profile of these soils is somewhat greenish or olive colored. In a few areas, however, the soils are reddish brown because they contain large amounts of oxidized iron minerals. These reddish-brown Norden soils are in sections 9 and 20 of Albany and Pepin Townships, respectively.

The Norden soils are near the Urne soils, which are shallow and excessively drained. In places they are so intermixed with the Urne soils that it is impractical to map them separately. Therefore, they are mapped together as undifferentiated units. The Urne soils are described elsewhere in this report.

The Norden soils are gently sloping to very steep. The less sloping soils generally are on narrow ridgetops, and the steeper soils are on ridge and valley slopes. The soils are widely distributed throughout the county, but the largest acreage is in the eastern part.

A representative profile of a Norden fine sandy loam in a cultivated field follows:

0 to 8 inches, dark-brown, very friable fine sandy loam.
8 to 13 inches, dark-brown, very friable fine sandy loam to very fine sandy loam.
13 to 28 inches, light olive-brown, firm loam.
28 to 36 inches, light olive-brown, friable very fine sandy loam.
36 inches +, partly weathered, greenish, fine-grained sandstone.

The horizons in the profile of the Norden fine sandy loams range from red to brown in color. Depth to the underlying sandstone ranges from 20 to 36 inches. The subsoil is fine sandy loam in places.

A representative profile of a Norden loam in an undisturbed area follows:

0 to 2 inches, black, very friable loam.
2 to 12 inches, dark grayish-brown, very friable loam to very fine sandy loam.
12 to 18 inches, dark yellowish-brown, friable very fine sandy loam.
18 to 36 inches, olive-brown to dark yellowish-brown, firm very fine sandy loam and silt loam.
36 inches +, partly weathered, light olive-brown sandstone.

In cultivated fields the surface layer of the Norden loams is lighter colored than in undisturbed areas. It ranges from dark grayish brown to very dark grayish brown. Depth to the underlying sandstone ranges from 24 to 36 inches.

A representative profile of a Norden silt loam in an undisturbed area follows:

0 to 4 inches, very dark grayish-brown, very friable silt loam.
4 to 10 inches, dark grayish-brown to grayish-brown, very friable silt loam.
10 to 30 inches, dark-brown, firm silt loam to silty clay loam.
30 to 34 inches, dark-brown, firm clay loam.
34 to 41 inches, light olive-brown, friable, sandy to silty material.
41 to 48 inches +, pale-olive sandstone.

The surface layer in the Norden silt loams is very dark grayish brown to dark grayish brown. Depth to the underlying sandstone is between 24 and 42 inches. The subsoil is silt loam in places.

The Norden soils are moderately permeable. They have moderate to high moisture-supplying capacity for plants. Runoff is medium on the less sloping soils to rapid on the more strongly sloping ones. Because they formed in glauconitic material, these soils have a fairly high content of potassium. Therefore, they are well suited to alfalfa, which requires large amounts of potash.

Unless they have been limed, Norden soils that have been used for cultivated crops for a prolonged period are likely to be acid. Originally, the surface layer was nearly neutral.

Norden fine sandy loam, 2 to 6 percent slopes, moderately eroded (NfB2).—The profile of this soil is similar to the representative profile described for the Norden fine sandy loams. This soil is on the crests of narrow ridges throughout the eastern part of the county.

Most of this soil is used for crops, and it is well suited to row crops, small grains, and hay. Runoff is not excessive. Nevertheless, this soil is subject to moderate erosion unless it is carefully managed. Practices are required that help supply organic matter and that maintain good moisture-supplying capacity and tilth. Crops on this soil respond well if manure is added and if lime and a complete fertilizer are added. Apply the lime and fertilizer according to the needs indicated by soil tests. (Capability unit IIe–2; woodland group 3)

Norden fine sandy loam, 6 to 12 percent slopes (NfC).—The surface layer of this soil is somewhat thicker and is slightly darker than that in the representative profile described for the Norden fine sandy loams. Most of this soil has remained in forest or has had a cover of grass. As a result, it is little eroded. Therefore, the surface layer contains more organic matter than that in the profile described.

This soil is in small areas on the sides and ends of ridges. In many places the shape or position of the areas makes them unsuitable for tillage. If this soil is used for cultivated crops, practices are needed to control erosion and to prevent damage by runoff. Moderately high yields of hay and pasture can be obtained if the soil is well managed. Areas in timber require protection from fire and grazing and need other good management to improve the stands and to sustain yields. (Capability unit IIIe–3; woodland group 3)

Norden fine sandy loam, 6 to 12 percent slopes, moderately eroded (NfC2).—The profile of this soil is like the one described for the Norden fine sandy loams. This soil has lost from one-third to two-thirds of its original surface layer through erosion. The present surface layer consists of brownish material from the subsoil that has been mixed with the remaining surface layer by plowing.

This soil is on the slopes of ridges throughout the eastern part of the county. It is subject to moderately severe erosion. Most areas are in cultivated crops. This soil is well suited to row crops, small grains, and hay. Yields are moderate if the soil is protected from erosion and if other good management is used. (Capability unit IIIe–3; woodland group 3)

Norden fine sandy loam, 6 to 12 percent slopes, severely eroded (NfC3).—This soil has a thinner, more variably colored surface layer than that in the profile described for the Norden fine sandy loams. Because of erosion, 3 inches or less of the original surface layer remains. Brownish and greenish material from the subsoil has been mixed with the remaining surface soil by plowing, and the present surface layer is olive or grayish brown.

This soil is on the sides of ridges. Most areas are cultivated, but hay crops make up the greater part of the cropping system.

This soil is not suited to intensive use for cultivated crops. Fertilizer and organic matter are needed, and practices are required to control erosion. (Capability unit IVe–3; woodland group 3)

Norden fine sandy loam, 12 to 20 percent slopes (NfD).—The surface layer of this soil is thicker and slightly darker than that in the representative profile described for the Norden fine sandy loams. It also contains more organic matter because most of this soil has been kept in forest and, therefore, is not eroded.

This soil is on ridge and valley slopes. It generally lies below areas of less sloping Norden soils. Many of the areas are small, and their shape and location make them poorly suited to tillage.

This soil is not suited to intensive use for cultivated crops. If it is used for crops, practices are needed to protect it from erosion. Wooded areas require protection from fire and grazing and need other good management if yields of timber are to increase. (Capability unit IVe–2; woodland group 4)

Norden fine sandy loam, 12 to 20 percent slopes, moderately eroded (NfD2).—The profile of this soil is similar to the representative profile described for the Norden fine sandy loams, but in some places depth to the parent sandstone is slightly less. This soil has lost from one-third to two-thirds of its original surface layer through erosion. The present surface layer consists of brownish and greenish material from the subsoil that has been mixed with the remaining surface layer by tillage.

This soil is on ridge and valley slopes. It generally is below areas of less sloping Norden soils. Most of this soil is cultivated, but hay crops make up much of the cropping system.

If this soil is well managed, moderately high yields of small grains and hay can be obtained. The soil is subject to severe erosion and needs protection from runoff from adjacent higher slopes. It is low in organic matter—and generally needs lime and fertilizer. (Capability unit IVe–2; woodland group 4)

Norden fine sandy loam, 12 to 20 percent slopes, severely eroded (NfD3).—The surface layer of this soil is thinner and more variable in color than that in the representative profile described for the Norden fine sandy loams. More than two-thirds of the original surface layer has been removed through erosion. The present surface layer is less than 3 inches thick and consists of a mixture of the original surface soil and of brownish and greenish material from the subsoil.

This soil is on ridge and valley slopes. Most areas are below less sloping Norden soils and receive considerable runoff from them.

This severely eroded soil is highly susceptible to further erosion. It needs to be kept in sod-forming crops or in trees. Practices are required to protect the areas from runoff from higher lying soils. There are gullies in some areas. In these areas special practices are required to control the gullies. (Capability unit VIe–2; woodland group 4)

Norden fine sandy loam, 20 to 30 percent slopes (NfE).—This soil has been protected by a cover of trees. Therefore, it is not eroded. The surface layer is thicker and slightly darker than that in the representative profile described for the Norden fine sandy loams. It is about 10 inches thick, and the uppermost 2 inches contains more humus than that in the profile described. Also, depth to the underlying sandstone is less. The sandstone is at a depth of about 24 to 28 inches.

This soil is on valley slopes. Steep slopes and a severe hazard of erosion make this soil better suited to permanent pasture and trees than to field crops. It is also well suited to use as wildlife areas. (Capability unit VIe-2; woodland group 4)

Norden fine sandy loam, 20 to 30 percent slopes, moderately eroded (NfE2).—The profile of this soil is shallower than the representative profile described for the Norden fine sandy loams. Depth to sandstone is about 24 to 28 inches, but in a few places the sandstone is nearer the surface. In some places there are fragments of sandstone on the surface and in the profile. This soil has lost from one-third to two-thirds of its original surface layer through erosion. Plowing has mixed brownish and greenish material from the former subsoil with the remaining surface soil. As a result, the color of the present surface layer is gradations of brown, gray, and green.

This soil is better suited to hay crops or pasture than to row crops, and most of it is used for hay or pasture. Because this soil is steep and susceptible to severe erosion, careful management is required to prevent further damage by runoff. (Capability unit VIe-2; woodland group 4)

Norden loam, 12 to 20 percent slopes, moderately eroded (NoD2).—The surface layer of this soil is lighter colored and contains less organic matter than the corresponding layer in the representative profile described for the Norden loams. It is a dark grayish brown. From 4 to 8 inches of the plow layer has been removed through erosion. The present surface layer is a mixture of material from the two former upper layers, and in places it contains material from the third layer.

This soil is on valley slopes. It generally lies below less sloping Norden soils and receives runoff from them. The runoff contributes to the hazard of gully erosion.

Most of this soil is cultivated. It is not suited to intensive use for cultivated crops, however, and should be kept in hay, pasture, or trees.

If this soil is used for small grains, hay, or pasture, lime and fertilizer are needed. Lime and fertilizer should be applied in amounts indicated by soil tests. Organic matter is also needed. (Capability unit IVe-2; woodland group 2)

Norden loam, 20 to 30 percent slopes (NoE).—The profile of this soil is similar to the representative profile described for the Norden loams, but it is shallower to sandstone. Depth to the partly weathered, greenish sandstone is between 24 and 30 inches.

This soil is on steep valley slopes. The areas are generally small and receive runoff from higher lying soils. A cover of trees, however, has protected the soil from erosion. This soil is well suited to permanent pasture or to hardwood trees. It is also suitable for use as wildlife areas. (Capability unit VIe-1; woodland group 2)

Norden loam, 20 to 30 percent slopes, moderately eroded (NoE2).—From 4 to 8 inches of the original surface layer of this soil has been removed by erosion. As a result, the present surface layer is lighter colored and lower in organic matter than that in the representative profile described for the Norden loams. Also, depth to the underlying sandstone is less.

This soil is on valley slopes below less sloping Norden soils. Most of it was cultivated at some time, but now nearly all of it is used for permanent pasture, to which it is well suited. Yields are moderately high if the soil is protected from erosion and is otherwise well managed. This soil is also suited to trees or to growing food and cover for wildlife. (Capability unit VIe-1; woodland group 2)

Norden silt loam, 2 to 6 percent slopes (NrB).—The profile of this soil is like the representative profile described for the Norden silt loams. Most areas are on the tops or ends of narrow ridges, or are in other positions that make them inaccessible or poorly suited to farming. As a result, most areas are in pasture or woodland. If this soil is cultivated, it is subject to moderate erosion. (Capability unit IIe-2; woodland group 1)

Norden silt loam, 2 to 6 percent slopes, moderately eroded (NrB2).—Except for the color and thickness of the surface layer, the profile of this sloping soil is similar to the representative profile described for the Norden silt loams. From one-third to two-thirds of the original surface layer has been removed through erosion. Material from the browner subsoil has been mixed with the remaining surface soil. As a result, the present surface layer is dark grayish brown. It is about 6 to 8 inches thick.

This soil is on the crests of ridges. Runoff is not excessive, but practices are required to control erosion in some places.

This soil is well suited to all the crops commonly grown in the county, and most of it is cultivated. The hazard of erosion is moderate. If this soil is protected from erosion and if other good management is used, crops make high yields. (Capability unit IIe-2; woodland group 1)

Norden silt loam, 6 to 12 percent slopes (NrC).—Except for milder slopes, the profile of this soil is similar to that of the representative profile described for the Norden silt loams.

This soil is on ridge slopes. Many of the areas are small, and their shape or location make them difficult to farm. Consequently, most areas are used for pasture or trees. They are not eroded or are only slightly eroded.

Areas of this soil that are feasible to farm are suited to row crops, small grains, and hay if practices are used to control erosion and if other good management is used. If it is well managed, this soil also is suited to pasture, trees, and to use for wildlife. (Capability unit IIIe-3; woodland group 1)

Norden silt loam, 6 to 12 percent slopes, moderately eroded (NrC2).—The surface layer of this soil is lower in organic matter than that in the representative profile described for the Norden silt loams. The present surface layer contains small amounts of brownish material from the subsoil that has been mixed into it by tillage.

This soil is on ridge slopes and is subject to moderately severe erosion. It is well suited to row crops, small grains, and hay, but careful management is needed to control further erosion. Crops on this soil respond well if lime and fertilizer are added according to the needs indicated by soil tests. (Capability unit IIIe-3; woodland group 1)

Norden silt loam, 6 to 12 percent slopes, severely eroded (NrC3).—The surface layer of this soil consists mainly of material that formerly was subsoil. Therefore, it is lower in organic matter and is less friable than that in the representative profile described for the Norden silt loams.

This soil is on ridge slopes, and in places it receives runoff from higher lying soils. It is not suited to intensive cultivation. This soil should be kept in sod-forming crops most of the time. Yields are fairly good if the content of organic matter is increased and if lime and fertilizer are added. Apply the lime and fertilizer in the amounts indicated by soil tests. (Capability unit IVe–2; woodland group 1)

Norden silt loam, 12 to 20 percent slopes (NrD).—The profile of this soil is like the representative profile described for the Norden silt loams.

This soil is on valley slopes. It generally lies below less sloping Norden soils. Many of the areas are small or are in positions that make them inaccessible or poorly suited to farming. Therefore, most areas are in trees. The wooded areas require management that will improve the stands. Cleared areas can be farmed if the soil is protected from erosion and if suitable cropping systems are used. (Capability unit IVe–2; woodland group 2)

Norden silt loam, 12 to 20 percent slopes, moderately eroded (NrD2).—This soil has lost 4 to 8 inches of its original surface layer through erosion. The present surface layer is dark grayish brown and contains small amounts of material from the former subsoil that have been turned up by plowing.

This soil is on valley slopes. It generally receives runoff from higher lying, less sloping Norden soils.

This soil is not well suited to cultivated crops. It is well suited, however, to small grains and hay if erosion is controlled and if lime and fertilizer are added. Applying manure and returning crop residues to the soil help to increase the content of organic matter. Yields are fairly high in areas that are planted to mixtures of grasses and legumes and that are renovated periodically. (Capability unit IVe–2; woodland group 2)

Norden silt loam, 12 to 20 percent slopes, severely eroded (NrD3).—The surface layer of this soil is less friable than that in the representative profile described for the Norden silt loams. It consists mainly of brownish, somewhat compact material from the subsoil that has been turned up by tillage. As a result, the present surface layer is lower in organic matter than the original one and is more difficult to keep in good tilth. Also, water infiltrates more slowly.

This soil is on valley slopes where it receives runoff from higher lying areas. The runoff increases the hazard of erosion.

This soil is better suited to forage crops and trees than to row crops. If forage crops are grown, fairly large amounts of lime and commercial fertilizer are required. Organic matter is also needed. Practices are needed to control the gullies that have formed, and to prevent others from forming. (Capability unit VIe–1; woodland group 2)

Norden silt loam, 20 to 30 percent slopes (NrE).—The profile of this soil is slightly shallower to the underlying, greenish sandstone than the representative profile described for the Norden silt loams. Native hardwood trees cover the areas, and the soil is only slightly eroded.

This soil is suited to permanent pasture and to trees. The wooded areas require protection from fire and grazing and need other good management. (Capability unit VIe–1; woodland group 2)

Norden silt loam, 20 to 30 percent slopes, moderately eroded (NrE2).—From 4 to 8 inches of the friable surface layer of this soil has been removed through erosion. The present surface layer is dark grayish brown and is thinner than that in the representative profile described for the Norden silt loams. Also, depth to the underlying sandstone is less.

This soil is on valley slopes where it receives runoff from higher lying soils. The runoff adds to the hazard of erosion and limits the use of this soil. This soil can be used for permanent pasture if grazing is controlled. Yields of bluegrass pastures are increased if a commercial fertilizer that is high in nitrogen is applied. Renovating the pastures periodically also increases yields. The fertilizer should be applied according to the needs indicated by soil tests. (Capability unit VIe–1; woodland group 2)

Norden silt loam, 20 to 30 percent slopes, severely eroded (NrE3).—The surface layer of this soil is thinner and browner than that in the representative profile described for the Norden silt loams. Also, depth to the underlying sandstone is less. Because of erosion, less than 3 inches of the original, friable, 10-inch surface layer remains and brown material from the subsoil is exposed in many places. As a result, tilth is fairly poor.

Steep slopes and severe erosion make this soil poorly suited to cultivated crops. If the soil is well managed, yields of pasture are fair. Some areas of this soil have been renovated and seeded to mixtures of grasses and legumes. Other areas remain in bluegrass. The areas in permanent pastures require careful management of grazing. Otherwise, erosion will continue. Areas that cannot be kept in a cover of sod are best planted to trees. (Capability unit VIIe–1; woodland group 2)

Norden silt loam and loam, 30 to 40 percent slopes (NsF).—This mapping unit is made up of about equal amounts of Norden silt loam and of Norden loam. The profiles of the soils range from 24 to 30 inches in thickness, but they are otherwise similar to the profiles described for the Norden silt loams and Norden loams.

These soils are on the sides of steep ridges and valley slopes. Little of the acreage has been cleared, and the areas that have been cleared generally have reverted to trees. The soils should remain in trees, and the areas should be managed to improve the stands. (Capability unit VIIe–1; woodland group 2)

Norden silt loam and loam, 30 to 40 percent slopes, moderately eroded (NsF2).—The soils in this mapping unit have a lighter colored surface layer and contain less organic matter than those in the representative profiles described for the Norden silt loams and the Norden loams. Also, depth to the underlying sandstone is less.

These soils are on the sides of steep ridges and on valley slopes. Most areas are in bluegrass pasture, but some areas are reverting to trees. Areas in permanent pasture require the careful control of grazing needed to prevent further erosion. The wooded areas need protection from fire and grazing and the other good management needed to improve the stands. (Capability unit VIIe–1; woodland group 2)

Norden Series, Dark Surface Variant

The variants from the normal Norden soils are well-drained, moderately permeable soils. These soils formed under prairie in 14 to 36 inches of fine sandy loam underlain by greenish, fine-grained sandstone. Unlike the soils of the Norden series, they have a thick, dark surface layer. These gently sloping to sloping variants are on low, undulating ridges within broad valleys in the eastern half of the county.

A representative profile of a Norden fine sandy loam, dark surface variant, in a cultivated field follows:

0 to 8 inches, very dark brown, very friable fine sandy loam.
8 to 11 inches, black, very friable fine sandy loam.
11 to 24 inches, yellowish-brown, friable fine sandy loam.
24 inches +, greenish or olive, fine-grained sandstone.

These variants are shallow to bedrock, and their moisture-supplying capacity for plants is moderately low. Consequently, during periods when rainfall is low or is poorly distributed, plants are likely to be damaged by drought. Before these soils were cultivated they were nearly neutral, but they now require lime.

Norden fine sandy loam, dark surface variant, 2 to 6 percent slopes, moderately eroded (NgB2).—The surface layer of this variant is slightly thinner than that of the representative profile described. This variant is on the rounded tops of ridges. Runoff is not excessive, but practices are required to control erosion.

Because of the hazards of erosion and drought, this soil requires careful management if it is used for cultivated crops. Nevertheless, yields are high if erosion is controlled and if a suitable cropping system is used. Generally, moderate amounts of lime and a complete fertilizer are required. The lime and fertilizer should be applied according to the needs indicated by soil tests. Nitrogen fertilizer is needed for corn and nonleguminous hay and pasture crops. Originally, this soil had a high content of organic matter, but, because it has been used for cultivated crops, more organic matter is needed. Organic matter can be supplied by adding manure and returning crop residues to the soil. (Capability unit IIIs–1; woodland group 3)

Norden fine sandy loam, dark surface variant, 6 to 12 percent slopes, moderately eroded (NgC2).—This soil has a slightly thinner surface layer than that in the representative profile described, and its solum is thinner. It occupies ridge slopes below less sloping soils on the ridgetops.

The moisture-supplying capacity of this soil is moderately low. Nevertheless, this soil is suited to row crops, small grains, and hay if a suitable cropping system is used and if practices are applied to control erosion and to prevent further loss of moisture. Plowing under crop residues and applying manure will supply organic matter and improve the moisture-supplying capacity. Crops on this soil respond well if lime and a complete fertilizer are applied according to the needs indicated by soil tests. (Capability unit IVe–3; woodland group 3)

Northfield Series

The Northfield series is made up of light-colored, gently sloping very fine sandy loams typically on low ridgetops. The soils are well drained. They formed on uplands in 20 inches or less of residuum from fine-grained, thin-bedded sandstone. The native vegetation was a deciduous forest.

A representative profile of a Northfield very fine sandy loam in a cultivated field follows:

0 to 9 inches, very dark grayish-brown, friable very fine sandy loam.
9 to 12 inches, dark grayish-brown, very friable very fine sandy loam.
12 to 18 inches, dark-brown to yellowish-brown, friable very fine sandy loam.
18 inches +, yellowish-brown, platy sandstone.

The surface layer is very dark grayish brown to dark grayish brown. Depth to sandstone ranges between 12 and 24 inches.

The permeability of these soils is moderately rapid. Runoff is medium. The moisture-supplying capacity for plants is low. These soils are slightly acid to medium acid. The depth of the root zone is limited by the underlying bedrock. The root zone is less than 2 feet from the surface.

The Northfield soils are in the eastern half of the county. Because they have gentle slopes and are fairly easy to till, most areas are used for cultivated crops. These soils are locally important to agriculture.

Northfield very fine sandy loam, 2 to 6 percent slopes (NvB).—The profile of this soil is like the representative profile described. This soil is little eroded and retains most of its original surface layer.

Most areas of this soil are in cultivated crops, but a few small areas are in native trees. This soil is moderately susceptible to water erosion and droughtiness. It can be cropped fairly intensively if it is protected from erosion and if it is otherwise well managed. Moderate amounts of lime and fertilizer are needed to increase fertility. Also, the content of organic matter is low. Crops on this soil, however, respond well if manure is added or if other practices are used to supply organic matter. (Capability unit IIIe–4; woodland group 3)

Northfield very fine sandy loam, 2 to 6 percent slopes, moderately eroded (NvB2).—This soil has a thinner, lighter colored surface layer than that in the representative profile described. From one-third to two-thirds of the original surface layer has been removed through erosion. Only 4 to 6 inches of the original surface layer remains. The present surface layer is a mixture of the remaining surface soil and less friable material from the subsoil.

This soil is suited to row crops, small grains, and hay if it is carefully managed. Nearly all the areas are cultivated. This soil is shallow over bedrock and is droughty. Therefore, practices are needed to supply organic matter and to control erosion. Crops on this soil respond well if moderate amounts of lime and fertilizer are applied and large amounts of manure are added. (Capability unit IIIe–4; woodland group 3)

Orion Series

The Orion series is made up of light-colored, deep, somewhat poorly drained soils. These soils formed in layers of silty sediments washed from uplands and terraces that were covered with loess. They are on the flood plains of the larger streams and on narrow bottoms along the smaller streams. A darker, buried soil is in the profile at a depth of more than 18 inches. The original vegetation was grasses, sedges, reeds, elms, willows, and other water-tolerant plants. Most of the acreage of Orion soils is in valleys throughout the western half of the county.

A representative profile of Orion silt loam follows:

0 to 32 inches, very dark grayish-brown, very friable silt loam; many mottles of reddish brown.
32 inches +, very dark grayish-brown to dark grayish-brown, very friable silt loam.

In a few places the soils have a thin layer of sandy overwash on the surface. Also, in some areas there are thin layers of sand in the profile. In the profile described, a darker, buried soil is at a depth of 32 inches, but depth to this buried soil ranges from 18 inches to 5 feet or more.

The Orion soils have moderately slow permeability and high moisture-supplying capacity for plants. They have slow internal drainage and surface drainage. These soils are neutral throughout the profile.

Orion silt loam (Or).—This is the only Orion soil mapped in this county. Most areas are cleared and are used for row crops and permanent pasture.

This soil is well suited to corn. It is also suited to small grains, hay, and pasture. Some areas can be used for crops without drainage, but most areas require some drainage for best yields. Cultivated crops are likely to be lost unless the areas are protected from flooding. This soil is suited to alfalfa only if it is adequately drained and protected from flooding.

This soil can be cropped intensively if adequate fertilizer is applied and if it is otherwise well managed. Corn needs supplemental nitrogen fertilizer. (Capability unit IIw-2; woodland group 8)

Otterholt Series

The Otterholt series consists of well-drained, light-colored, silty soils that are well drained. These gently undulating to rolling soils formed on uplands in a mantle of windborne silt 42 to 60 inches thick. They are underlain by glacial till. The slope ranges between 2 and 12 percent. Hardwood trees made up the native vegetation.

A representative profile of an Otterholt silt loam, loamy substratum, in a forested area follows:

0 to 4 inches, black to very dark gray, friable silt loam.
4 to 13 inches, dark grayish-brown, friable silt loam.
13 to 38 inches, dark-brown, firm silt loam; in many places there are veins or tongues of bleached silt.
38 to 53 inches, dark-brown, friable silt loam.
53 inches +, yellowish-brown, sticky and plastic clay loam till.

The surface layer in cultivated areas is lighter colored than that in the representative profile described. It is generally dark grayish brown. The underlying till ranges from loam to clay loam.

These soils have moderate internal drainage and permeability. Runoff is medium to rapid, depending on the slope. The moisture-supplying capacity is high, and natural fertility is moderately high. Crops on these soils respond well if fertilizer is applied. These soils are medium acid to strongly acid and need lime for increased yields. The root zone is not limited for crops commonly grown in the area.

The Otterholt soils are susceptible to erosion by water, especially if the slope is long and steep. Therefore, practices are required to control erosion. These soils are fairly easy to cultivate and manage. Where the slope is favorable, they are well suited to all of the crops commonly grown.

Otterholt silt loam, loamy substratum, 2 to 6 percent slopes (OsB).—The profile of this soil is like the representative profile described.

Mapped with this soil are a few small areas of a soil that is underlain by clay loam or loam till at a depth between 24 and 30 inches. These included areas can be used and managed the same as this soil.

Otterholt silt loam, loamy substratum, 2 to 6 percent slopes, is on the broad, rounded tops of ridges. Areas that have been cleared, or that feasibly can be cleared, are well suited to row crops, small grains, and hay. The hazard of erosion is moderate if this soil is cultivated, but erosion can be controlled easily. If erosion is controlled and if adequate amounts of lime and fertilizer are applied, this soil can be cropped intensively. Yields are high if the soil is well managed. (Capability unit IIe-1; woodland group 1)

Otterholt silt loam, loamy substratum, 2 to 6 percent slopes, moderately eroded (OsB2).—This soil has lost from 4 to 8 inches of its original friable surface soil. The present surface layer is lighter colored than that in the representative profile described. It also contains less friable material from the subsoil that has been mixed into it by tillage.

Mapped with this soil are a few small areas of a soil that is underlain by till at a depth between 24 and 30 inches. These included areas can be used and managed the same as this soil.

Otterholt silt loam, loamy substratum, 2 to 6 percent slopes, moderately eroded, is on the tops of broad, rounded ridges in the western half of the county. The areas are fairly large.

Nearly all of this soil is cultivated. It is well suited to row crops, small grains, and hay. If a suitable cropping system is used and practices are applied to control erosion, this soil can be used fairly intensively for crops. Yields are high if the level of plant nutrients is kept high. Fertilizer and lime should be applied according to the needs indicated by soil tests. Supplemental applications of nitrogen are needed for high yields of corn. (Capability unit IIe-1; woodland group 1)

Otterholt silt loam, loamy substratum, 6 to 12 percent slopes, moderately eroded (OsC2).—This soil has a lighter colored surface layer than that in the representative profile described. From 4 to 8 inches of the original friable surface layer has been lost through erosion. The present surface layer is dark grayish brown. It consists of the remaining material from the original surface layer and of material from the former subsoil that has been mixed into it by tillage.

Mapped with this soil are a few areas of a soil that formed in 24 to 30 inches of silt over till.

Otterholt silt loam, loamy substratum, 6 to 12 percent slopes, moderately eroded, in some places caps the tops of fairly narrow ridges. Where the ridges are broader, this soil is generally on the part of the ridge that slopes away from the top toward the steep sides of the ridge.

Most of this soil is cultivated and is susceptible to moderately severe erosion. Nevertheless, it is well suited to row crops, small grains, and hay if practices are used to prevent further erosion. Fairly intensive practices are needed to control erosion, and in most places the practices are fairly easy to apply. If a suitable cropping system is used, and if the supply of plant nutrients is maintained, yields are high. Crops on this soil respond well if a complete fertilizer is added and manure is applied. Lime is generally required. It should be applied according to the needs indicated by soil tests. (Capability unit IIIe–1; woodland group 1)

Peat and Muck

Peat and muck is made up of organic soils that formed in basins and depressions in shallow stagnant water and along seepage lines at the base of sandstone uplands. These organic soils were derived mainly from reeds, grasses, sedges, and other plant materials. The soils are very poorly drained, and the water table remains at or near the surface throughout most of the year.

These soils differ chiefly in the degree of decay of the original plant fibers. The peaty material is dark brown or black, and many of the fibers retain the identity of the original plants. It is spongy and fibrous and can be seen drying in thick matted plates and blocks along the banks of drainage ditches. On the other hand, in mucky material all or most of the original plant fibers are decomposed. The mucky material is black and has a waxy or greasy consistence when wet. It contains a fairly large amount of mineral soil material in places. In Pepin County, these soils range in thickness from 1½ to about 7 feet. They are underlain by loose sand or sandstone.

Peat and muck soils are saturated during most of the year. They are subject to flooding when the streams overflow. These soils retain large amounts of water, but they release the water readily if drained. They are slightly acid to neutral.

Peat and muck soils are of moderate extent. They occur throughout the stream valleys in the eastern part of the county, and they are important to the economy of the area.

A representative profile of Peat and muck follows:

0 to 8 inches, black, well-decomposed mucky peat.
8 to 44 inches, black, partly decomposed, matted sedge peat.
44 inches +, very dark brown sedge peat.

In places Peat and muck soils have an overwash of mineral materials, as much as 12 inches thick, on the surface. Nearly all areas of Peat and muck were burned over at some time and then were drained and cultivated. Thus, the surface layer in most areas is made up of material that is in an advanced stage of decay. Because of these practices and pasturing of the areas, Peat and muck soils have passed through the initial stages of subsidence and compaction that normally follow when organic soils are drained and reclaimed.

Peat and muck, deep (Pa).—The profiles of these soils are like the representative profile described.

Areas of these soils that are adequately drained are used for crops. Yields are high. The soils can be cropped intensively if they are well managed. The soils are low in potassium, and in many places they lack phosphorus. Areas that are inadequately drained are used for pasture or as wildlife areas. (Capability unit IIIw–2; woodland group 10)

Peat and muck, shallow (Pb).—These soils are shallower to sand than the soils for which the representative profile was described. Depth to sand is 12 to 40 inches. Because the sand is fairly near the surface, it is difficult to drain the areas and to improve them for crops. These soils are suited, however, to permanent pasture and can be used as wildlife areas. (Capability unit Vw–1; woodland group 10)

Plainfield Series

The Plainfield series is made up of deep, light-colored, sandy soils that are excessively drained. These nearly level to rolling soils are on stream terraces. They are mostly within the eastern half of the county. The original vegetation was a forest of hardwoods.

A representative profile of a Plainfield loamy fine sand in a cultivated field follows:

0 to 9 inches, dark grayish-brown, very friable loamy fine sand.
9 to 17 inches, dark-brown, very friable loamy fine sand.
17 inches +, yellowish-brown, loose fine sand.

The surface layer ranges from very dark grayish brown to dark grayish brown. In places there are one or more thin layers of loamy or clayey material at a depth below 3 feet.

These soils have rapid permeability and low moisture-supplying capacity. They are droughty, especially during seasons when rainfall is low or is poorly distributed. Unless they have been limed, these soils are acid throughout the profile. These loose, sandy soils are low in fine-textured binding material, and therefore, they are susceptible to wind and water erosion. Their natural fertility is low.

Plainfield loamy fine sand, 0 to 2 percent slopes (PfA).—The profile of this soil is similar to the representative profile described. This soil is little eroded and retains most of its original surface layer.

Most of this soil is cultivated, but some areas are in slow-growing hardwood trees. This soil is suited to row crops, small grains, and hay if a suitable cropping system is used and if the soil is otherwise well managed. Because it is droughty, this soil is better suited to crops that mature early or that are deep rooted than it is suited to other crops. This soil is low in plant nutrients and organic matter. It is easily eroded by wind, and special practices are needed to prevent the soil from blowing. (Capability unit IVs–1; woodland group 5)

Plainfield loamy fine sand, 2 to 6 percent slopes (PfB).—This soil is made up of gently sloping and gently undulating areas. In some places as much as one-third of its original surface soil has been lost through water and wind erosion. Otherwise, the profile is similar to the representative profile described.

Although much of this soil is cultivated, large areas are in grass or trees. If practices are used to prevent erosion, this soil is suited to most crops commonly grown in the county. The soil is low in organic matter and plant nutrients. (Capability unit IVs–1; woodland group 5)

Plainfield loamy fine sand, 2 to 6 percent slopes, eroded (PfB2).—The profile of this soil is like the representative profile described. It has lost from one-third to more than two-thirds of its original surface layer through wind and water erosion.

Most of this soil is cultivated, but some areas have been planted to coniferous trees. This soil is droughty, low in plant nutrients, and easily eroded. It is suited to cultivated crops if good management is used. Yields are fair during years of favorable rainfall. During seasons when rainfall is low or poorly distributed, however, yields are low or the crops fail. (Capability unit IVs-1; woodland group 5)

Plainfield loamy fine sand, 6 to 12 percent slopes (PfC).—This soil is in areas that never have been cleared and cultivated or that have been cultivated but that have lost no more than one-third of the original surface soil. Its profile is similar to the representative profile described.

This soil is mostly in trees and brush, or is idle. Only a small acreage is cultivated. The low moisture-supplying capacity and severe hazard of wind and water erosion make this soil poorly suited to continuous use for cultivated crops. It can be used for forage crops for hay or pasture, or for pine trees. To control erosion and conserve moisture, seed forage crops only when the pastures are renovated. (Capability unit VIs-1; woodland group 5)

Plainfield loamy fine sand, 6 to 12 percent slopes, eroded (PfC2).—This soil has lost from one-third to more than two-thirds of its original surface soil through wind and water erosion.

Most of this soil has been used for crops, but many areas are now being planted to pines. Some areas are idle and support a sparse cover of grass or weeds. This soil is droughty, is low in fertility, and is susceptible to wind and water erosion. If it is carefully managed, it can be used for hay or pasture. Yields are generally low. This soil is also suited to pine trees. (Capability unit VIs-1; woodland group 5)

Plainfield loamy fine sand, 12 to 20 percent slopes (PfD).—The profile of this soil is similar to the representative profile described, but in some places the surface layer contains more organic matter and is slightly darker. The organic matter comes from decaying leaves from the native hardwood trees that grow on this soil.

This soil is droughty, low in fertility, and subject to erosion. It is not well suited to hardwood trees, but it is well suited to pines. If the hardwood trees are removed, the soil should be planted to pines. (Capability unit VIIs-1; woodland group 6)

Plainfield loamy fine sand, 12 to 20 percent slopes, eroded (PfD2).—The surface layer of this soil is thinner than that in the representative profile described. Some areas are cultivated, but yields are low because the soil is droughty and is low in natural fertility. This soil is best suited to pines, and many areas are being planted to pines. (Capability unit VIIs-1; woodland group 6)

Plainfield Series, Mottled Subsoil Variant

These variants of the Plainfield series are deep, moderately light colored loamy fine sands that are moderately well drained. These soils are in nearly level to slightly depressed areas on broad, sandy stream terraces that border streams and marshes. They are in the eastern half of the county.

A representative profile of a Plainfield loamy fine sand, mottled subsoil variant, in a cultivated field follows:

0 to 12 inches, very dark gray to very dark grayish-brown, very friable loamy fine sand.
12 to 18 inches, dark grayish-brown, loose loamy sand.
18 inches +, brown to light-brown, loose fine sand; few to common mottles of brown, yellowish brown, and reddish brown.

In some areas the subsoil is less mottled than in the profile described. The surface layer is dark grayish brown in places. In some places there are one or more thin layers of fine-textured material in the underlying sand at a depth below 3 feet.

The permeability of these soils is rapid. The level of the ground water rises during wet seasons. The moisture-supplying capacity of these soils is then somewhat higher than in seasons of normal rainfall, when the ground water is at a depth of 4 feet or more. The soils are somewhat droughty. Natural fertility is low. Unless they have been limed, these soils are strongly acid.

Plainfield loamy fine sand, mottled subsoil variant, 0 to 2 percent slopes (PmA).—The profile of this soil is like the representative profile described.

This soil is suited to row crops, small grains, and hay. It is better suited, however, to crops that mature early or that are deep rooted than it is to other crops. Yields are generally low because the soil is droughty and is low in fertility. During dry years, or when rainfall is poorly distributed throughout the growing season, crops are damaged by lack of moisture.

This soil needs to be protected from wind erosion. Fertilizer and organic matter are needed, and a suitable cropping system should be used if this soil is used for cultivated crops. (Capability unit IVs-1; woodland group 7)

Richwood Series

In the Richwood series are deep, dark-colored, silty soils that are well drained. These soils formed in loess, or windborne silt, on high stream benches. They are underlain by layers of sand at varying depths below 42 inches. These soils are nearly level to sloping, but most of the acreage is nearly level. The original vegetation was prairie grasses.

A representative profile of a Richwood silt loam in a cultivated field follows:

0 to 12 inches, black to very dark gray, very friable silt loam.
12 to 34 inches, dark yellowish-brown, firm silty clay loam.
34 to 60 inches +, dark yellowish-brown to yellowish-brown, friable silt loam.

In places there are layers of sand at a depth below 42 inches.

These soils are moderate in permeability and high in moisture-supplying capacity. Runoff is slow to medium, depending on the degree of slope. Internal drainage is medium. Natural fertility is high. Crops on these soils respond well if fertilizer is applied and if the soils are otherwise well managed. The content of organic matter originally was high. Even though these soils have been used intensively for crops, they still contain more organic matter than newly tilled soils that formed under timber. These soils are medium acid to slightly acid unless they have been limed.

Richwood silt loam, 0 to 2 percent slopes (RcA).—The profile of this soil is like the representative profile described.

This soil can be used intensively for crops. Yields are high if organic matter and fertilizer are added. No special practices are required to control erosion.

Crops on this soil respond well if a fertilizer high in phosphate and potash is added. Corn requires supplemental applications of nitrogen for high yields, and legumes need lime. Apply the lime and fertilizer according to the needs indicated by soil tests. (Capability unit I–1; woodland group 9)

Richwood silt loam, 2 to 6 percent slopes (RcB).—The surface layer and the subsoil of this soil are slightly thinner than those in the representative profile described. The slope of this soil is fairly short; therefore, runoff is not excessive. This soil is highly productive if it is well managed. Simple practices are needed to control erosion. (Capability unit IIe–1; woodland group 9)

Riverwash

Riverwash (Re) is a miscellaneous land type made up of loose sand and gravel deposited recently in stream channels or in intermittent drainageways. Most of the areas are along the major streams. This land type is droughty and receives fresh deposits frequently. Consequently, the areas have little or no useful vegetation. This land type is not suited to agriculture, but it can be used for wildlife or for recreation. It also is not suited to trees. Therefore, it has not been placed in a woodland group. (Capability unit VIIIs–1)

Rowley Series

In this series are deep, silty, dark-colored soils that are somewhat poorly drained. These nearly level soils formed on low stream terraces. They are mainly in the eastern half of the county.

A representative profile of Rowley silt loam in a cultivated field follows:

0 to 12 inches, black, friable silt loam.
12 to 16 inches, very dark gray, friable silt loam; many mottles of grayish brown and yellowish brown.
16 to 38 inches, grayish-brown, somewhat firm silty clay loam; many mottles of yellowish brown and brown.
38 inches +, grayish-brown, massive, friable silty clay loam; many mottles of dark brown.

The silty deposits in which these soils formed are generally 5 feet or more thick. In places these soils are underlain by layers of sand at a depth below 42 inches.

These soils have moderately slow permeability. Runoff is slow, and in some areas these soils receive runoff from adjacent soils of uplands. These soils have high moisture-supplying capacity for plants. They are medium acid to neutral.

Rowley silt loam (Ro).—This is the only Rowley soil mapped in the county. It is in nearly level to slightly depressed areas.

If this soil is drained and is well managed otherwise, it is highly productive. In most areas tile drains or deep ditches are required for adequate drainage. For the other areas, surface drains will provide adequate drainage for good yields. After this soil is drained, it can be cropped fairly intensively. (Capability unit IIw–1; woodland group 8)

Sandy Alluvial Land

Sandy alluvial land (Sa) is a miscellaneous land type made up of deep, light-colored, sandy alluvium. The areas are on level flood plains along the Chippewa River. Most of them are large. The soil material is sand or loamy sand and overlies stratified fine to coarse sand. This land type is excessively drained to well drained. Because the areas are near streams, however, ground water is at or near the surface for short periods when the water level is high. Therefore, in some places there are a few yellow and brown mottles at a depth below 2 or 3 feet. The soil material dries rapidly after the water level recedes.

Sandy alluvial land is subject to frequent flooding. In places the floodwaters remain for extended periods, and several inches of sand may be deposited on the surface. In some places the deposits are deep enough to kill growing plants. Also, the stream channel shifts positions in places.

Sandy alluvial land is rapidly permeable. It has low moisture-supplying capacity for plants, is droughty, and is low in natural fertility. As a result, the growth of plants is limited.

The surface layer of this land type is brown to grayish-brown sand that is about 4 inches thick. It is underlain by brown or reddish-brown sand that becomes lighter colored with increasing depth.

This land type is near Loamy alluvial land and Loamy alluvial land, wet. It is coarser textured and has better drainage than those miscellaneous land types.

Sandy alluvial land has a sparse cover of bluegrass, willow, oak, elm, soft maple, and birch. The plants that require the most moisture are on the streambanks, and those that tolerate drought are farther from the streams.

This land type is used mainly for wildlife habitats or recreational areas. Some areas are in permanent pasture and woodland. Moderate yields can be obtained from the pasture and woodland if the areas are managed carefully. A small acreage is in crops, but this land type has little value for agriculture. (Capability unit VIIs–2; woodland group 7)

Seaton Series

In the Seaton series are light-colored, deep, silty soils that are well drained. These soils are on ridges and on valley slopes. They formed in loess, or windblown silt, more than 42 inches thick. In some places the silt is as much as 10 feet or more thick, but it generally is 5 feet or more thick. The loess was originally neutral to calcareous, but it has been leached of carbonates to a depth of 5 feet or more. It overlies dolomitic limestone in most places. In some places it overlies sandstone. The native vegetation was a hardwood forest made up of oak, hickory, and maple trees.

Two topographic phases of the Seaton silt loams—uplands and valleys—have been recognized. The Seaton soils on valley slopes have a somewhat coarser textured subsoil and substratum than the Seaton soils on uplands.

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They also have slightly less structural development in the subsoil and a few fragments of sandstone and limestone in the solum. Generally, the soils of the ridges have slopes between 2 and 12 percent, and those of the valleys have slopes between 12 and 30 percent.

The Seaton soils are similar to the Fayette soils, but they formed from coarser textured silt and have less clay in the subsoil.

A representative profile of a Seaton silt loam, uplands, in a forested area follows:

0 to 4 inches, black to very dark brown, friable silt loam.
4 to 7 inches, dark grayish-brown, friable silt loam.
7 to 15 inches, dark-brown, friable silt loam.
15 to 31 inches, dark yellowish-brown to dark-brown, friable to somewhat firm silt loam.
31 to 72 inches, dark-brown, friable silt loam.
72 inches +, dolomitic limestone.

In cultivated fields the surface layer is very dark grayish brown to dark grayish brown. In forested areas it is very dark grayish brown to black.

The Seaton soils are high in moisture-supplying capacity and moderate in permeability. Runoff is medium on the gently sloping soils and rapid on the steep ones. These soils are generally strongly acid throughout the solum, unless they have been limed.

In Pepin County the Seaton soils are mapped only in undifferentiated units with the Fayette soils. The soils can be used and managed in about the same way, and they respond in a similar way to management. These soils do not occur in a consistent pattern, nor is the proportionate distribution the same in all areas. The soils occur in the same general areas in the uplands, however, as well as on valley slopes.

The Seaton and Fayette soils are high in natural fertility. The steep areas are used mainly for forage crops and trees. The less steep areas are used for row crops. These soils occur throughout the county, but most areas are in the western part. They are highly productive and are important to the economy of the county.

Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes (SeB).—The profiles of these soils are like the representative profiles described for the Seaton and the Fayette series.

These soils are on the tops of broad, loess-covered ridges throughout the county. Much of the acreage is in cultivated crops, but a fairly large acreage is in native hardwoods. If cultivated, areas of these soils are subject to erosion by runoff, even though the slope is mild. Fairly simple practices can be used, however, to control erosion.

These soils are highly productive if well managed. They are well suited to all the crops commonly grown in the county. (Capability unit IIe–1; woodland group 1)

Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes, moderately eroded (SeB2).—The surface layer of these soils is slightly lighter colored and lower in organic matter than those in the representative profiles described for the Seaton and the Fayette series.

These soils are on broad, rounded ridgetops. Nearly all the areas are cultivated. Corn, small grains, and forage crops grow well on these soils. A suitable cropping system is required, and practices are needed to control further erosion. In some places yields are limited because the soils lack organic matter and nitrogen. Yields are high, however, if a complete fertilizer and lime are added. Apply the fertilizer and lime according to the needs indicated by soil tests. (Capability unit IIe–1; woodland group 1)

Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes (SeC).—The profiles of these soils are similar to the representative profiles described for the Seaton and the Fayette series, but the slope is stronger.

These soils are on the narrow tops and slopes of ridges. Many of the areas are small, and their shape and position make them poorly suited to farming. Most areas are in native hardwoods. These soils need to be protected from erosion if they are used for cultivated crops. Areas in trees require protection from fire and grazing, as well as the other good management required to obtain high yields. (Capability unit IIIe–1; woodland group 1)

Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, moderately eroded (SeC2).—The surface layer of these soils is lighter colored and lower in organic matter than those in the representative profiles described for the Seaton and the Fayette series. In some places plowing has turned up brownish, less friable material from the subsoil.

In areas where the ridges are fairly narrow, these soils generally cover the entire ridgetop. On broad ridges the soils lie between less sloping soils on the top of the ridges and steeper soils along the edges of the ridges. The hazard of erosion is moderately severe.

Most areas of these soils are cultivated. These soils are well suited to row crops, small grains, and hay if they are well managed. They need a cropping system and supporting practices that will prevent further erosion. These soils are generally productive. In places yields are low because the soils need organic matter and a complete fertilizer. Apply the fertilizer and add lime according to the needs indicated by soil tests. (Capability unit IIIe–1; woodland group 1)

Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, severely eroded (SeC3).—More than two-thirds of the original surface soil, and in places part of the subsoil, of these soils has been lost through erosion. Plowing has mixed material from the subsoil with the remaining surface soil. As a result, the present surface layer is lighter colored than that in the representative profiles described for the Seaton and the Fayette series. Patches of brown material from the former subsoil are exposed in more than two-thirds of the acreage.

These soils are on ridge slopes. They generally lie below less sloping Seaton and Fayette soils and receive runoff from them. The runoff increases the hazard of erosion. These soils are not suited to intensive use for cultivated crops. Clean-tilled crops can be grown if a suitable cropping system is used and supporting practices are applied to control further erosion. Organic matter is needed, and lime and fertilizer are required. Apply the lime and fertilizer according to the needs indicated by soil tests. (Capability unit IIIe–1; woodland group 1)

Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes (SeD).—The profiles of these soils are like the representative profiles described for the Seaton and the Fayette series, but the slope is stronger.

These soils are in small areas on ridge slopes. The shape or position of many areas make them poorly suited to farming. Therefore, most areas have remained in hardwood trees and are only slightly eroded. If these soils are used for crops, intensive practices are needed to control erosion. The wooded areas require protection from fire and grazing and need other good management to sustain yields. (Capability unit IVe-1; woodland group 2)

Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, moderately eroded (SeD2).—The profiles of these soils show the effects of erosion more then the representative profiles described for the Seaton and the Fayette series. Also, plowing has mixed material from the former subsoil with the remaining surface layer and made it lighter colored than the original one.

These soils are in fairly large areas on ridge slopes. They are below less sloping Seaton and Fayette soils and receive runoff from them. Strong slopes, rapid runoff, and the serious hazard of erosion limit the use of these soils for crops. These soils are better suited to grain and hay crops than to row crops. Nevertheless, a row crop can be grown for 1 year if hay is grown for 4 or more years in the cropping system. Supporting practices are also needed to control erosion. If these soils are planted to a mixture of grasses and legumes and then are renovated periodically, yields are fairly high. (Capability unit IVe-1; woodland group 2)

Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, severely eroded (SeD3).—Nearly all of the surface layer of these soils, and in places part of the subsoil, has been removed through erosion. The present surface layer consists mainly of brown material from the former subsoil. It is low in organic matter and in plant nutrients.

These soils are on ridge slopes where they receive runoff from higher lying soils. They are better suited to forage crops or trees than to cultivated crops. In areas used for cultivated crops, special practices are needed to control erosion until some less intensive use can be applied. If these soils are used for pasture or hay crops, the areas need to be renovated before good yields can be made. To prevent further erosion, grazing should be controlled on renovated areas that are pastured. In places it is feasible to plant the areas to trees. The areas in trees require protection from fire and grazing. (Capability unit VIe-1; woodland group 2)

Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes (SeE).—The profiles of these soils are similar to the representative profiles described for the Seaton and the Fayette series, but the subsoil is thinner.

These soils are on ridge slopes where they receive runoff from soils on the ridgetops. Most areas have remained in native hardwoods, and therefore, they have been protected from erosion. It is best to keep these areas in trees or in renovated pasture. (Capability unit VIe-1; woodland group 2)

Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, moderately eroded (SeE2).—The surface layer of these soils is lighter colored and lower in organic matter than that in the representative profiles described for the Seaton and the Fayette series. Also, in places the subsoil is thinner.

These soils are on ridge slopes. The hazard of erosion is severe. They are too steep for cultivated crops, but they are suited to hay or pasture if renovated. If these soils are planted to forage crops, moderate amounts of phosphate and potash are needed. Apply lime and fertilizer according to the needs indicated by soil tests. Controlling grazing helps to control erosion and to increase yields. Where feasible, trees can be planted to help control erosion. Areas in trees require protection from fire and grazing, as well as other good management. (Capability unit VIe-1; woodland group 2)

Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, severely eroded (SeE3).—These soils have lost more than two-thirds of their original surface layer through erosion, and in places part of their subsoil is gone. Brown material from the former subsoil is exposed in a large acreage.

Most areas of these soils are fairly small. They are on ridge slopes, where they receive runoff from less sloping Seaton and Fayette soils on the ridgetops. Gullies form rapidly in these soils. In many places the gullies cause losses of crops and damage to crops on the more productive soils below.

Cultivated areas of these soils ought to be taken out of cultivation as soon as feasible to prevent further erosion. If grasses and legumes are seeded for forage, lime and fertilizer are needed. Yields are fairly high. The forage crops can be harvested for hay if the slope is not too steep. Areas not used for hay are best suited to pasture. The pastures need to be managed with care to prevent overgrazing. Trees planted on these soils require protection from fire and from grazing. (Capability unit VIIe-1; woodland group 2)

Seaton and Fayette silt loams, valleys, 2 to 6 percent slopes (SfB).—In most areas the upper part of the profiles of these soils contains a small amount of grit. Otherwise, the profiles are similar to the representative profiles described for the Seaton and the Fayette series. Most areas are not eroded or are only slightly eroded, but a few small areas are moderately eroded.

These soils are on valley slopes below areas of Steep stony and rocky land. The hazard of erosion is moderate. If these soils are well managed, they are suited to all the crops commonly grown in the county. Yields are high. A suitable cropping system is required, and fertilizer and organic matter are needed. If feasible, terracing, stripcropping, and other practices should be used to prevent further water erosion. Crops on these soils respond well if a complete fertilizer is applied. In most places lime is needed for legumes. (Capability unit IIe-1; woodland group 1)

Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes (SfC).—Except for having grit in the surface layer and subsoil in places, the profiles of these soils are similar to the representative profiles described for the Seaton and the Fayette series.

These soils are in small areas at the base of Steep stony and rocky land and in other steep areas. Many areas are of a size or shape that make them difficult to farm, or they are in pasture. Most of the acreage, however, has remained in trees and is little eroded. The hazard of erosion is moderately severe. Fairly intensive practices are required to control erosion if these soils are cultivated. If erosion is controlled and this soil is otherwise well managed, areas that are feasible to cultivate are highly productive. Wooded areas require protection from fire and from grazing. (Capability unit IIIe-1; woodland group 1)

Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes, moderately eroded (SfC2).—The surface layer of these soils is lighter colored and lower in organic matter than those in the representative profiles described for the Seaton and the Fayette series. Also, there is a small amount of grit throughout the profiles.

These soils are on valley slopes below Steep stony and rocky land and other steep areas. Nearly all the areas are cultivated.

These soils are well suited to most of the crops commonly grown in the county if a suitable cropping system is used and if supporting practices are applied to control erosion. Fertilizer and organic matter are needed for high yields. Apply the fertilizer and lime according to the needs indicated by soil tests. (Capability unit IIIe-1; woodland group 1)

Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes (SfD).—The profiles of these soils are similar to the representative profiles described for the Seaton and the Fayette series, but they have grit in the surface layer and subsoil. Also, in a few places, scattered stones or boulders are on the surface or in the profile. In some places a thin covering of fine sand, washed from the steep sandstone escarpments above, is on the surface.

Most areas of these soils are in hardwoods. These soils are suited to cultivated crops, but intensive practices are needed to control runoff. The areas in trees require protection from fire and grazing. (Capability unit IVe-1; woodland group 2)

Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, moderately eroded (SfD2).—These soils have lost from one-third to two-thirds of their original surface layer through erosion. Plowing has mixed brown material from the former subsoil with the remaining surface soil. As a result, the present surface layer is lighter colored than those in the representative profiles described for the Seaton and the Fayette series. The profiles of these soils contain grit in some places. In a few small areas, the surface layer is fine sandy loam or loam.

The areas are on valley slopes below areas of Steep stony and rocky land. The steep slopes and severe hazard of erosion limit the use of these soils for crops. If these soils are not protected from runoff, gullies form quickly.

These soils are better suited to forage crops than to row crops. Row crops can be grown, however, if intensive practices are applied to control erosion. If fertilizer is added, forage crops make fairly high yields. (Capability unit IVe-1; woodland group 2)

Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, severely eroded (SfD3).—These soils have lost more than two-thirds of their original surface layer through erosion and in places part of their subsoil is gone. The present surface layer is brown and is low in organic matter. These soils have grit in their profiles in some places. In a few small areas, the surface layer is sandy loam or loam.

Because these soils are strongly sloping and severely eroded, careful management is needed to control further erosion and to prevent gullies from forming. These soils are better suited to forage crops than to row crops. If intensive practices are applied to control erosion and if the soils are otherwise well managed, row crops can be grown occasionally. The content of organic matter can be increased by adding manure and returning crop residues to the soils. Crops on these soils respond well if lime and fertilizer are applied. Grasses and legumes grown for forage make high yields if the areas are renovated periodically. (Capability unit IVe-1; woodland group 2)

Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes (SfE).—The profiles of these soils contain grit in places and have a slightly thinner subsoil than those in the representative profiles described for the Seaton and the Fayette series. A few small areas have a surface layer of fine sandy loam or loam.

These soils have been protected from erosion by a cover of hardwoods. The steep slopes and runoff from higher lying areas make these soils subject to serious erosion. Therefore, the soils are better suited to forage crops or trees than to row crops. The areas in trees need protection from fire and grazing, and the other good management required to obtain high yields. If these soils are used for forage crops, they should be seeded only when renovation is done. Careful management of grazing is needed to prevent erosion in pastures. (Capability unit VIe-1; woodland group 2)

Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, moderately eroded ((SfE2).—These soils have lost from one-third to two-thirds of their original surface layer through erosion. Plowing has mixed brown material from the former subsoil with the remaining surface soil. As a result, the present surface layer is lighter colored, less friable, and lower in organic matter than those in the representative profiles described for the Seaton and the Fayette series.

The surface soil and subsoil contain grit in some places. A few small areas have a surface layer of sandy loam or loam. Also, in places there are a few fragments of sandstone or large stones on the surface or in the upper part of these soils.

These soils are steep and are hard to cultivate. The hazard of erosion is serious, and careful management is needed to control further erosion. These soils are not suited to cultivated crops, but they are suited to permanent pasture or to trees. Areas in pasture require renovation for high yields. Controlling grazing helps to control erosion and to increase the yields of forage crops. Areas that are in trees require protection from fire and from grazing. (Capability unit VIe-1; woodland group 2)

Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, severely eroded (SfE3).—These soils have lost more than two-thirds of their original surface layer through erosion, and the brown subsoil is exposed in many places. Unlike the representative profiles described for the Seaton and Fayette series, the profiles of these soils contain varying amounts of grit in the surface layer and subsoil.

Because these soils are steep and are easily eroded, it is best to keep them in trees or to use them for grazing. If they are pastured, care is needed to prevent overgrazing. Also, if feasible, the pasture should be renovated. Areas in trees need protection from fire and from grazing, and the other good management needed to improve yields. (Capability unit VIIe-1; woodland group 2)

Sparta Series

The Sparta series is made up of deep, dark-colored loamy fine sands and sands. These soils are excessively drained. They are on broad, sandy terraces along the

Chippewa and Mississippi Rivers. In many places the soils are nearly level, but they are undulating to rolling where wind has blown the soil material into mounds.

A representative profile of a Sparta loamy fine sand follows:

0 to 24 inches, very dark brown, very friable loamy fine sand.
24 to 38 inches, dark-brown, loose fine sand.
38 inches +, yellowish-brown, loose fine sand.

The color of the surface layer is black in many places. In a few areas the lowest layer contains thin layers that are finer textured than the material described.

These soils are rapid in permeability and low in moisture-supplying capacity. Consequently, they are droughty, especially during seasons when rainfall is limited or is poorly distributed. Unless these soils have been limed, they are acid throughout the profile. These soils are low in natural fertility. They are subject to wind and water erosion.

Sparta loamy fine sand, 2 to 6 percent slopes (SpB).—In some places this soil has lost as much as one-third of its original surface layer through wind and water erosion.

Most of this soil is cultivated. If it is well managed, row crops, small grains, and hay can be grown. Yields are generally low because the natural fertility and moisture-supplying capacity are low. They are even lower during seasons when rainfall is below normal or is poorly distributed. This soil is better suited to crops that mature early or that are deep rooted than it is to other crops. The areas need protection from wind erosion. Growing crops in strips and planting shelterbelts of trees and shrubs help to control wind erosion. (Capability unit IVs–1; woodland group 5)

Sparta loamy, fine sand, 2 to 6 percent slopes (SpB).—The profile of this soil is like the representative profile described. In places as much as one-third of the original surface layer has been removed through wind and water erosion.

Most of this soil is cultivated, but yields are generally low. This soil is better suited to crops that mature early or that are deep rooted than it is to other crops. Intensive management is required to control erosion and to maintain the necessary plant nutrients and organic matter. (Capability unit IVs–1; woodland group 5)

Sparta loamy fine sand, 2 to 6 percent slopes, eroded (SpB2).—The surface layer of this soil is thinner than that in the representative profile described.

This soil is suited to cultivated crops. Yields are limited by the low moisture-supplying capacity, sandy texture, and low fertility. This soil is likely to be blown about by wind. Special management is required to control erosion. (Capability unit IVs–1; woodland group 5)

Sparta loamy fine sand, 6 to 12 percent slopes (SpC).—This soil has stronger slopes than the soil for which a profile was described, but its profile is similar to the representative profile. Most areas are in grass or trees and, therefore, are little eroded. This soil is droughty, low in natural fertility, and susceptible to erosion. As a result, it is poorly suited to continuous use for cultivated crops. (Capability unit VIs–1; woodland group 5)

Sparta loamy fine sand, 6 to 12 percent slopes, eroded (SpC2).—The surface layer of this soil is thinner than that in the representative profile described. As the result of wind and water erosion, the present surface layer is about 8 to 10 inches thick.

Most areas of this soil have been cultivated at some time. Now, many areas are being planted to pine trees, and some areas are in pasture or are idle. The hazards of erosion and drought are severe. If this soil is protected from erosion and is otherwise well managed, forage crops for hay or pasture can be grown. Legumes, grasses, and other deep-rooted crops are the crops that are best suited. Yields are generally low, especially if rainfall is low or is poorly distributed. This soil is suited to pine trees, particularly in areas where the soil cannot otherwise be protected from erosion. (Capability unit VIs–1; woodland group 5)

Sparta loamy fine sand, 12 to 20 percent slopes, eroded (SpD2).—The surface layer of this soil is thinner than that in the representative profile described. From one-third to more than two-thirds of the original surface layer has been removed by wind and water erosion. In a small acreage the soil has retained most of its original surface layer.

This soil formerly was used for crops, but many areas are now in pasture or are being planted to pine trees. Some areas are idle.

This soil is too steep and droughty for agriculture. It is best suited to pine trees. (Capability unit VIIs–1; woodland group 6)

Sparta fine sand and Dune land (Sh).—This mapping unit is made up of areas of dark-colored Sparta fine sand and of areas of dune sand that have been blown into mounds by wind. The slope ranges from 6 to 20 percent. Most areas are stabilized and support thin stands of grass or scattered scrub oaks (fig. 9). There are still a few blowouts in the areas. Most of these have been planted to pines, but in some of them the sand is still being shifted by wind.

These soils are too droughty for crops. Their use is limited to pine trees or other plants that withstand drought. (Capability unit VIIs–1; woodland group 6)

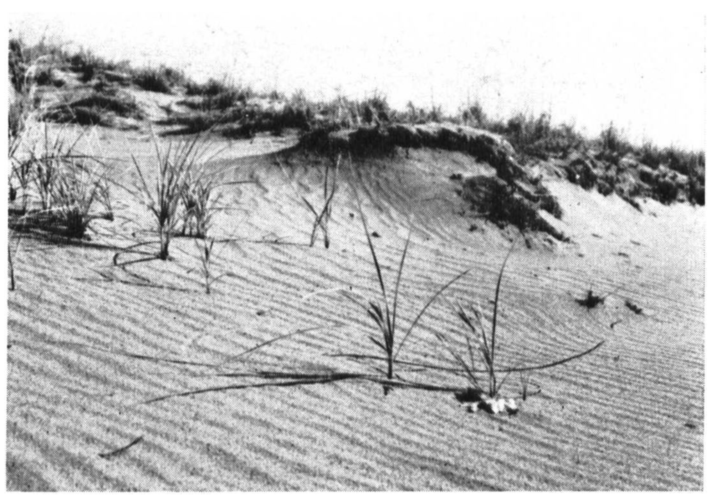

Figure 9.—Active blowouts in Sparta fine sand and Dune land; the beachgrass will spread and stabilize the dunes.

Steep Stony and Rocky Land

Steep stony and rocky land (St) is a miscellaneous land type made up of areas that have a slope of more than 30 percent. It is on steep breaks below the upland ridges and consists of areas of mixed, shallow soils in which there are many outcrops of rock. A few areas of better soils of the uplands, too small to delineate separately on the map, are mapped with it.

The soil materials in this land type are highly variable. They range in texture from sand to silt. In places the underlying bedrock is sandstone, and in other places it is limestone. On the north- and east-facing slopes, the soil materials are commonly deeper and more silty than the soil materials on the south- and west-facing slopes, and yields of timber are better there.

The wooded areas in trees require protection from grazing. Leaves and other plant remains then accumulate on the surface and help to control runoff and flooding of the streams below. This land type furnishes a large part of the habitats for wildlife in the county. (Capability unit VIIs–1; woodland group 4)

Terrace Escarpments

These miscellaneous land types are made up of steep to very steep, long, narrow areas along the edges of stream terraces. The soil materials have a sandy or silty texture in the uppermost part. Depth to the underlying material and the kind of underlying material vary. The areas are difficult to use and manage. Few of them are suited to cultivated crops. The soil materials are highly susceptible to serious gullying.

Terrace escarpments, loamy (Tm) is made up of loams and silt loams that have slopes of 12 to 45 percent. It includes Medary, Richwood, Jackson, Bertrand, and Dakota soils, all of which were too limited in extent or too variable to be mapped separately.

The soils are moderate in moisture-supplying capacity and moderate in natural fertility. Because of their steep slopes, however, and severe hazard of erosion, they are not well suited to crops. Areas that are not too steep for cultivation can be used for pasture by renovating them. The other areas should be kept in grass or trees. Most of the areas are now in pasture. (Capability unit VIIe–1; woodland group 2)

Terrace escarpments, sandy (Tn) is made up of sandy soils that form narrow bands around the steep edges of stream terraces. It includes sandy Plainfield, Sparta, Hubbard, and Gotham soils that were too limited in extent or too variable to be mapped separately. The slope ranges from 20 to 45 percent.

These soils are low in moisture-holding capacity. They are susceptible to severe erosion and are not well suited to cultivated crops. The areas should be kept in permanent vegetation. They can be pastured, planted to trees, or used for wildlife. Some areas that are pastured can be improved for pasture, but care must be taken to prevent overgrazing. Yields of hardwoods are fairly low. Pine trees, however, grow well on these soils. Most areas are now in pasture. (Capability unit VIIs–1; woodland group 6)

Toddville Series

The Toddville series consists of dark-colored, deep, silty soils on terraces along streams. These soils are moderately well drained. They are nearly level to gently sloping. The soils formed under prairie in silty material that is generally 5 feet or more thick. In places sand is at a depth below 42 inches.

A representative profile of a Toddville silt loam in a cultivated field follows:

0 to 11 inches, very dark brown to black, very friable silt loam.
11 to 18 inches, very dark brown to very dark gray, very friable silt loam.
18 to 24 inches, dark grayish-brown, firm silt loam.
24 to 35 inches, dark-brown, firm silty clay loam; many small mottles.
35 inches +, dark-brown, friable silt loam; many mottles.

These soils are moderately permeable. They have high moisture-supplying capacity for plants and are high in natural fertility. They contain much organic matter. Runoff is slow on the nearly level areas but medium on the gently sloping ones. These soils are neutral to slightly acid.

Toddville silt loam, 0 to 2 percent slopes (ToA).—The profile of this soil is like the representative profile described.

This soil is not subject to erosion and is easy to keep in good tilth. It can be farmed intensively and is well suited to all the crops commonly grown in the county. Yields are high if fertilizer and organic matter are added. Areas that have been cropped intensively for a long time need lime for high yields of legumes. (Capability unit I–1; woodland group 9)

Toddville silt loam, 2 to 6 percent slopes (ToB).—The surface layer of this soil is slightly thinner than that in the representative profile described.

This soil has fairly short slopes, and runoff is not excessive. It is well suited to row crops, small grains, and hay. It can be farmed fairly intensively if erosion is controlled and if it is otherwise well managed. (Capability unit IIe–1; woodland group 9)

Urne Series

The Urne series is made up of shallow, light-colored fine sandy loams that are excessively drained. These soils formed in residuum weathered from fine-grained, glauconitic sandstone, which gives them a greenish color. In some places, however, oxidized iron from this mineral makes the soils reddish. The Urne soils are on uplands, mainly within the eastern half of the county. The slope ranges from 2 to more than 45 percent. Most of the soils, however, are on the sides of steep ridges or on valley slopes and have slopes between 20 and 45 percent. The native vegetation was a forest of hardwoods.

These soils are near the Norden soils. They formed from similar materials, but they have a thinner solum than those soils. In places they are so intermixed with the Norden soils that it is impractical to map them separately. Therefore, they are mapped together as undifferentiated units. The Norden soils are described elsewhere in the report.

A representative profile of an Urne fine sandy loam in an undisturbed field follows:

0 to 6 inches, very dark grayish-brown, very friable fine sandy loam.
6 to 11 inches, dark grayish-brown to very dark grayish-brown, very friable fine sandy loam; a few fragments of sandstone.
11 to 24 inches, olive-brown, very friable very fine sandy loam; many fragments of sandstone.
24 inches +, greenish sandstone.

Depth to consolidated sandstone ranges from 9 to 24 inches. In places the surface layer is olive or reddish brown.

These soils have moderately rapid permeability. Generally, the moisture-supplying capacity is low, but on the less sloping soils where the parent sandstone is weathered to a greater depth than described, the moisture-supplying capacity is slightly higher. Runoff is medium on the less sloping soils to rapid on the steep ones. The soils that have not been cultivated are nearly neutral.

Urne fine sandy loam, 30 to 45 percent slopes (UfF).—The profile of this soil is like the representative profile described. Most areas have a cover of native hardwoods, and, therefore, they have a mat of leaf litter on the surface. The leaf litter protects the soil from erosion and helps absorb moisture.

This soil should remain in timber, but good management is required to improve the stands. The trees yield timber and provide protection for the watershed. This soil also provides habitats for wildlife. (Capability unit VIIe–1; woodland group 4)

Urne fine sandy loam, 30 to 45 percent slopes, moderately eroded (UfF2).—The surface layer of this soil is slightly thinner than that in the representative profile described. Greenish sandstone is exposed in places.

Most of this soil is in bluegrass or is reverting to trees. Careful management is required to control grazing and to prevent further erosion. This soil should be planted to trees, if feasible, or managed so that trees will regenerate naturally. This soil also is suitable for wildlife areas. (Capability unit VIIe–1; woodland group 4)

Urne fine sandy loam, 30 to 45 percent slopes, severely eroded (UfF3).—The surface layer of this soil is thinner than that in the representative profile described. More than two-thirds of the original surface layer has been removed through erosion. Greenish sandstone and consolidated bedrock are exposed in large areas. Some areas have numerous shallow gullies.

Most areas of this soil have a cover of bluegrass, but some areas are in brush and are reverting to trees. The areas in pasture require careful control of grazing. Yields are fairly low. This soil should be planted to trees, if feasible, or managed so that trees will regenerate naturally. This soil is also suitable for wildlife areas. (Capability unit VIIe–1; woodland group 4)

Urne and Norden fine sandy loams, 2 to 6 percent slopes, moderately eroded (UnB2).—This mapping unit is in small areas on narrow ridgetops. In most places the soils have lost from one-third to two-thirds of their original surface layer through water erosion. Plowing has exposed greenish material from the parent sandstone in some places. A few areas that are not eroded or that are only slightly eroded are included with these soils.

Areas of these soils are mainly in crops, but some areas are not easily accessible and are in permanent pasture or trees. The hazard of drought and erosion is moderately severe. Careful management is needed to control further erosion and the subsequent lowering of the moisture-supplying capacity. If erosion is controlled, these soils can be used for cultivated crops. A cropping system is required that will increase the amount of organic matter. If fertilizer and lime are added where needed, moderate yields can be obtained. (Capability unit IIIs–1; woodland group 3)

Urne and Norden fine sandy loams, 6 to 12 percent slopes, moderately eroded (UnC2).—From one-third to two-thirds of the original surface layer of these soils has been removed through water erosion. In many places plowing has exposed material from the greenish underlying sandstone. In a few places sandstone chips are scattered on the surface. The hazard of erosion is severe.

These soils generally are on low ridges between drainageways, but a few areas are on higher lying ridge slopes. Most of the areas are in crops. These soils are suited to cultivated crops if a suitable cropping system is used and supporting practices are applied to control erosion. Crops on these soils respond well if manure is added and if lime and a complete fertilizer are applied. Apply the lime and fertilizer according to the needs indicated by soil tests. Because of the low moisture-supplying capacity, the crops are likely to be damaged by drought, especially if rainfall is low or is poorly distributed. (Capability unit IVe–3; woodland group 3)

Urne and Norden fine sandy loams, 6 to 12 percent slopes, severely eroded (UnC3).—More than two-thirds of the original surface layer of these soils has been removed through erosion. In most places the present surface layer consists mostly of greenish material from the underlying sandstone. Numerous sandstone fragments are on the surface.

These soils are on ridge slopes below less sloping soils. Most of the areas are used for hay or pasture. These soils are not suited to intensive use for cultivated crops. They should be kept in grasses or legumes. If suitable renovating practices are applied, moderate yields of forage crops can be obtained. The pastures are likely to be damaged by drought in midsummer, but yields are good in spring and fall. (Capability unit VIe–2; woodland group 3)

Urne and Norden fine sandy loams, 12 to 20 percent slopes (UnD).—These soils have a cover of grass and trees and are little eroded. They are better suited to pasture or trees than to cultivated crops. (Capability unit VIe–2; woodland group 4)

Urne and Norden fine sandy loams, 12 to 20 percent slopes, moderately eroded (UnD2).—From one-third to two-thirds of the original surface layer of these soils has been removed through water erosion. The present surface layer in many areas is greenish because tillage has mixed material from the underlying sandstone with the remaining surface soil. A few sandstone chips are on the surface.

These soils are on ridge and valley slopes, and most of the acreage is used for forage crops for hay and pasture. The forage crops should be reseeded only when the areas are renovated, and then as a means of conserving moisture and controlling erosion. Yields are fair if a good supply of plant nutrients is maintained. Yields are likely to be low, however, if rainfall is low or is poorly distributed. (Capability unit VIe–2; woodland group 4)

Urne and Norden fine sandy loams, 12 to 20 percent slopes, severely eroded (UnD3).—More than two-thirds of the original surface layer of these soils has been lost through erosion. The present surface layer consists mainly of sandstone fragments and greenish material from the underlying sandstone.

These soils are on ridge and valley slopes. Because much of the original organic matter is gone, the infiltration rate and moisture-supplying capacity have been lowered. As a result, yields are lower than on the less eroded Urne and Norden fine sandy loams. The hazard of accelerated erosion is a serious problem.

Some areas of these soils are used for crops. Because of the poor tilth and the hazard of erosion, however, many areas are used for hay and pasture. Areas of these soils that are not already in forage crops, trees, or other permanent vegetation should be seeded to pasture or hay crops or planted to trees. Grazing needs to be controlled in pastured areas. The areas in trees need protection from fire and from grazing. (Capability unit VIIe–1; woodland group 4)

Urne and Norden fine sandy loams, 20 to 30 percent slopes (UnE).—These soils have a cover of native trees and are little eroded. They should be kept in trees. Good management is needed to improve the stands. (Capability unit VIIe–1; woodland group 4)

Urne and Norden fine sandy loams, 20 to 30 percent slopes, moderately eroded (UnE2).—From one-third to two-thirds of the original surface layer of these soils has been removed through erosion. Plowing has mixed sandy material from the underlying sandstone with the remaining original surface soil. There are sandstone chips in the surface layer and throughout the profile.

These soils are used chiefly for hay crops and pasture. Because they are shallow to sandstone, careful management is required to control further erosion. Forage crops should be reseeded when pastures are renovated. Grazing needs to be managed carefully. Areas that are not kept in sod-forming crops should be planted to trees. (Capability unit VIIe–1; woodland group 4)

Urne and Norden fine sandy loams, 20 to 30 percent slopes, severely eroded (UnE3).—Because of erosion, most of the present surface layer of these soils now consists of greenish material from the underlying sandstone. More than two-thirds of the original, friable surface layer has been lost through erosion.

These soils are used mainly for pasture. Many of the areas have been renovated and reseeded to a mixture of legumes and grasses. In areas where pasture is plentiful, the forage crop is cut for hay. Forage crops should be reseeded when pastures are renovated. Because of the rapid runoff and low moisture-supplying capacity, crops on these soils are likely to be damaged by drought. The areas that are not kept in sod-forming crops should be planted to trees. (Capability unit VIIe–1; woodland group 4)

Wallkill Series

In the Wallkill series are poorly drained soils of bottom lands. These soils formed in light-colored, recent, silty, alluvial material that overlies peat or muck. The silty material has washed onto the areas from adjacent uplands and terraces. Generally, the Wallkill soils form a fringe or margin between broad areas of peat and muck on bottom lands and areas on stream terraces or uplands. The native vegetation was mainly grasses, sedges, and cattails. These soils are in the eastern half of the county.

The mineral deposits are approximately 18 inches thick near the areas of peat and muck. In the areas next to uplands or along stream terraces, they are as much as 42 inches thick.

A representative profile of Wallkill silt loam follows:

0 to 9 inches, dark-gray, very friable silt loam; many mottles of yellow, gray, and red.
9 to 22 inches, dark-gray to gray, very friable silt loam; many mottles of yellow, gray, and red.
22 inches +, black mucky peat; contains a few fragments of wood.

The permeability of the overlying silty material is moderately slow, but the permeability of the underlying peat and muck is moderately rapid to rapid. Because these soils are in low areas, the water table remains close to the surface most of the year. The Wallkill soils are also subject to frequent flooding and receive additional silty deposits during the floods. These soils are nearly neutral.

Wallkill silt loam (Wa).—This is the only Wallkill soil mapped in the county. Its profile is like the representative profile described.

This soil needs drainage, and in some places it needs protection from overflow before it can be farmed. If this soil is adequately drained and fertilizer is added, it can be cropped intensively. The areas that are not drained are best suited to pasture. (Capability unit IIw–2; woodland group 10)

Watseka Series

The soils in the Watseka series are deep and dark colored. They are moderately well drained or somewhat poorly drained. These level to undulating soils are on sandy stream terraces in the eastern half of the county. They occupy low places on terraces next to marshes and streams. The original vegetation was tall prairie grasses.

A representative profile of Watseka loamy fine sand follows:

0 to 11 inches, black, friable loamy fine sand.
11 to 18 inches, very dark gray, very friable loamy fine sand.
18 to 24 inches, brown, loose sand; common mottles of yellow and brown.
24 inches +, light brownish-gray, moist sand.

The position and intensity of the mottling in these soils vary. In places the soil is less mottled than described and is better drained.

These soils have rapid permeability. The water table fluctuates from a depth of about 3 feet in spring or during wet seasons to a depth of 5 feet or more in midsummer or during seasons when rainfall is low. Unless these soils have been limed, they are medium acid to strongly acid. They are moderately low in natural fertility.

Watseka loamy fine sand (Wf).—This is the only Watseka soil mapped in the county. Its profile is like the representative profile described.

This soil is suited to most crops commonly grown in the county. Generally, the supply of moisture for crops is adequate in the early part of the growing season, but crops may be damaged by drought in midsummer. Therefore, this soil is better suited to early maturing or deep-rooted crops than it is to other crops. If an adequate supply of plant nutrients and organic matter is maintained, yields are moderate. This soil is subject to wind erosion when it is dry and its surface is not protected. (Capability unit IVs-1; woodland group 5)

Waukegan Series

The Waukegan series is made up of moderately deep, silty soils that are well drained. These soils are underlain by sand at a depth between 20 and 42 inches. They are nearly level to gently undulating and are on stream terraces. Originally, the vegetation was prairie grasses.

A representative profile of a Waukegan silt loam in a cultivated field follows:

0 to 8 inches, very dark gray to black, very friable silt loam.
8 to 14 inches, dark-brown, friable silt loam.
14 to 24 inches, dark yellowish-brown, friable silt loam.
24 to 32 inches, dark yellowish-brown loam.
32 to 36 inches +, dark-brown fine sand; has lenses of finer textured materials.

In some eroded fields the color of the surface layer is very dark grayish brown. In places these soils contain enough fine sand to have a somewhat gritty silt loam texture.

The Waukegan soils have moderate permeability in the solum but rapid permeability in the underlying sandy material. Their moisture-supplying capacity is moderate to high. Natural fertility is high. Crops on these soils respond well if lime and fertilizer are applied. These soils are naturally slightly acid to medium acid and originally contained a large amount of organic matter. Intensive farming has lowered the content of organic matter. Nevertheless, these soils still contain more organic matter than similar soils formed under timber. The root zone extends to the underlying sandy material. These soils are slightly droughty to moderately droughty. Consequently, their productivity is somewhat limited.

Waukegan silt loam, 0 to 2 percent slopes (WkA).—In most places the profile of this soil is like the representative profile described. In some areas, however, it is slightly thicker, and the silt loam or loam subsoil extends to a depth of as much as 42 inches.

This soil is slightly eroded or is not eroded, and no special practices are needed to control erosion. If fertilizer and organic matter are added, this soil can be used fairly intensively for clean-tilled crops. During prolonged periods of dry weather, however, crops on this soil are damaged from lack of water sooner than crops on deeper soils. (Capability unit IIs-1; woodland group 9)

Waukegan silt loam, 2 to 6 percent slopes (WkB).—The profile of this soil is similar to the representative profile described. This soil is only slightly eroded. Runoff is not excessive, but some practices are needed to control erosion. In some areas erosion can be controlled if a suitable cropping system is used. In other areas terracing or stripcropping is also needed. If erosion is controlled and if the soil is otherwise well managed, this soil can be farmed fairly intensively. Yields are generally high. If rainfall is low or is poorly distributed, however, crops are damaged by drought sooner than on deeper soils. (Capability unit IIe-2; woodland group 9)

Waukegan silt loam, 2 to 6 percent slopes, moderately eroded (WkB2).—The surface layer of this soil is thinner and lighter colored than that in the representative profile described. Also, in many places depth to the underlying sand is less.

This soil is subject to moderate erosion. Practices are needed to control further erosion and the resultant lowering of the moisture-supplying capacity. This soil is well suited to row crops, small grains, and hay. Yields are high if fertilizer and organic matter are added. In places crops are damaged slightly by drought in midsummer. (Capability unit IIe-2; woodland group 9)

Waukegan silt loam, 6 to 12 percent slopes, moderately eroded (WkC2).—The surface layer of this soil is slightly thinner and more brownish than that in the representative profile described. Also, in places depth to the underlying sand is slightly less. From one-third to two-thirds of the original surface layer has been lost through erosion.

Most of this soil is in small acreages on breaks along draws or along the edges of terraces. The hazard of erosion is moderately severe. If this soil is protected from erosion, it is well suited to the crops commonly grown in the county. Yields are moderately high if organic matter and fertilizer are added. Because this soil is shallower to sand and retains less water, crops on it are more likely to be damaged by drought than on the less sloping Waukegan soils. (Capability unit IIIe-3; woodland group 9)

Zwingle Series

The Zwingle series consists of deep, light-colored, silty soils that are somewhat poorly drained. These nearly level soils are on high stream terraces. The upper 12 to 24 inches of these soils formed in silty materials laid down by wind. Below this depth, the soils formed in silt and clay deposited by slack water. The native vegetation was a water-tolerant forest. All of these soils are within Hicks Valley in Pepin Township.

A representative profile of Zwingle silt loam in a cultivated field follows:

0 to 8 inches, very dark gray to dark gray, friable silt loam.
8 to 10 inches, dark-gray, friable silt loam.
10 to 12 inches, brown, friable silt loam; mottles of yellow, gray, and brown.
12 to 18 inches, grayish-brown silty clay loam; hard when dry, and plastic when wet; mottles of brown and reddish brown.
18 to 33 inches, reddish-brown to brown silty clay; hard when dry, and plastic when wet; mottles of dark brown and grayish brown.
33 to 38 inches, grayish-brown silty clay loam; hard when dry, and plastic when wet; mottles of dark brown.
38 inches +, grayish-brown silt; slightly hard when dry, and slightly plastic when wet.

The material that underlies these soils ranges from silt to clay. In places it contains thin layers of fine sand.

These soils have moderately slow permeability. Runoff is slow, but the moisture-supplying capacity for plants is high. Unless they have been limed, these soils are slightly acid.

Zwingle silt loam (Zg).—The profile of this soil is like the representative profile described. This soil has slow surface and internal drainage and should be drained for best yields. If it is adequately drained, this soil can be

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cropped fairly intensively. A good supply of organic matter is needed to maintain good tilth, and the soil should not be tilled if it is excessively wet. If fertilizer is added and the soil is otherwise well managed, yields are high. (Capability unit IIw–1; woodland group 8)

Zwingle Series, Poorly Drained Variant

The soils of this variant from the normal Zwingle series are deep, level, dark colored, and very poorly drained. These variants formed in silty and clayey materials on high stream terraces. They are in flat or slightly depressed areas. All the areas are within Hicks Valley in Pepin Township.

A representative profile of Zwingle silt loam, poorly drained variant, in a cultivated field follows:

0 to 15 inches, black to very dark gray, friable silt loam.
15 to 42 inches, reddish-gray and grayish-brown silty clay loam; firm when moist, and sticky when wet.
42 inches +, layers of grayish-brown silt loam, silty clay loam, and silty clay; hard when dry, and sticky when wet.

These soils have slow permeability, and surface drainage is slow. Water moves slowly down through these soils. Unless additional drainage is provided, these soils seldom dry out enough for the areas to be tilled. In undrained areas the penetration of roots below a depth of 2 feet is somewhat restricted. These soils have high moisture-supplying capacity for plants. The surface layer is naturally nearly neutral, and the underlying soil materials, at a depth of 3 feet, are moderately alkaline.

Zwingle silt loam, poorly drained variant (Zw).—This is the only variant from the Zwingle series mapped in the county. Its profile is like the representative profile described.

If drainage is improved and if this soil is otherwise well managed, it can be farmed fairly intensively. Yields are high if fertilizer is added. The structure of the surface layer will be damaged and this soil will be difficult to work if it is tilled when it is wet. (Capability unit IIw–1; woodland group 8)

Formation, Morphology, and Classification of Soils[4]

In this section are discussed the factors that affect the formation, morphology, and composition of the soils of Pepin County, and also the classification of the soils into higher categories. Following this discussion, each soil series in the county is described and a soil profile typical of that series is given.

Factors of Soil Formation

Soil is formed by weathering and other processes that act on the parent material. The characteristics of the soil at any given point depend upon (1) parent material, (2) climate, (3) living organisms, (4) relief, and (5) time, or age.

Climate and living organisms are the active forces of soil formation. Climate, and its effect on soils and living organisms, is modified by the characteristics of the soil and by relief. Relief, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure of the surface of the soil to sun and wind.

Parent material

The parent material of the soils in Pepin County consists mainly of (1) material derived from the weathering of rocks in place, (2) glacial till, and (3) material transported by wind, water, or gravity and laid down as unconsolidated deposits of sand, silt, and clay. In addition, the parent material of a few soils is organic matter. These differences in parent material are important in the kinds of soils that occur in the county; therefore, it is helpful to know something of the geology of the county.

Most of this county has been glaciated. Only a fairly small area in the eastern part of the county is in the unglaciated, or Driftless Area. Remnants of glacial till, however, occur only in the western uplands, and they are covered by a moderately deep or deep mantle of loess.

The parent material derived through the weathering of rocks in place consists of material weathered from formations of limestone, sandstone, and shale. Because the underlying material was weathered from various formations of rocks as well as glacial till, and because this material differs greatly in chemical and mineralogical composition, the soils formed in it also differ in characteristics. For example, some parent rocks are coarse textured. The soils formed in material weathered from these rocks are coarse textured. Other parent rocks are fine textured, and the soils formed in material weathered from them are fine textured. The relationship of some of the principal soil series in Pepin County to the underlying material is shown in figure 10.

The rocks from which the parent material of some of the soils was derived consist of Prairie du Chien dolomite of the Ordovician period and of Trempealeau, Franconia, and Dresbach sandstone of the Upper Cambrian period. The Prairie du Chien dolomite may once have been a continuous surface formation. As a result of erosion, however, the limestone has been dissected deeply and has worn away. Now, there is only a remnant of this capping of limestone on the higher hills and ridges west of the Eau Galle and Chippewa Rivers and in two smaller areas south of Durand and in the central part of Albany Township.

Material weathered from sandstone of the Dresbach and Trempealeau formations was the parent material of the Hixton and Boone soils, the largest areas of which are in the uplands in Albany and Lima Townships in the eastern part of the county. The Norden and Urne soils, characterized primarily by the greenish hue in the lower part of the profile, formed principally in material weathered from thin-bedded Franconia sandstone that contained glauconite. These soils are in large areas, which are also in the uplands in the eastern part of the county.

Of the materials transported by wind, water, or gravity, loess has been the most important in the formation of the soils of the county. Loess, thought to be of Peorian age (*4*), covers more than 50 percent of the county. It is wholly or in part the parent material of most of the soils in the uplands west of the Eau Galle and Chippewa Rivers and in smaller areas south of Durand and in the southeastern part of the county. The loess ranges in thickness from a few inches to as much as several feet. It generally is

[4] By PAUL H. CARROLL, soil scientist, Soil Conservation Service.

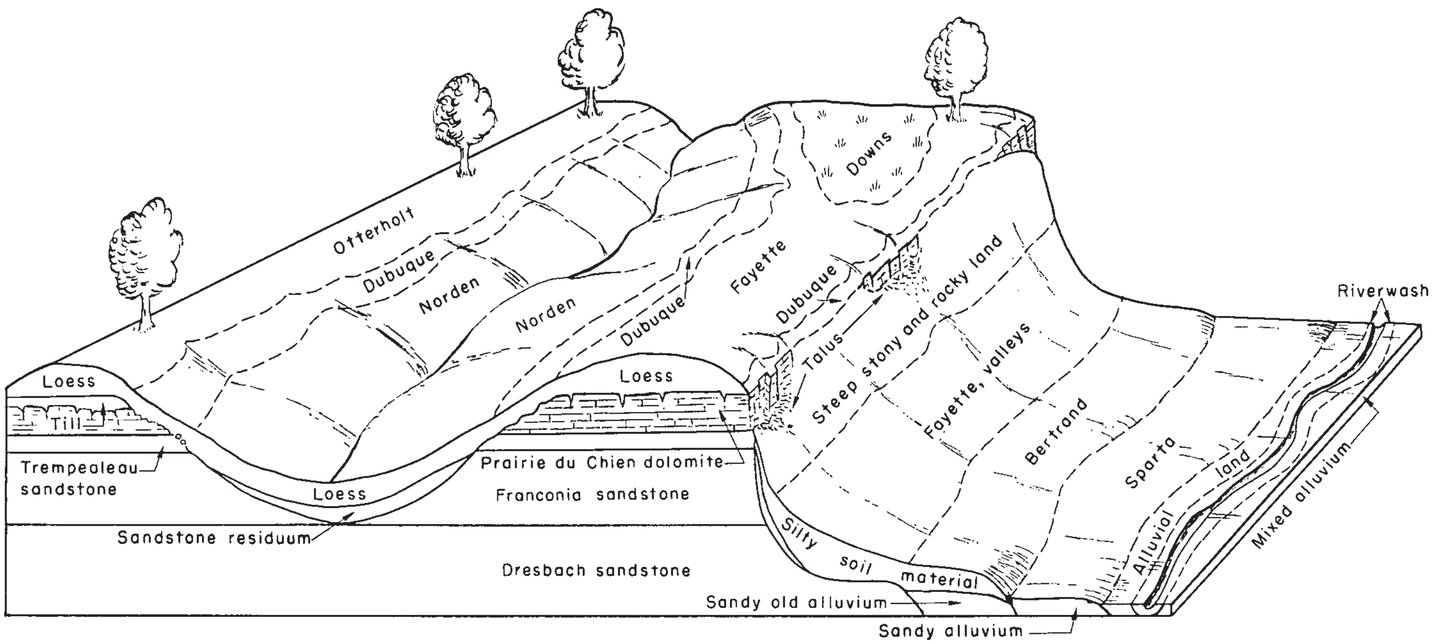

Figure 10.—**Some of the principal soil series and their underlying material.**

thickest on the level or nearly level parts of uplands, where it ranges in thickness from 30 to 100 inches. The Fayette, Seaton, and Downs soils formed in this thick layer of loess. Where the mantle of loess is moderately thick to thick and is underlain by till, the Otterholt and Almena soils predominate.

Peripheral to the areas of soils formed in deep loess, and in most places adjacent to the marginal breaks of Steep stony and rocky land are the soils of the Gale and Dubuque series. The soils of these two series formed in a moderately thick layer of loess—the Gale soils in loess that overlies sandstone, and the Dubuque in loess that overlies limestone. Material weathered from sandstone also forms part of the profile of the Gale soils. On the other hand, the Dubuque soils have in their profile a well-defined horizon of material weathered from limestone. Beyond the outer boundaries of the Gale and Dubuque soils, the loess thins out on the steeper slopes and in areas along streams where accelerated erosion has been active. In these areas the Urne soils, which are classified as Lithosols, predominate.

Although in this county loess has been the most important of the materials transported by wind, water, or gravity, a few of the soils formed in colluvium and alluvium. The soils on stream terraces and on flood plains of the present streams and rivers were formed in material deposited originally as local alluvium washed from the uplands or as glaciofluvial material washed from adjacent areas of glacial drift.

Where streams built a succession of terraces in the valleys, the higher terraces represent earlier deposits of alluvium, and the lower terraces, the later ones. The age of the various terraces has been obscured, however, by the layers of loess that cover the older materials. Among the soils that are on these loess-covered alluvial terraces are the soils of the Bertrand, Curran, Jackson, Richwood, Rowley, Toddville, and Waukegan series and the Downs soils on benches. Fairly extensive areas of these terraces are along the Arkansaw and Plum Creeks in the western part of the county.

Many of the older terraces have received no fresh deposits for centuries. In contrast, some of the more recent terraces, at lower elevations, are still receiving deposits of material when streams overflow. These more recent terraces are in the areas adjoining the Mississippi and Chippewa Rivers. They are generally north of the towns of Pepin and Durand and along Bear, Fall, Duscham, and Rock Creeks in the eastern part of the county. On these more recent, lower lying terraces are the Dakota, Meridian, and Burkhardt soils. Also on these lower lying terraces are soils of the Sparta and Plainfield series, which are classified as Regosols.

The dominant areas of soils formed in alluvium are along the Chippewa River in the vicinity of Pepin and Durand and along Bear Creek in the southern part of Lima Township. These soils are mainly those of the Arenzville, Orion, and Ettrick series. In addition to the areas where soils have formed in colluvium or alluvium, there is a broad area of low bottom lands where the parent material consists primarily of sedges and grasses in various stages of decomposition. In this area organic soils, or peats and mucks, have formed.

Climate

Climate affects the soils, both directly and indirectly, and is an important factor of their formation. Climate expresses itself through the moisture (precipitation) and heat energy (temperature) it contributes to an environment.

The most important effect climate has on the formation of soils is the weathering of rocks and the altering of parent materials. The indirect effects, however, are often of equal or even greater importance than the direct effects. For example, as an indirect effect, the content of clay tends to increase in the soils as the amount of precipitation increases and as the temperature rises.

Climate also influences the formation of soils through its effect on living organisms, for which it supplies energy and a suitable environment. This is of special significance because organisms affect the fertility of the soils and the amount of organic matter that accumulates in them. In Pepin County the effect of climate, through its effect on living organisms, is shown in the Lindstrom soils, which are classified as Brunizem (Prairie) soils, and the Sparta soils, which are intergrading toward the Brunizem great soil group.

The formation of soils on extensive land areas, such as continents, is affected by general, or macroclimatic, conditions. In smaller areas, such as a county, however, variations in climate are more limited, and, as a result, the effect of climate on the formation of soils is more restricted. On the steep slopes in many parts of the county, more of the moisture from rainfall is lost through runoff than in areas where slopes are gentle. Therefore, in the steep areas, less water penetrates the soils to furnish moisture for plant growth, to support microbiological activity, and to cause rocks to weather and disintegrate. As a result, in the steep areas, biological, physical, and chemical agents of weathering are suppressed and the formation of soils is slowed.

On slopes facing south or west, the soils are warmed and dried by sun and wind more than the soils facing north or east. On slopes that face north or east, more moisture is retained and the temperature is somewhat cooler. Consequently, there is generally a denser growth of trees on the north- and east-facing slopes. On the warmer, less humid, south- and west-facing slopes, there is more grass, but the stands of trees are sparser.

Living organisms

Plants have been the principal living organism influencing the formation of soils in this county, but bacteria, fungi, earthworms, rodents, and man have also been important. Two of the chief functions of plant and animal life are to furnish organic matter and to bring plant nutrients from the lower part of the solum to the upper layers.

In this county the native vegetation on the uplands was dominantly a heavy growth of hardwoods and conifers. A mixture of trees and grasses grew on the benches and valley slopes. An example of the influence of the vegetation on the characteristics of the soils can be seen in the contrast between the dark-colored Brunizem (Prairie) soils that formed under grass and the lighter colored Gray-Brown Podzolic soils that formed under trees. Even though the soils of both great soil groups may have formed in the same kind of parent material, the presence of trees as the dominant vegetation in some areas, and of grass in others, has caused Gray-Brown Podzolic or Brunizem soils to form.

The greater amount of organic matter in the Brunizem soils, formed under grass, as compared to that in soils formed under trees, is ascribed partly to the fact that soils formed under trees are generally more acid than soils formed under grass. This is because the relatively nonacid organic matter of grasslands is more stable than the more soluble, acid organic matter in soils formed under trees (*8*).

In areas where the vegetation was a mixture of trees and grasses, the characteristics of the soils are intermediate between those of the Gray-Brown Podzolic soils and of the Brunizems.

In areas that have been cultivated, man has been responsible for extensive changes in the soils. These changes include (1) altering the pH and fertility of acid soils by liming; (2) perpetuating grass by burning over areas that are normally wooded; (3) using improper cropping and tillage practices and thus causing loss of organic matter; and (4) removing the cover of plants on terraces and uplands and thus causing accelerated erosion.

Man has also changed the soils in many areas by changing the kind of vegetation growing on them. For example, he may have kept one field in permanent pasture and have used another for row crops. Eventually, even though the soils in the two fields were originally similar in fertility, in organic matter, or in other characteristics, their characteristics change because of the differences in the kinds of plants growing on them. Through repeated clearing of the woodlands, cultivating of the soils, introducing of new plant species, building of structures to control water, and improving of natural drainage, man continues to influence the kind of soils that form in the county and their rate of development.

The Arenzville soils are examples of soils formed as the result of changes made by man. In many places these soils formed as the result of recent erosion in areas where the cover of plants was removed by man. Soil materials were washed from the silty soils on uplands and terraces, where the vegetation had been removed, and they were deposited over areas of wet, dark-colored alluvium on the flood plains of streams. The Arenzville soils formed in such transported materials that were deposited over older alluvium.

Relief

Relief influences the formation of soils by controlling drainage, runoff, and erosion. Differences in elevation or inequalities of the land surface in Pepin County are closely related to differences in drainage, to differences in the thickness of the A horizon and in content of organic matter, to differences in the thickness of the solum, and to differences in the degree of horizon differentiation.

Drainage characteristics are generally reflected in the color of the soil and in the degree and kind of mottling or gleying in the soil profile. Of the well-drained soils, the Fayette, Seaton, Downs, Dubuque, Norden, Gale, and Hixton soils are all on gently undulating to rolling uplands, and the Bertrand, Meridian, Dakota, Richwood, and Waukegan soils are on gently undulating to rolling terraces along streams. All of these soils are mottled in about the same way. All are free of mottling in the A and B horizons, but may be mottled in places in the C horizon or at a depth below several feet.

In contrast to the well drained soils, the moderately well drained Jackson and Toddville soils, on nearly level to gently sloping terraces along streams, have mottles in the lower part of the B horizon and in the C horizon. The somewhat poorly drained Curran soils are Gray-Brown Podzolic soils, and the somewhat poorly drained Rowley soils are Brunizems, but inasmuch as they have some gleying immediately below the A1 horizon, both intergrade toward the Low-Humic Gley great soil group. None of the soils of the county are classified as Low-Humic Gley soils.

The Dillon soils, which are very poorly drained, occupy level to concave areas on sandy outwash plains and along stream terraces. They are classified as Humic Gley soils. The Low-Humic Gley and Humic Gley soils have very dark colored, organic-mineral surface horizons, generally more than 6 inches thick, and are commonly strongly mottled or gleyed immediately below the dark surface layer. Within any soil toposequence, the Low-Humic Gley soils are generally somewhat better drained than the Humic Gley soils, and their surface layer is thinner and lower in organic matter. Also, the subsurface horizons are dominantly mottled and brown, instead of dominantly gleyed, have a higher degree of textural differentiation, and are somewhat more acid.

The thickness of the surface layer and its content of organic matter are commonly related, directly or indirectly, to relief. The usual toposequence in Pepin County consists of light-colored soils on the steeper slopes and of soils that have a successively darker and thicker surface layer in convex to concave areas and on the more gentle slopes. In areas that have mild slopes, runoff is slower and the soils absorb more moisture than on strong slopes. As a result, the content of moisture in soils that have mild slopes is more favorable for plant growth and, consequently, for accumulation of organic matter.

In areas that have concave relief, the soils are likely to be waterlogged. Such areas are better suited to hydrophytic than to mesophytic plants; micro-organisms become less active or die and decompose; and the soils take on the characteristic black A horizon. In very poorly drained areas, decomposing plant remains may accumulate to a depth of several feet, and organic soils form.

Relief also affects the thickness of the solum and the degree of horizon differentiation. The soils that have steep slopes characteristically are shallow and lack horizon differentiation. They are classified as Lithosols. As the slope becomes milder, the solum of these soils becomes progressively deeper and the soils have a more clayey subsoil. The Urne and Norden soils are examples of this relationship. The soils of both series have formed in the same kind of parent material, but the Urne soils have strong slopes and a thin solum. They lack the textural and structural B horizon of the Norden soils.

Time, or age

Time is required by the active agents of soil formation to form soils from parent material. Some soils form rapidly, others slowly. The length of time required for a particular kind of soil to form depends on the other factors involved.

The materials now forming the land surface in the part of Pepin County that is glaciated probably were deposited during and after the Wisconsin glaciation. The last of these glaciers moved into the county about 11,000 years ago (*9*). When soils begin to form, the soil material has characteristics almost identical to those of the parent material, and the soils are said to be immature. Among such immature soils in this county are the Arenzville, Chaseburg, Huntsville, Judson, and Wallkill soils. These soils have little or no profile development, although there is some geological layering. During a long period of time, these soils will go through successive stages of development from immaturity, to maturity, and to old age.

Generally, a soil is said to be mature when it acquires well-developed profile characteristics and when it is nearly in equilibrium with its present environment. Not all soil components, however, mature at the same rate. Also, there is no reliable method for determining accurately when a soil is mature, or in equilibrium with its environment.

The ages of the original soils on the high terraces along streams in the county are difficult to determine. This is because the material of various ages in the terraces has been covered by a mantle of loess, which conceals the ages of the underlying material. The older alluvium underlying the loess-covered stream terraces is called old alluvium to distinguish it from alluvium deposited recently on the lower lying terraces. Among the silty soils formed in loess overlying the older alluvium on terraces are the Bertrand, Curran, Jackson, Richwood, Rowley, and Toddville soils. Among the soils on the lower lying terraces where sandy deposits have been left more recently are the Sparta and Plainfield soils, in which genetic horizons are only weakly developed.

Morphology and Composition of Soils

Soil morphology in Pepin County generally is expressed in prominent horizons. In some of the soils, however, the solum is weakly developed and the horizons are faint or indistinct. For example, soils formed in medium- to fine-textured materials on well-drained, gently sloping uplands generally show distinct differentiation of horizons. The Fayette and Seaton soils are some of these. In contrast, the Plainfield soils, formed in recent, sandy alluvium, and the Boone soils, formed in residuum from Dresbach sandstone, have faint horizons or none.

The differentiation of horizons in soils of the county is the result of one or more of the following processes: (1) Accumulation of organic matter, (2) leaching of carbonates and salts, (3) removal and subsequent accumulation of silicate clay minerals, and (4) reduction and transfer of iron.

Some organic matter has accumulated in the uppermost layer of all but a few soils in Pepin County to form an A1 horizon. Much of that organic matter is in the form of humus. The quantities are small in some soils but fairly large in others. Soils such as Plainfield loamy fine sand have faint and thin A1 horizons, low in organic matter at best. Other soils, such as those of the Sparta, Richwood, and Waukegan series, have thick A1 horizons, and in their natural state are fairly high in organic matter.

Leaching of carbonates and salts has occurred in almost all the soils of the county, although it has been of limited importance in horizon differentiation. The effects of leaching have been indirect, in that the leaching permitted the subsequent translocation of silicate clay minerals in some soils. Carbonates and salts have been carried completely out of the profiles of most of the well-drained soils. Even in the wettest soils, some leaching is indicated by the absence of free carbonates and by the acid reaction. Leaching of these wet soils is slow because water movement through the profile is itself slow.

Accumulation of silicate clay minerals has contributed to the development of horizons in many soils of Pepin County. Soils in an advanced stage of development have illuvial horizons of clay accumulation. In some mature soils, such as the Fayette and Seaton soils formed in deep loess on uplands, silicate clay accumulation is expressed in illuvial B horizons that contain more total clay and more fine clay than the horizons above or below. In soils formed in shallower deposits of loess, for example the Dubuque soils, the B horizon developed partly in residuum from the underlying dolomite. In such soils the horizons of illuviation may have no more total clay than the C horizon, but they do have more fine clay. Clay films occur in most soils that have blocky structure. The films occur as thin layers on the faces of the peds. The long axes of the clay particles lie parallel to the surface on which they were deposited. If the amount of translocated clay is large, it fills the natural cracks of the soil and juts into crevices and openings left by plant roots, animals, or insects.

The Gotham, Hubbard, Judson and other nearly structureless soils have slight silicate clay accumulation in their B horizons. They do not, however, have clay films on the surfaces of the peds, because none of the peds have prominent cleavage planes. The clays in the illuvial horizons of these soils generally occur as coatings on the individual sand grains, and in many places they are oriented with the surface of the grain. Occasional pores in these horizons persist long enough to have weak, patchy clay films.

In some of the soils of the county—for example, in soils of the Otterholt and Almena series—horizons of silicate clay accumulation were formed and later were partly destroyed. This degradation or destruction of the B horizon, which apparently is only in its initial stages in development of these soils, has removed the clay films from the faces of the primary peds and left coatings of bleached silt or sand. This can be seen in bleached silt veins along vertical and horizontal structural cleavage planes. Degradation is not far advanced in these soils, because oriented clays, within and on the surfaces of the structural peds, still persist in the illuvial horizons beyond the elutriated and bleached faces of the major cleavage planes.

The reduction and transfer of iron has occurred in all of the very poorly drained, poorly drained, and somewhat poorly drained soils. In the naturally wet soils of Pepin County, the reduction and transfer of iron, a process often called gleying, is of importance in horizon differentiation. It is most pronounced in the Ettrick and Dillon soils, in the poorly drained variant from the Zwingle series, in Loamy alluvial land, wet, and in Loamy very wet terrace land.

The gray colors of the deeper horizons of the wet soils indicate the reduction of iron oxides. This reduction is commonly accompanied by some transfer of the iron, which may be local or general in character. After it has been reduced, iron may be removed completely from some horizons and may even go out of the soil profile. More commonly, in Pepin County, it has moved a short distance and stopped either in the horizon of its origin or in a nearby horizon. Iron has been segregated within deeper horizons of some of the soils to form yellowish-red, strong-brown, or yellowish-brown mottles. Spots of black manganese also are common.

Classification of Soils

Classification of soils is based on the recognition of soils as natural entities possessing definite, unique characteristics. The system used is somewhat similar to those used to classify plants, animals, and other natural objects. A plant, for example, is identified by the structure of the flower, the form of the leaf, and other characteristics unique to the plant. In somewhat the same manner, a soil is identified by the kind, number, and arrangement of horizons, by its color, its reaction, and by other characteristics unique to that particular soil.

The lower categories of classification, the soil series and soil type, are defined in the section "How Soils Are Named, Mapped, and Classified." The soil phase, a subdivision based on characteristics significant in management, is also defined.

Soil series are also classified into great soil groups. The great soil groups in the county are given in table 7, and the soil series within each group are listed along with major physiographic features. Each of these soil groups is described in the pages that follow. Many of the soil series within each group are not representative of the central concept of that group but intergrade toward the Low-Humic Gley great soil group, which is otherwise not represented. Each series represented in the county is described in the pages that follow the discussion of the great soil groups. Also described is a representative profile for each series.

Gray-Brown Podzolic soils

These soils, under virgin conditions, have a thin cover of organic matter (A0) and an organic-mineral (A1) horizon. The organic-mineral horizon overlies a grayish-brown, leached A2 horizon, which, in turn, rests upon a fine-textured, illuvial, brown B horizon. Degradation is manifest in the B horizon of some of the soils. In Pepin County the material underlying the Gray-Brown Podzolic soils consists of sandstone, limestone, till, and loessal or alluvial silt, clay, and sand.

The Gray-Brown Podzolic soils in this county formed under deciduous trees in a cool, moist, subhumid, continental climate. The Bertrand, Dubuque, Fayette, Gale, Hixton, Jackson, Medary, Meridian, Norden, Northfield, Otterholt, and Seaton soils are in this great soil group. The Downs, Almena, Curran, and Zwingle soils are also classified as Gray-Brown Podzolic soils, but the Downs soils are intergrading toward the Brunizems, and the others, toward the Low-Humic Gley soils.

Soils of the Gray-Brown Podzolic great soil group occupy most of the acreage in Pepin County. Of these, the Fayette and Seaton soils are the most extensive, and soils of the Hixton, Gale, Dubuque, Norden, Jackson, and Bertrand series occupy a slightly smaller acreage. In addition to the major soils, there is a smaller acreage of Northfield, Medary, Meridian, and Otterholt soils.

The differences among the Gray-Brown Podzolic soils in this county are chiefly related to differences in parent material and relief. The parent material weathered from a number of different kinds of rocks and minerals. It was altered as the result of differences in relief, which influenced drainage, horizon differentiation, the thickness of the solum, and the depth of the accumulation of organic matter.

TABLE 7.—*Classification of the soils and major physiographic features*

Great soil group and soil series	Physiographic position	Relief	Internal drainage	Parent material
Gray-Brown Podzolic:				
Almena (intergrading toward Low-Humic Gley soils).	Uplands	Gently sloping	Slow	Thick loess over glacial till.
Bertrand	Stream terraces	Nearly level to moderately steep.	Medium	Thick loess over old, sandy alluvium.
Curran (intergrading toward Low-Humic Gley soils).	Stream terraces	Nearly level	Slow	Thick loess over old, sandy alluvium.
Downs (intergrading toward Brunizems).	Uplands and high stream terraces.	Gently sloping to steep.	Medium	Loess.
Dubuque	Uplands	Gently sloping to very steep.	Medium	Loess over limestone residuum; limestone bedrock.
Fayette	Uplands and concave valley slopes.	Gently sloping to steep.	Medium	Loess.
Gale	Uplands	Sloping to very steep	Medium	Loess over sandstone or sandstone residuum.
Hixton	Uplands	Gently sloping to very steep.	Medium	Nonglauconitic sandstone residuum.
Jackson	Stream terraces	Nearly level to sloping	Medium to slow	Deep loess over old, sandy alluvium.
Medary	High terraces along streams.	Nearly level to gently sloping.	Slow	Thin loess over slackwater deposits of silt and clay.
Meridian	Terraces along streams.	Nearly level to moderately steep.	Medium	Old, sandy alluvium.
Norden	Uplands	Gently sloping to very steep.	Medium	Green, glauconitic sandstone residuum; in places has a mantle of loess.
Northfield	Uplands	Gently sloping	Rapid	Platy, nonglauconitic sandstone.
Otterholt	Uplands	Gently sloping to sloping.	Medium	Thick loess over till.
Seaton	Uplands and concave valley slopes.	Gently sloping to steep.	Medium	Loess.
Zwingle (intergrading toward Low-Humic Gley soils).	High terraces along streams.	Nearly level	Slow	Thin loess over slackwater deposits of silt and clay.
Brunizem (Prairie):				
Burkhardt	Terraces along streams	Nearly level to sloping	Rapid	Moderately coarse textured material over sandy and gravelly outwash.
Dakota	Terraces along streams	Nearly level to sloping	Medium	Glaciofluvial and alluvial sands.
Gotham (intergrading toward Gray-Brown Podzolic soils).	Outwash plains and terraces along streams.	Nearly level to sloping	Rapid	Sandy alluvium.
Hubbard	Outwash plains and terraces along streams.	Nearly level	Rapid	Glaciofluvial and alluvial sands.
Judson (intergrading toward Alluvial soils).	Drainageways in uplands.	Nearly level to sloping	Medium	Thick deposits of local colluvium and alluvium in the Brunizem region.
Lindstrom	Uplands, concave valley slopes.	Sloping to steep	Medium	Loess.
Norden, dark surface variant.	Uplands	Gently sloping to sloping.	Medium	Green, glauconitic sandstone residuum; in places has a mantle of loess.
Richwood	Terraces along streams	Nearly level to gently sloping.	Medium	Thick loess over old, sandy alluvium.
Rowley	Terraces along streams	Nearly level	Slow	Thick loess over old, sandy alluvium.
Toddville	Terraces along streams	Nearly level to gently sloping.	Medium to slow	Thick loess over old, sandy alluvium.
Watseka (intergrading toward Regosols).	Outwash plains and low terraces along streams.	Nearly level	Medium to slow	Glaciofluvial and alluvial sands.
Waukegan	Terraces along streams	Nearly level to sloping	Medium	Loess over glaciofluvial and alluvial sands and gravel.

TABLE 7.—*Classification of the soils and major physiographic features*—Continued

Great soil group and soil series	Physiographic position	Relief	Internal drainage	Parent material
Humic Gley:				
Dillon	Outwash plains and terraces along streams.	Nearly level	Very slow; water table is near the surface most of the time.	Glaciofluvial and alluvial sands.
Ettrick	Near small streams	Nearly level	Very slow; water table is near the surface most of the time.	Mixed moderately coarse to medium-textured alluvium.
Zwingle, poorly drained variant.	High terraces along streams.	Nearly level	Slow	Thin loess over slack-water deposits of silt and clay.
Bog soils:				
Peat and muck, deep (more than 40 inches deep).	Near small streams	Nearly level	Very slow unless artificially drained.	Grassy or sedgy organic materials that in places contain woody fragments.
Peat and muck, shallow (12 to 40 inches deep over sand).	Near small streams	Nearly level	Very slow unless artificially drained.	Grassy or sedgy organic materials that in places contain woody fragments.
Alluvial soils:				
Arenzville	Flood plains of streams	Nearly level to very gently sloping.	Medium	Silty alluvium that in many places overlies an old, buried alluvial soil.
Chaseburg (intergrading toward Gray-Brown Podzolic soils).	Drainageways in uplands.	Nearly level to sloping	Medium	Thick deposits of local colluvium or alluvium washed from areas of Gray-Brown Podzolic soils.
Huntsville	Flood plains of streams	Nearly level to very gently sloping.	Medium	Silty alluvium that in many places overlies an old, buried alluvial soil; occurs in the Prairie soil zone.
Orion (intergrading toward Low-Humic Gley soils).	Flood plains of streams	Nearly level to very gently sloping.	Slow	Silty alluvium that in many places overlies an old, buried soil formed in alluvium.
Wallkill	Near small streams	Nearly level to concave.	Very slow	Silty alluvium over grassy or sedgy peat or muck.
Lithosol:				
Urne	Uplands	Gently sloping to very steep.	Medium to rapid	Material weathered from Franconia sandstone, in places with a thin cap of loess.
Regosol:				
Boone	Uplands	Gently sloping to very steep.	Rapid	Nonglauconitic sandstone residuum.
Morocco (intergrading toward Low-Humic Gley soils).	Outwash plains and terraces of streams.	Nearly level	Slow	Glaciofluvial and alluvial sands.
Plainfield	Outwash plains and low terraces of streams.	Nearly level to strongly sloping.	Medium to very rapid	Glaciofluvial and alluvial sands.
Sparta (intergrading toward Brunizems).	Outwash plains and low terraces of streams.	Nearly level to moderately steep.	Very rapid	Glaciofluvial and alluvial sands.

The Fayette and Seaton soils, typical of the Gray-Brown Podzolic soils in the county, are gently undulating to rolling. These soils are mapped together as undifferentiated units. They formed in a mantle of loess, generally 42 inches or more thick, and overlie sedimentary rock. In most places the silt is several feet thick. These soils are on upland ridges or on valley slopes below escarpments of dolomite or sandstone. The ridge slopes are generally between 3 and 15 percent, and the valley slopes, between 6 and 30 percent. The Fayette and Seaton soils are well drained, but in places in the more nearly level areas the C horizon is slightly mottled. The Seaton soils differ from the Fayette mainly in that they formed in coarse-textured loess, rather than in medium-textured loess.

The Dubuque and Gale soils are generally associated with the Fayette and Seaton soils, but they are generally steeper. These soils formed partly in loess, 10 to 12 inches thick, and partly in material weathered from the underlying bedrock. The lower part of the solum of the Dubuque soils formed in residuum from limestone, and that of the Gale soils, in residuum from sandstone.

The Northfield, Hixton, and Norden soils differ from the other Gray-Brown Podzolic soils of the uplands in having formed in residuum from Cambrian sandstone rather than in till, loess, or silty alluvium. The Hixton and Northfield soils formed in material weathered from yellowish-brown or buff-colored Trempealeau or Dresbach sandstone. The Norden soils formed in material weathered from Franconia (glauconitic) sandstone, in places covered by a shallow mantle of loess. The Franconia sandstone is greenish in color, weathers readily, and contains iron. The glauconite in the Franconia sandstone causes the Norden soils to contain more colloidal clays than the Hixton soils. As a result, the Norden soils have a somewhat higher moisture-holding capacity than the Hixton soils.

The Otterholt soils and the associated somewhat poorly drained Almena soils are the only soils underlain by glacial till mapped in the county. They are associated with the Fayette and Seaton soils of the uplands, but they formed in somewhat shallower deposits of loess. The loess in which the Otterholt soils formed was 42 to 60 or more inches thick. It was underlain by glacial till of the Iowan and Cary substages.

The Bertrand, Jackson, Curran, Meridian, Medary, and Zwingle soils are examples of Gray-Brown Podzolic soils formed on terraces. The Bertrand soils, like their catenary associates, the Jackson and Curran soils, formed in a mantle of silt 42 inches or more thick. The Jackson soils are moderately well drained, and the Curran are somewhat poorly drained. The Meridian soils formed in loamy material 24 to 42 inches thick over sand. The Medary and Zwingle soils differ from other soils on the terraces in being underlain by reddish-brown, lacustrine clay.

The Almena, Curran, and Zwingle soils are somewhat poorly drained instead of being well drained like the other Gray-Brown Podzolic soils. The Downs soils are well drained. They formed in a thick mantle of loess.

Brunizem (Prairie) soils

The Brunizem, or Prairie, soils formed in a cool, moderately humid climate under a cover of tall grasses dominated by bluestem (*Andropogon* spp.). Typically, the Brunizems that have not been cultivated have a thick, very dark brown to black A horizon. This soil material grades through a dark yellowish-brown B horizon to the lighter colored parent material below. After the soil has been cultivated, changes may occur in the color and thickness of the A horizon. The B horizon in most Brunizems contains slightly higher concentrations of clay than the horizons in the rest of the profile.

Generally, Brunizems are said to have formed under prairie in a moderately humid climate, and Gray-Brown Podzolic soils, under timber in a humid climate. Within Pepin County, however, there is little room for such climatic differences, and prairie and timber coexist.

Although the reason for prairie and timber growing in the same area is not known, it is thought that prairie grasses prefer level soils that are slowly permeable and that have a high water table. Trees, on the other hand, prefer rolling areas where drainage is good. It is also believed that because prairies were pastured by herds of buffalo and burned by man, grasslands were perpetuated and trees prevented from growing in areas that would normally be wooded. Another theory is that a climatic change favorable to the growth of trees has taken place and that all areas in the county in prairie would ultimately have been forested if they had not been cultivated.

The parent material of the Brunizem soils in this county, like the parent material of most of the Gray-Brown Podzolic soils, is loess and alluvial silts and sands or material weathered from sandstone and limestone. None of the Brunizems, however, are underlain by glacial till.

The Burkhardt, Dakota, Hubbard, Lindstrom, Richwood, Rowley, Toddville, and Waukegan soils and the dark surface variants from the Norden series are in the Brunizem great soil group. The Gotham, Judson, and Watseka soils are also in this great soil group, but the Gotham soils are intergrading toward Gray-Brown Podzolic soils, the Judson, toward Alluvial soils, and the Watseka, toward Regosols.

The Burkhardt, Dakota, Hubbard, Lindstrom, Richwood, Rowley, and Waukegan soils occupy most of the acreage in this group. Soils of the Toddville series and the dark surface variants from the Norden series make up most of the rest of the acreage.

Except for the Lindstrom soils and the dark surface variants from the Norden series, all of these soils are on terraces. The Lindstrom soils are on valley slopes, and the dark surface variants from the Norden series are in the uplands. This is in marked contrast to the Gray-Brown Podzolic soils, which are predominantly in the uplands.

The Lindstrom soils are somewhat similar to the Fayette soils of the Gray-Brown Podzolic great soil group, and the dark surface variants from the Norden series are somewhat similar to the Norden. The Lindstrom soils formed on concave valley slopes in a mantle of silt that was more than 42 inches thick. The dark surface variants from the Norden series formed in residuum from Franconia sandstone.

The Richwood soils, which are somewhat similar to the Bertrand soils of the Gray-Brown Podzolic great soil group, formed in silt that was 42 to 60 inches or more thick. The Richwood soils, like their catenary associates, the Toddville and Rowley soils, are on terraces that overlie old, sandy alluvium. The Richwood soils are well drained, the Toddville are moderately well drained, and the Rowley are somewhat poorly drained.

The Waukegan soils differ from the Richwood soils, mainly in having formed in a thinner mantle of silt. The silt was 24 to 42 inches thick over alluvial or glaciofluvial sands that contained little or no gravel.

The Dakota soils, which are somewhat like the Meridian soils of the Gray-Brown Podzolic great soil group, formed on terraces over sandy outwash. The Burkhardt soils, associated with the Dakota soils, formed in a somewhat thinner mantle of similar material that was 18 to 24 inches thick over sandy and gravelly outwash.

The Hubbard soils formed in sandy outwash on low stream terraces. They differ from the Sparta soils of the Regosol great soil group in having a weak textural B horizon and finer textured material in the rest of the solum.

The Gotham soils are similar to the Hubbard soils, but they have a slightly thinner surface layer and less fines in the profile. The Watseka soils are moderately well drained to somewhat poorly drained. The Judson soils formed in thick, colluvial or alluvial silts that were recently deposited, and their structural development is very weak.

Humic Gley soils

The Humic Gley soils, formerly called Wiesenboden or Half Bog soils, formed in depressions where natural drainage is poor or very poor. They have a dark-colored, organic-mineral surface layer that is generally more than 6 inches thick. The subsoil is strongly gleyed and is mottled. These soils lack an A2 horizon. The texture of the different horizons differs little throughout the profile.

In Pepin County the soils of the Dillon and Ettrick series and the poorly drained variant from the Zwingle series are in the Humic Gley great soil group. The Dillon soils formed on sandy outwash plains and stream terraces. The Ettrick soils are very poorly drained. They formed in silty materials on the high bottoms of alluvial flood plains. The poorly drained variant from the Zwingle series, associated with the Medary and Zwingle soils, formed in silty and clayey materials on high stream terraces.

Bog soils

Bog soils, or Peat and muck, are organic soils. These soils generally have a surface layer of peat or muck that is underlain by peat. They are forming in a humid or subhumid climate under swamp or marsh vegetation. These soils are in depressions in flood plains and terraces and are wet unless they are drained. They vary in thickness over mineral soil material.

The description given in the section "Descriptions of the Soils" is typical of the majority of Peat and muck soils in the county. In some of the wet areas, however, the plant remains near the surface may be less decomposed than in the profile described. The thickness of the organic material over mineral soil material is 12 to 40 inches in Peat and muck, shallow, and more than 40 inches in Peat and muck, deep.

Alluvial soils

Alluvial soils are forming in material recently deposited on flood plains and in fans and draws. They have little or no profile development and are subject to flooding. They receive fresh deposits of sediment during periods of high runoff. In Pepin County the Arenzville, Chaseburg, Huntsville, Orion, and Wallkill soils are in this great soil group.

The well-drained Arenzville soils, like their catenary associates, the Orion soils, formed in thick, silty alluvium. In many places the silty alluvium overlies an older and darker, buried alluvial soil. The Orion soils are intergrading toward Low-Humic Gley soils.

The Huntsville soils, also associated with Arenzville soils, formed under prairie. They are similar to the Arenzville soils, but they have a darker surface layer.

The Chaseburg soils formed in drainageways on the uplands in thick deposits of local alluvium, and their profile is weakly developed. They are intergrading toward the Gray-Brown Podzolic great soil group.

The Wallkill soils formed in recent alluvial-mineral material over grassy or sedgy peat and muck. They are in nearly level to concave areas on stream bottoms.

Lithosols

Typically, Lithosols are shallow and have little or no profile development. They are made up primarily of partly weathered fragments of rock or of nearly bare rock.

In Pepin County the Urne soils are classified as Lithosols. These soils are shallow over bedrock and lack a B horizon. They are underlain by greenish, glauconitic sandstone.

Regosols

The Regosols are made up of deep, sandy deposits or of shallow, soft, rocky deposits in which few or no soil characteristics have developed. They have only an AC profile.

In Pepin County the Boone, Morocco, Plainfield, and Sparta soils are in this great soil group. The Morocco soils and the mottled subsoil variant from the Plainfield series are the catenary associates of the Plainfield soils. The Morocco soils are intergrading toward the Low Humic Gley great soil group, and the Sparta, toward the Brunizems.

Miscellaneous land types

Miscellaneous land types are areas of land that have little or no true soil. They also include areas that are nearly inaccessible and cannot be examined carefully or other areas not feasible to classify by soil series. Such areas are named primarily in terms of landform and, secondarily, in terms of material. In Pepin County the kinds of miscellaneous land types mapped are: (1) Loamy alluvial land, (2) Loamy terrace land, (3) Riverwash, (4) Sandy alluvial land, (5) Steep stony and rocky land, and (6) Terrace escarpments.

Detailed Descriptions of Soil Series

The soil series in Pepin County are described in the following pages. In addition, at least one representative profile of a soil of each series is described in some detail. The great soil group is given for each series for easy cross-reference to table 7.

ALMENA SERIES

Almena soils are somewhat poorly drained. They belong to the Gray-Brown Podzolic great soil group but are intergrading toward Low-Humic Gley soils. These gently sloping soils formed on uplands in a thick mantle of loess that was 42 to 60 inches thick. They are underlain by loam or clay loam till of Iowan age. The original vegetation was a forest of maple and basswood. These soils are associated with the well-drained Otterholt soils.

The following describes a representative profile of an Almena silt loam in a cultivated field (NE¼NW¼ sec. 6, T. 25 N., R. 14 W.):

A_p—0 to 8 inches, very dark grayish-brown to dark grayish-brown (10YR 3/2 to 4/2)[5] silt loam; weak, very fine, subangular blocky structure; friable; moderately alkaline; clear, smooth boundary.

A2—8 to 12 inches, grayish-brown (10YR 5/2) silt loam; moderate, very thin, platy structure; a few, patchy, bleached silt coats on the lateral faces of structural peds; a few, fine, distinct mottles of dark yellowish brown (10YR 4/4); friable; very strongly acid; abrupt, smooth boundary.

B1—12 to 14 inches, grayish-brown (10YR 5/2) silt loam; compound weak, thin and medium, platy and moderate, very fine, subangular blocky structure; firm to friable; thick, bleached, silt coats on the vertical and horizontal faces of structural peds; a few, fine, distinct mottles of dark yellowish brown (10YR 4/4); very strongly acid; abrupt, smooth boundary.

B21—14 to 20 inches, dark-brown (10YR 3/3) heavy silt loam; compound weak, thick, platy and moderate, fine, subangular blocky structure; firm; heavy, bleached, silt coats on the vertical and horizontal faces of structural peds; a few, fine, prominent mottles of dark brown (7.5YR 4/4); very strongly acid; clear, smooth boundary.

B22—20 to 25 inches, dark-brown to brown (10YR 4/3 to 5/3) heavy silt loam; compound weak, thick, platy and moderate, medium, subangular blocky structure; firm; very heavy, bleached, silt coats and pockets on the vertical and horizontal faces of structural peds, with the greatest thickness along the vertical cleavage planes; few to common, fine, prominent mottles of dark brown (7.5YR 4/4); very strongly acid; clear, smooth boundary.

B3—25 to 45 inches, dark-brown to dark yellowish-brown (10 YR 4/3 to 4/4) silt loam to heavy silt loam; moderate, coarse, subangular blocky structure; strongly expressed vertical cleavage planes and general macroplatiness; firm; thick, bleached, silt coats on the vertical faces of structural peds; a few, fine, distinct mottles of dark brown (7.5YR 4/4); very strongly acid; gradual, smooth boundary.

IIC—45 inches +, grayish-brown to brown (10YR 5/2 to 5/3) gritty clay loam glacial till; massive; a few, fine, prominent mottles of strong brown (7.5YR 5/6); very strongly acid.

In areas that have not been disturbed, the A1 horizon is 1 to 4 inches thick and is black to very dark grayish brown (10YR 2/1 to 3/2).

[5] Symbols express Munsell color notations. (See Glossary.) Unless otherwise stated, the color is that of a moist soil. Other terms used in describing the soil characteristics are explained in the Glossary or in the Soil Survey Manual (*10*).

Variations are mainly in the thickness of the mantle of silt over till and in the thickness of the bleached silt coatings on the faces of the peds in the B horizon. Depth to till ranges from 42 to 60 inches. In places there are thin clay films on the faces of the peds in the B horizon. The solum is 30 to 45 inches thick. In some places the profile has a C horizon that formed in the mantle of silt, and in others the B horizon extends to the underlying till. The color of the till ranges from grayish brown to dark brown (10YR 5/2 to 7.5YR 4/4), and the texture ranges from sandy loam to clay loam.

ARENZVILLE SERIES

The soils of the Arenzville series are deep and silty and are well drained to moderately well drained. They belong to the Alluvial great soil group. These soils are on broad flood plains along the major streams and on narrow bottom lands along the smaller streams. They formed in alluvium washed from areas on the uplands that had a mantle of loess. The Arenzville soils have a light-colored surface layer and overlie an old, buried, dark-colored soil.

These soils are lighter colored than the Huntsville soils, which are similar in texture and occupy similar positions. They are more stratified than the Chaseburg soils.

The following describes a representative profile of an Arenzville silt loam in a cultivated field (SW¼SE¼ sec. 24, T. 25 N., R. 11 W.):

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; thin streaks of yellowish brown and very dark grayish brown (10YR 5/4 and 3/2); weak, medium, granular structure; very friable; neutral; abrupt, smooth boundary.

C1—8 to 13 inches, brown (10YR 5/3) silt loam; weak, thin, platy structure; very friable; a few, fine, faint mottles of yellowish brown (10YR 5/4) in the lower part of this horizon; a few, thin lenses of very fine sand are throughout this layer; slightly acid; abrupt, smooth boundary.

C2—13 to 22 inches, thin layers of dark-gray and gray (10YR 4/1 and 5/1) silt loam; weak, thin, platy structure that grades to weak, fine, subangular blocky in the lower 6 inches of this horizon; the lower 6 inches has a few, medium, prominent mottles of dark brown (7.5YR 4/4) and dark reddish brown (5YR 3/4); very friable; slightly acid; abrupt, smooth boundary.

A1b—22 to 34 inches, black (N 2/0) silt loam; weak; thick, platy structure; very friable; common, fine, distinct mottles of dark brown (7.5YR 4/4) and dark reddish brown (5YR 3/4); high in organic matter; slightly acid; clear, smooth boundary.

A3b—34 to 40 inches, very dark gray (10YR 3/1) silt loam; weak, thick, platy structure; very friable; common, fine, distinct mottles of dark brown (7.5YR 4/4) and dark reddish brown (5YR 3/4); high in organic matter, but contains less than the A1b horizon; medium acid; clear, smooth boundary.

Cb—40 inches +, dark grayish-brown (2.5Y 4/2) massive silt loam.

In places this soil has a thin layer of sandy overwash. Depth to the buried soil is between 18 and 48 inches. There are thin layers of sand throughout the profile in places. Minor differences in color are caused by mottling and by differences in the sediments in which the soils are forming. Mottles are not present in all areas. At a depth above 18 inches, there are few mottles.

BERTRAND SERIES

The Bertrand soils are deep and silty and are well drained. They belong to the Gray-Brown Podzolic great soil group. These soils formed on terraces in silty alluvium that was more than 42 inches thick. The alluvium was washed mainly from areas that were covered with loess. The native vegetation was a deciduous forest made up mainly of oak, hard maple, and hickory.

The Bertrand soils formed in similar materials and are associated with the moderately well drained Jackson soils and the somewhat poorly drained Curran soils. They have a thinner, lighter colored surface layer than the Richwood soils, which formed in similar parent materials and in similar positions. The Bertrand soils are similar to the Fayette soils, which formed in loess, but their substratum is stratified with silt and varies slightly in color.

The following describes a representative profile of a Bertrand silt loam in a cultivated field (NW¼NW¼ sec. 29, T. 24 N., R. 14 W.):

Ap—0 to 8 inches, very dark grayish-brown and dark grayish-brown (10YR 3/2 and 4/2) silt loam; moderate, fine, granular structure; very friable; neutral; abrupt, smooth boundary.

A2—8 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, platy structure in places, but breaks readily to moderate, very fine, subangular blocky; very friable; slightly acid; clear, smooth boundary.

B1—10 to 13 inches, dark-brown (10YR 4/3) silt loam; moderate, thick, platy structure that breaks to moderate, fine, subangular blocky; friable; a few, light-gray (10YR 7/2), bleached silt coatings on the peds; medium acid; clear, smooth boundary.

B2—13 to 36 inches, dark-brown (10YR 4/3) silty clay loam; moderate, medium and fine, subangular blocky structure; firm when moist and slightly hard when dry; dark-brown (10YR 3/3) clay films and light-gray (10YR 7/2), bleached silt coatings on the peds; strongly acid; gradual, smooth boundary.

B3—36 to 42 inches, dark yellowish-brown (10YR 4/4) light silty clay loam; weak, coarse, subangular blocky structure; friable when moist; light-gray (10YR 7/2), bleached silt coatings on the peds; a few roots; strongly acid; gradual, smooth boundary.

C—42 inches +, dark yellowish-brown (10YR 4/4) silt; massive; friable; strongly acid.

The color of the Ap horizon ranges from very dark grayish brown to dark grayish brown (10YR 3/2 to 4/2), and the thickness of the solum, from 36 to 42 inches. Depth of the silty parent material over sand ranges from 42 inches to several feet.

BOONE SERIES

In the Boone series are sandy, excessively drained soils of uplands. They belong to the Regosol great soil group. These soils formed under a hardwood forest in material weathered from sandstone. The forest was made up chiefly of oak, but it included other deciduous trees.

These soils are near the Hixton and Northfield soils, but they differ from those soils in having coarser texture. Also, they lack the textural B horizon typical of the Hixton soils. The Boone soils differ from the Urne and Norden soils in having formed from nonglauconitic sandstone.

The following describes a representative profile of a Boone loamy fine sand in a cultivated field (NE¼NE¼ sec. 9, T. 25 N., R. 11 W.):

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loamy fine sand; weak, very fine, granular structure; very friable; strongly acid; clear, abrupt boundary.

C1—7 to 17 inches, yellowish-brown (10YR 5/4) loamy sand; weak, medium, subangular blocky structure; very friable; contains a few, small sandstone fragments; very strongly acid; gradual, smooth boundary.

C2—17 to 36 inches, light yellowish-brown (10YR 6/4) sand that is very pale brown (10YR 7/4) in the lower part of the horizon; single grain; loose; very strongly acid; gradual, smooth boundary.

IIR—36 inches +, yellow sandstone.

In undisturbed areas the A1 horizon ranges from less than 1 inch to as much as 3 inches in thickness and from very dark grayish brown to black (10YR 3/2 to 2/1) in color. The surface layer ranges from dark grayish brown to very dark grayish brown (10YR 4/2 to 3/2) in cultivated fields, but in places it is yellow because materials from the substratum are exposed.

Depth to consolidated sandstone ranges from a few inches to several feet, but, typically, it is 24 to 36 inches. In the areas that are steep, the depth is more variable than in the less sloping areas. Where the slope is less than 12 percent, depth to bedrock is greater than where the slope is stronger. In many places the profile contains some fine and very fine sand. The sand washed or fell from higher lying areas that are underlain by glauconitic or nonglauconitic sandstone. A few sandstone chips are on the surface and in the profile in places.

BURKHARDT SERIES

The soils of this series are moderately shallow and are somewhat excessively drained. They belong to the Brunizem great soil group. These soils formed on stream terraces under tall prairie grass in stratified sand and gravel.

These soils are associated with Dakota, Hubbard, Gotham, and Sparta soils, but they have more gravel in the profile than those soils. Their solum is thinner than that of the Dakota, Hubbard, and Gotham soils. Also, their B horizon contains more clay than that in the Gotham and Hubbard soils. They have a darker colored surface layer than the Gotham soils. The Burkhardt soils differ from the Sparta soils in having a finer textured surface layer and an illuvial B horizon.

The following describes a representative profile of a Burkhardt sandy loam in a cultivated field (SW¼SW¼ sec. 24, T. 25 N., R. 14 W.):

Ap—0 to 9 inches, black (10YR 2/1) sandy loam; weak, medium, subangular blocky structure that breaks to weak, medium, granular; very friable; medium acid; clear, smooth boundary.

A12—9 to 12 inches, black (10YR 2/1) sandy loam; weak, medium, subangular blocky structure; very friable; medium acid; clear, smooth boundary.

B2—12 to 18 inches, very dark brown (7.5YR 2/2) sandy loam; weak, medium, subangular blocky structure; very friable; medium acid; clear, smooth boundary.

B3—18 to 24 inches, dark-brown (7.5YR 3/2) loamy sand; a few pebbles; weak, medium, subangular blocky structure; very friable; medium acid; clear, smooth boundary.

C1—24 to 30 inches, dark-brown (7.5YR 3/4) coarse sand and fine and medium gravel that has a high percentage of dark mineral particles; single grain; loose; medium acid; gradual, smooth boundary.

C2—30 inches +, brown (7.5YR 5/4) coarse sand and fine and medium gravel that contains a high percentage of dark mineral particles; single grain; loose; medium acid.

Variations are chiefly in the color of the surface layer and in the thickness of the solum. The surface layer is black to very dark brown (10YR 2/1 to 2/2). The solum ranges from 12 to 24 inches in thickness. Also, the percentage of gravel in the profile varies somewhat.

CHASEBURG SERIES

In the Chaseburg series are well drained to moderately well drained soils. These soils belong to the Alluvial great soil group, but they are intergrading toward Gray-Brown Podzolic soils. They formed in deep, silty deposits moved by water or soil creep from nearby areas that were mantled with loess and underlain by limestone or sandstone. These soils are in small areas in draws, are on fans at the ends of draws, and are along the base of steep slopes.

Chaseburg soils occupy positions similar to those of the Judson soils, but they are lighter colored. They are less stratified than the Arenzville soils and lack the buried, darker soil that is typical of those soils.

The following describes a representative profile of a Chaseburg silt loam (SW¼SW¼ sec. 22, T. 25 N., R. 14 W.):

A11—0 to 24 inches, very dark grayish-brown to dark grayish-brown (10YR 3/2 to 4/2) silt loam; weak, fine and medium, granular structure; very friable; abundant roots; neutral; gradual, smooth boundary.
A12—24 to 32 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, platy structure; friable; slightly acid; gradual, smooth boundary.
C1—32 to 42 inches, dark-brown (10YR 4/3) silt loam; weak, medium, platy structure; friable; slightly acid; gradual, smooth boundary.
C2—42 inches +, yellowish-brown (10YR 5/4) silt loam; weak, medium, platy structure; friable; medium acid.

Differences in the source of sediments cause minor color variations throughout the profile. In places there is a thin layer of sandy or gravelly overwash on the surface.

CURRAN SERIES

In the Curran series are somewhat poorly drained soils of terraces. They belong to the Gray-Brown Podzolic great soil group, but they are intergrading toward Low-Humic Gley soils. These soils formed on uplands in silt that was 42 inches or more thick. They are in valleys on terraces below areas that were mantled with loess and underlain by limestone or sandstone. The native vegetation was a forest of hardwoods.

These soils are associated with the moderately well drained Jackson soils and the well drained Bertrand soils, and they formed from similar parent materials. They differ from the Rowley soils in having a thinner, lighter colored surface layer.

The following describes a representative profile of a Curran silt loam in a cultivated field (SE¼NW¼ sec. 9, T. 25 N., R. 14 W.):

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, subangular blocky structure; friable; neutral; abrupt, smooth boundary.
A2—7 to 8 inches, gray to grayish-brown (10YR 5/1 to 5/2) silt loam; moderate, thin, platy structure; friable; a few, fine, distinct mottles of dark yellowish brown (10YR 4/4); medium acid; clear, smooth boundary.
B11—8 to 9 inches, grayish-brown (10YR 5/2) silt loam; moderate, medium, subangular blocky structure; friable; a few, medium, distinct mottles of dark yellowish brown (10YR 4/4); medium acid; clear, smooth boundary.
B12—9 to 12 inches, grayish-brown to dark grayish-brown (2.5YR 5/2 to 4/2) silt loam; moderate, medium, angular blocky structure; firm; thin, gray, bleached silt coatings on the surfaces of the blocks; a few, fine, distinct mottles of dark yellowish brown (10YR 4/4); medium acid; clear, smooth boundary.
B21—12 to 19 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; moderate, angular blocky structure; firm; a few dark-brown (7.5YR 3/2) stains from organic matter on the faces of the blocks; a few, fine, distinct mottles of dark yellowish brown (10YR 4/4); medium acid; clear, smooth boundary.
B22—19 to 25 inches, dark grayish-brown (2.5Y 4/2) silt loam; moderate, medium, angular blocky structure; firm; a few dark-brown (7.5YR 3/2) stains from organic matter on the faces of the blocks; common, fine, distinct and prominent mottles of dark yellowish brown and yellowish brown (10YR 4/4 and 5/6); slightly acid; clear, smooth boundary.
B3—25 to 34 inches, grayish-brown (2.5Y 5/2) silt loam; weak, coarse, subangular blocky structure; friable; many, medium, distinct mottles of dark yellowish brown (10YR 4/4); slightly acid; gradual, smooth boundary.
C—34 inches +, grayish-brown (2.5Y 5/2) silt loam; thinly laminated and structureless; friable; many, medium, prominent mottles of yellowish red (5YR 5/6).

The Ap horizon ranges from dark gray to very dark gray (10YR 4/1 to 3/1) in color, and in places the structure is granular. The dominant color of the B horizon is brown (10YR 5/3). The silty parent materials are 42 inches to several feet thick over the underlying sand.

DAKOTA SERIES

In the Dakota series are moderately deep, well-drained soils underlain by loose sand. These soils belong to the Brunizem great soil group. They formed under tall prairie grasses on stream terraces in sandy and loamy outwash.

These soils formed in materials similar to those of the Meridian soils, and are in similar positions. They differ from those soils in having a thicker, darker colored surface layer. Dakota soils are near the Waukegan, Burkhardt, Hubbard, and Sparta soils. Their solum is less silty than that of the Waukegan soils and is thicker than that of the Burkhardt soils. Also, they have less gravel in the profile and underlying material than the Burkhardt soils. The Dakota soils are generally finer textured than the Hubbard and Sparta soils.

The following describes a representative profile of a Dakota fine sandy loam in a cultivated field (NE¼SW¼ sec. 29, T. 23 N., R. 14 W.):

Ap—0 to 8 inches, very dark brown (10YR 2/2) fine sandy loam; moderate, fine, granular structure; very friable; neutral; clear, smooth boundary.
A12—8 to 13 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, medium, subangular blocky structure that breaks to weak, fine granules; very friable; medium acid; clear smooth boundary.
B21—13 to 17 inches, dark-brown (7.5YR 3/2) loam; weak, medium, subangular blocky structure; friable; medium acid; gradual, smooth boundary.
B22—17 to 25 inches, dark-brown (7.5YR 3/4) fine sandy loam; weak, medium, subangular blocky structure; friable; medium acid; gradual, smooth boundary.
B3—25 to 31 inches, dark-brown (7.5YR 4/4) loamy sand; weak, medium, subangular blocky structure; very friable; medium acid; gradual, smooth boundary.
IIC—31 inches +, strong-brown (7.5YR 4/6) sand; structureless; a few, fine pebbles and many dark mineral particles; medium acid.

The surface layer ranges in texture from very fine sandy loam to loam, and in color, from very dark brown to black (10YR 2/2 to 2/1). In some eroded areas the color is very dark grayish brown (10YR 3/2). Other variations are mainly in the thickness of the solum and in the nature of the underlying sand. The solum is 24 to 36 inches thick.

The underlying sand ranges in texture from fine to coarse. In places it contains thin strata of fine gravel.

DILLON SERIES

The soils in the Dillon series are deep and sandy and are very poorly drained. They belong to the Humic Gley great soil group. These soils occupy level to slightly depressed areas on stream terraces. Grasses, sedges, reeds, and other water-tolerant plants made up the original vegetation.

These soils have drainage similar to that of Loamy wet terrace land, but their substratum lacks the finer textured layers typical of that land type. The Dillon soils are associated with the well-drained Plainfield soils and the somewhat poorly drained Morocco soils.

The following describes a representative profile of a Dillon fine sandy loam (NW¼NE¼ sec. 17, T. 25 N., R. 11 W.):

Ap—0 to 8 inches, black (10YR 2/1) fine sandy loam; moderate, fine, granular structure; friable; medium acid; clear, wavy boundary.
A12—8 to 11 inches, black (10YR 2/1) fine sandy loam; weak, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.
A3g—11 to 14 inches, very dark gray to dark grayish-brown (10YR 3/1 to 4/2) loamy fine sand; weak, medium, subangular blocky structure; very friable; medium acid; clear, smooth boundary.
C1g—14 to 20 inches, light brownish-gray (2.5Y 6/2) fine sand; a few, medium, distinct mottles of yellowish brown (10YR 5/6); weak, coarse, subangular blocky structure that breaks under slight pressure to single grain; loose; medium acid; gradual, smooth boundary.
C2g—20 to 26 inches, light brownish-gray (2.5Y 6/2) fine sand; a few, medium, distinct mottles of yellowish brown (10YR 5/6); weak, coarse, subangular blocky structure; very friable, very strongly acid; gradual, smooth boundary.
C3g—26 to 46 inches, grayish-brown (2.5Y 5/2) fine sand; single grain; loose; strongly acid; gradual, smooth boundary.
C4—46 inches +, brown (10YR 5/3) medium sand; single grain; loose; medium acid.

These soils vary chiefly in the thickness of the A1 horizon, which is 10 to 15 inches thick. In places there is a thin layer of peat or muck on the surface.

DOWNS SERIES

The soils of the Downs series are deep, silty, and well drained. They belong to the Gray-Brown Podzolic great soil group but are intergrading toward soils of the Brunizem great soil group. They formed under a mixture of prairie grasses and hardwoods, or under prairie grasses that later were replaced by hardwoods.

The normal Downs silt loams formed on uplands in a mantle of loess, 42 or more inches thick. They are near the Fayette and Dubuque soils, but they have a thicker, darker surface layer than those soils. Their surface layer is thinner and lighter colored than that of the Lindstrom soils. In Pepin County the normal Downs soils are mainly in Stockholm Township in the western part of the county.

The Downs soils on benches also formed in loess, but they are underlain by thinly laminated silt deposited by streams. These soils are on benches in the eastern part of the county along the southern boundary of Durand and Lima Townships. The profile of the Downs silt loams on benches is similar to that of the normal Downs silt loams, but the normal Downs silt loams formed in loess underlain by limestone.

The following describes a representative profile of a Downs silt loam in a cultivated field (NE¼NE¼ sec. 1, T. 23 N., R. 16 W.):

Ap—0 to 9 inches, very dark brown (10YR 2/2) silt loam; moderate, fine, granular structure; very friable; many earthworm casts and a few wormholes; fibrous plant roots abundant; neutral; abrupt, smooth boundary.
A2—9 to 12 inches, brown (10YR 5/3) silt loam; moderate, medium, platy structure; gray, bleached silt coats on the surfaces of the plates; moderately vesicular; very friable; many wormholes; plentiful plant roots; neutral; clear, smooth boundary.
B1—12 to 16 inches, dark-brown (10YR 4/3) silt loam; structure is weak, thick, platy in the upper part of the horizon but grades to moderate, fine, subangular blocky in the lower part; gray, bleached silt coats on the surfaces of the peds; moderately vesicular; friable; a few wormholes; plant roots plentiful; medium acid; clear, wavy boundary.
B21—16 to 23 inches, dark-brown (10YR 4/3) silty clay loam; moderate, medium, subangular blocky structure; moderately vesicular; gray, bleached silt coats on the surfaces of the peds; firm; roots plentiful; a few wormholes; medium acid; clear, wavy boundary.
B22—23 to 32 inches, dark yellowish-brown (10YR 3/4) silty clay loam; moderate, medium, subangular blocky structure; gray, bleached silt coats on the surfaces of the peds; a few, very dark brown stains from organic matter on the surface of the blocks; slightly vesicular, firm; a few plant roots; strongly acid; clear, wavy boundary.
B3—32 to 38 inches, dark yellowish-brown (10YR 3/4) light silty clay loam; weak, medium, subangular blocky structure; gray, bleached silt coats on the surfaces of the blocks; a few plant roots; slightly vesicular; firm; strongly acid; gradual, irregular boundary.
C—38 inches +, dark yellowish-brown (10YR 4/4) silt loam; massive; friable; medium acid.

This soil varies mainly in the color of the surface layer. In undisturbed areas or in areas that are only slightly eroded, the color of the surface layer is black to very dark brown (10YR 2/1 to 2/2). In areas that are more eroded, the surface layer is very dark grayish brown to brown (10YR 3/2 to 3/3). Depth of the loess over limestone bedrock ranges from 42 inches to several feet. The thickness of the solum ranges from 36 to 42 inches. In places the material in the C horizon is several feet thick over limestone.

The following describes a representative profile of a Downs silt loam, benches, in an undisturbed area (SE¼NE¼ sec. 36, T. 25 N., R. 13 W.):

A0—¾ inch to ¼ inch or less, mat of decomposed bluegrass and leaves.
A1—0 to 8 inches, black (10YR 2/1) silt loam; moderate, fine, granular structure; very friable; roots abundant; neutral; clear, wavy boundary.
A2—8 to 13 inches, very dark grayish-brown to dark grayish-brown (10YR 3/2 to 4/2) silt loam; weak, thin or medium, platy structure; very friable; roots abundant; medium acid; clear, wavy boundary.
B11—13 to 17 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, subangular blocky structure; very dark grayish-brown (10YR 3/2) coatings of organic matter on the surfaces of the peds; friable; roots abundant; strongly acid; clear, wavy boundary.
B12—17 to 21 inches, dark-brown (10YR 4/3) silt loam; weak, thick, platy structure in places, but breaks readily to weak, fine, subangular blocky; very dark brown (10YR 3/2) coats on the surfaces of the peds; moderately vesicular; friable; roots plentiful; strongly acid; abrupt, smooth boundary.

B21—21 to 29 inches, dark-brown (10YR 3/3 to 4/3) light silty clay loam; weak, thick, platy structure in place, but breaks readily to moderate, fine, subangular blocky; moderately vesicular; friable; roots plentiful; strongly acid; clear, wavy boundary.

B22—29 to 36 inches, dark-brown (10YR 3/3 to 4/3) light silty clay loam; weak, thick, platy structure in place, but breaks readily to moderate, fine subangular blocky; moderately vesicular; friable; roots plentiful; medium acid; clear, wavy boundary.

B3—36 to 40 inches, dark-brown (10YR 4/3) silt loam; weak, thick, platy structure in place, but breaks readily to weak, fine, subangular blocky; moderately vesicular; friable; roots plentiful; medium acid; clear, wavy boundary.

C1—40 to 52 inches, dark-brown (10YR 4/3), friable silt; strongly vesicular; massive; a few roots; slightly acid; gradual, smooth boundary.

C2—52 to 120 inches, pale-brown (10YR 6/3), friable silt that contains thin, strong-brown (7.5YR 5/8) laminations of fine silt; the upper part of this horizon is slightly acid, but the lower part is calcareous.

IIR—120 inches +, greenish, glauconitic sandstone.

Like the normal Downs silt loams, the Downs silt loams on benches differ chiefly in the color of the surface layer. In undisturbed areas or in areas that are only slightly eroded, the surface layer is black to very dark brown (10YR 2/1 to 2/2). In areas that are more eroded, the surface layer is very dark grayish brown (10YR 3/2 to 3/3). The solum ranges from 36 to 42 inches in thickness. Depth of the silt over greenish, glauconitic sandstone ranges from 42 inches to several feet.

DUBUQUE SERIES

In the Dubuque series are silty, well-drained soils of the uplands. These soils belong to the Gray-Brown Podzolic great soil group. They formed under hardwoods, partly in loess and partly in cherty red clay that weathered from dolomite. Depth to clay in the normal silt loams ranges from 10 to 20 inches. In the deep Dubuque silt loams, the clay is at a depth of 20 to 42 inches. Most of the B horizon of the normal Dubuque silt loams formed in the red clay, but that in the deep, Dubuque silt loams formed mainly in loess. These soils are undulating to rolling or steep.

The Dubuque soils are associated with the Fayette soils, but they formed in thinner deposits of loess. They are similar to the Gale soils, but they are underlain by dolomitic limestone rather than sandstone.

The following describes a representative profile of a Dubuque silt loam in a cultivated field (NE¼NW¼ sec. 10, T. 24 N., R. 14 W.):

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular and weak, fine, subangular blocky structure; friable; neutral; clear, smooth boundary.

A2—6 to 13 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, thin, platy structure; very friable; slightly acid; clear, wavy boundary.

B1—13 to 18 inches, yellowish-brown to dark yellowish-brown (10YR 5/4 to 4/4) silt loam; weak, thin, platy structure; very friable; strongly acid; abrupt, smooth boundary.

B2—18 to 28 inches, yellowish-brown and strong-brown (10YR 5/6 and 7.5YR 5/8) clay; strong, fine, subangular blocky structure; very hard when dry, plastic when wet; strongly acid; clear, smooth boundary.

IIB3—28 to 36 inches, reddish-brown to yellowish-red (5YR 4/4 to 4/6) clay; massive but breaks to coarse, angular blocky structure; very hard when dry, plastic when wet; strongly acid; clear, smooth boundary.

IIIR—36 inches +, broken limestone.

The normal Dubuque silt loams vary mainly in depth to red clay, in the amount of chert fragments on the surface and in the profile, and in depth of the clay to bedrock. Depth to bedrock ranges from a few inches to several feet. In fields that are cultivated, the surface layer is very dark grayish brown to dark grayish brown (10YR 3/2 to 4/2), but in undisturbed areas the thin A1 horizon is darker colored in places.

The following describes a representative profile of a Dubuque silt loam, deep, in an undisturbed area (SW¼ NW¼ sec. 3, T. 24 N., R. 14 W.):

A0—1½ inches or less, black (10YR 2/1), loose mat of decomposed oak leaves and twigs.

A1—0 to 1 inch, black (10YR 2/1) silt loam; moderate, thin, platy structure; very friable; abundant roots; clear, smooth boundary.

A21—1 to 4 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, thick, platy structure; very friable; plentiful roots; slightly acid; clear, smooth boundary.

A22—4 to 9 inches, brown (10YR 5/3) silt loam; moderate, fine, subangular blocky structure; finely vesicular; very friable; slightly acid; abrupt, smooth boundary.

B1—9 to 12 inches, dark-brown (10YR 4/3) silt loam; strong, medium, subangular blocky structure; finely vesicular; friable; light-gray (10YR 7/1) coats on peds; medium acid; clear, smooth boundary.

B21—12 to 26 inches, dark-brown (10YR 4/3) silty clay loam; strong, fine and medium, angular blocky structure; very vesicular; firm; very strongly acid; gradual, smooth boundary.

B22—26 to 32 inches, dark-brown (7.5YR 4/4) silty clay loam; strong, coarse, subangular blocky structure; firm; strongly acid; abrupt, smooth boundary.

IIB3—32 to 42 inches, reddish-brown (5YR 4/3) clay; massive, but breaks to weak, coarse, angular blocky structure; very hard when dry, plastic when wet; strongly acid; small, dark spots of iron and manganese; gradual, smooth boundary.

IIIR—42 inches, unweathered dolomitic limestone.

The deep Dubuque silt loams vary mainly in the thickness of loess over clay and in the thickness of the red clay over limestone. In cultivated fields the surface layer is very dark grayish brown to dark grayish brown (10YR 3/2 to 4/2).

ETTRICK SERIES

The soils in the Ettrick series are very poorly drained. They belong to the Humic Gley great soil group. These soils formed in deep, silty alluvium along the bottoms of streams. The alluvium was carried by streams from uplands that were mantled with silt and underlain by limestone or sandstone. The original vegetation was grasses, sedges, reeds, and other water-tolerant plants.

These soils are near the Orion and Wallkill soils. They are also near areas of the miscellaneous land types of Loamy alluvial land and areas of the organic Peat and muck soils. The Ettrick soils have less variable soil characteristics than the miscellaneous land types. They are darker colored and more poorly drained than the Orion soils. Unlike the Wallkill soils, they lack deposits of organic material below the solum.

The following describes a representative profile of Ettrick silt loam, coarse silt substratum (NE¼SE¼ sec. 36, T. 25 N., R. 13 W.):

Ap—0 to 8 inches, black (10YR or 2.5Y 2/1) silt loam; massive in the upper part of this horizon, but moderate, fine and medium, granular structure in the lower part; friable; high content of organic matter; roots abundant; mildly alkaline; abrupt, smooth boundary.

A12—8 to 15 inches, black (10YR or 2.5Y 2/1) silty clay loam; moderate, fine, subangular blocky structure; friable; roots abundant; mildly alkaline; clear, smooth boundary.

C1g—15 to 36 inches, dark-gray to gray (5Y 4/1 to 5/1) silty clay loam; massive, but breaks to weak, medium, subangular blocky structure; firm when moist, and slightly hard when dry; a few roots; mildly alkaline; clear, wavy boundary.

C2g—36 inches +, gray (5Y 5/1) coarse silt; massive; friable; mildly alkaline.

The A1 horizon is 10 to 15 inches thick, and in places has a thin covering of peat or of muck. Depth to massive, coarse, silty material ranges from 20 to 36 inches, and in places there are thin strata of fine sand within this depth. The water table is at or near the surface unless it has been lowered by ditching. Frequency of flooding is variable.

FAYETTE SERIES

The Fayette series consists of deep, well-drained soils of the Gray-Brown Podzolic great soil group. These soils formed in deposits of loess, 42 or more inches thick, on undulating to rolling uplands underlain by limestone and sandstone. The original vegetation was a deciduous forest of oak, hard maple, and hickory.

The Fayette silt loams, uplands, are associated with the Seaton, Norden, Gale, Dubuque, and Downs soils. They formed in finer textured loess than the Seaton soils and have a finer textured B horizon. The material underlying Fayette silt loams, uplands, is at a greater depth than that underlying the Norden and Gale soils, which are underlain by sandstone, or than that underlying the Dubuque soils, which are underlain by limestone residuum and limestone. Fayette silt loam, uplands, formed in parent material similar to that of the Downs soils and in similar positions, but their surface layer is lighter colored and thinner.

Fayette silt loams, valleys, are near the upland Fayette silt loams and are similar to them, but their subsoil and substratum are somewhat coarser textured. Also, they have less structural development in the B horizon, a few fragments of sandstone and limestone in the solum, and in places sand is mixed in the surface layer.

The following describes a representative profile of a Fayette silt loam, uplands, in an undisturbed area (NE¼ SW¼ sec. 29, T. 25 N., R. 11 W.):

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, very fine, crumb structure; friable; many, fine, fibrous roots; slightly acid; abrupt, smooth boundary.

A2—3 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, very thin, platy structure; vesicular; friable; many, fine, fibrous roots; slightly acid; clear, smooth boundary.

B1—9 to 14 inches, dark-brown (10YR 4/3) silt loam; moderate, fine, subangular blocky structure, but weak, thick, platy in the undisturbed horizon; vesicular; firm; thin coatings of bleached silt on the faces of peds; strongly acid; clear, smooth boundary.

B21—14 to 22 inches, dark-brown (10YR 4/3) heavy silt loam; strong, fine and very fine, subangular blocky structure, but weak, very thick, platy structure in the undisturbed horizon; firm; thin coats of bleached silt and intermittent, thin films of clay on the faces of peds; strongly acid; gradual, smooth boundary.

B22—22 to 32 inches, dark-brown (10YR 4/3) heavy silt loam; strong, fine and medium, subangular blocky structure, but generally weak, thick, platy structure throughout the undisturbed horizon; firm; many, thin clay films on the faces of peds; strongly acid; gradual, smooth boundary.

B23—32 to 40 inches, dark-brown (10YR 4/3) heavy silt loam; moderate, medium, subangular blocky structure, but generally weak, thick, platy structure throughout the undisturbed horizon; vesicular; firm; a few, thin clay films on the faces of peds; strongly acid; gradual, smooth boundary.

B3—40 to 52 inches, brown (10YR 5/3) silt loam; weak, coarse, subangular blocky structure, but generally weak, platy structure throughout the undisturbed horizon; vesicular; friable; a few, thin clay films on the faces of peds; strongly acid, but medium acid at lower boundary of this horizon; diffuse, smooth boundary.

C—52 to 72 inches +, brown (10YR 5/3) silt loam; vesicular; massive; a few, fine, prominent mottles of strong brown (7.5YR 5/8) at a depth below 72 inches; slightly acid, but neutral to slightly alkaline at a depth of 72 inches.

The color of the Ap horizon ranges from very dark grayish brown to dark grayish brown (10YR 3/2 to 4/2), and that of the A1 horizon, from very dark grayish brown to black (10YR 3/2 to 2/1). The thickness of the solum ranges from 36 to 55 inches. In the B horizon the content of clay ranges from 24 to 35 percent.

GALE SERIES

The Gale series is made up of moderately deep, well-drained soils of uplands. The soils belong to the Gray-Brown Podzolic great soil group. They formed in 24 to 42 inches of loess. These soils are rolling to hilly and are mostly in the eastern part of the county. The lower part of the solum contains some sandy fragments weathered from the underlying sandstone. The original vegetation was a forest of hardwoods.

The Gale soils are associated with the Fayette, Hixton, Boone, and Norden soils. They are similar to the Fayette soils, but they formed in a thinner mantle of loess. In contrast to the Hixton and Boone soils, they formed mostly in loess rather than in residuum from sandstone. The Gale soils are similar to the Norden soils, but the Norden soils developed from fine-grained, glauconitic parent materials.

The following describes a representative profile of a Gale silt loam in a cultivated field (NE¼NE¼ sec. 35, T. 25 N., R. 11 W.):

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, subangular blocky structure in place, but breaks readily to moderate, fine, granular; friable; roots abundant; medium acid; abrupt, smooth boundary.

A2—7 to 13 inches, brown and dark-brown (10YR 5/3 and 4/3) silt loam; moderate and medium, thin, platy structure; friable; roots plentiful; medium acid; clear, wavy boundary.

B1—13 to 18 inches, dark-brown (10YR 4/3) heavy silt loam; weak and moderate, fine and medium, subangular blocky structure; friable; a few grayish-brown (10YR 5/2) bleached silt coats on peds; roots plentiful; medium acid; clear, wavy boundary.

B2—18 to 28 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, fine and medium, subangular blocky structure; firm when moist, and slightly hard when dry; a few grayish-brown (10YR 5/2), bleached silt coats; roots plentiful; strongly acid; clear, wavy boundary.

B3—28 to 31 inches, dark yellowish-brown (10YR 4/4) gritty silty clay loam; moderate, medium, subangular blocky structure; the blocks have dark-brown (10YR 3/3) coats, and a few grayish-brown (10YR 5/2), bleached silt coats; firm when moist, and slightly hard when dry; roots plentiful; strongly acid; clear, wavy boundary.

IIR—31 inches +, partly weathered sandstone that ranges from white to yellow (10YR 8/2 to 7/8) in color; massive in place, but breaks to single grain; no roots; strongly acid.

The Gale soils vary mainly in depth to underlying sand or sandstone. The mantle of loess ranges from 24 to 42 inches in thickness, but it is commonly 30 to 36 inches thick. The texture of the B3 horizon is loam in places. The Ap horizon is very dark grayish brown to dark grayish brown (10YR 3/2 to 4/2), but in undisturbed areas the A1 horizon is darker colored.

GOTHAM SERIES

In the Gotham series are deep and somewhat excessively drained soils. They belong to the Brunizem great soil group, but they are intergrading toward Gray-Brown Podzolic soils. These soils formed in sandy outwash on stream terraces. They are level to undulating. The parent materials were derived partly from local sandstone formations. The original vegetation was a mixture of grasses and hardwoods.

These soils are near the Hubbard, Sparta, and Plainfield soils. Their A horizon is lighter colored than that of the Hubbard soils and is intermediate in color between that of the Sparta and Plainfield soils. Also, unlike the Sparta and Plainfield soils, the Gotham have a weakly developed textural B horizon. The Gotham soils have a thicker, darker colored A horizon and coarser texture than the Meridian soils.

The following describes a representative profile of a Gotham loamy fine sand in a cultivated field (NW¼ NW¼ sec. 12, T. 25 N., R. 11 W.):

A1—0 to 10 inches, very dark grayish-brown to dark-brown (10YR 3/2 to 3/3) loamy fine sand; weak, fine granular structure; very friable; medium acid; clear, smooth boundary.

A3—10 to 14 inches, dark-brown (10YR 4/3) loamy fine sand; weak, medium, subangular blocky structure; very friable; strongly acid; gradual, wavy boundary.

B2—14 to 22 inches, dark yellowish-brown (10YR 4/4) loamy fine sand; weak, coarse and medium, subangular blocky structure; very friable; strongly acid; gradual, smooth boundary.

B3—22 to 30 inches, yellowish-brown (10YR 5/4) loamy fine sand; weak, coarse, subangular blocky structure; very friable; strongly acid; gradual, smooth boundary.

C—30 inches +, yellowish-brown to light yellowish-brown (10YR 5/4 to 6/4) sand; single grain; loose; strongly acid.

The Gotham soils vary chiefly in the color and thickness of the A horizon. In color the soils range from very dark brown to very dark grayish brown (10 YR 2/2 to 3/2), and in thickness, from 10 to 14 inches. The solum is 24 to 36 inches thick. In places, at a depth between 3 and 6 feet, there are fine-textured strata that are less than 1 inch to as much as 3 inches thick.

HIXTON SERIES

The soils of the Hixton series are moderately deep and are well drained. They belong to the Gray-Brown Podzolic great soil group. These soils formed on uplands in residuum derived from medium- to coarse-textured, nonglauconitic sandstone. The original vegetation was a deciduous forest made up mainly of oak and hickory.

Hixton soils are associated with the Norden, Gale, and Boone soils. The sandstone underlying the Hixton soils differs from that underlying the Norden soils, which is glauconitic. The Hixton soils are coarser textured than the Gale soils. They are finer textured than the Boone soils. Unlike the Boone soils, they have a textural B horizon.

The following describes a representative profile of a Hixton fine sandy loam in a cultivated field:

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) fine sandy loam; weak, medium, granular structure; very friable; medium acid; clear, smooth boundary.

B1—5 to 8 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; weak, fine, subangular blocky structure; friable; medium acid; clear, smooth boundary.

B2—8 to 22 inches, dark-brown (7.5YR 4/4) loam; moderate, medium, subangular blocky structure; friable; very strongly acid; clear, smooth boundary.

B3—22 to 27 inches, strong-brown (7.5YR 5/6) fine sandy loam; weak, coarse, subangular blocky structure; very friable; very strongly acid; gradual, smooth boundary.

C—27 to 36 inches, yellowish-brown (10YR 5/8) fine sand; single grain; loose; a few roots; very strongly acid; gradual, smooth boundary.

IIR—36 inches +, broken and partly weathered sandstone.

In cultivated areas the color of the surface layer ranges from very dark grayish brown to dark grayish brown (10YR 3/2 to 4/2), but in undisturbed areas the color may be darker. The solum ranges from 22 to 36 inches in thickness. Depth to bedrock ranges from 2 to 4 feet. The texture of the B horizon ranges from loam to sandy loam. Varying amounts of sandstone fragments occur throughout the profile.

HUBBARD SERIES

The Hubbard series consists of deep, somewhat excessively drained soils. These level to undulating soils formed under prairie in sandy outwash on broad stream terraces. They belong to the Brunizem great soil group.

These soils are associated with Dakota, Sparta, Gotham, and Burkhardt soils. They are coarser textured than the Dakota soils and have less clay in the B horizon. Unlike the Sparta soils, they have a weakly developed textural B horizon. Their A horizon is darker than that in the Gotham soils. The Hubbard soils have fewer pebbles in the profile, less clay in the B horizon, and a thicker solum than the Burkhardt soils.

The following describes a representative profile of a Hubbard loamy fine sand in a cultivated field (SE¼SE¼ sec. 13, T. 25 N., R. 13 W.):

Ap—0 to 8 inches, very dark brown (10YR 2/2) loamy fine sand; weak, medium, granular structure; very friable; mildly alkaline; gradual, smooth boundary.

A12—8 to 15 inches, black to very dark brown (10YR 2/1 to 2/2) loamy fine sand; weak, coarse, subangular blocky structure; very friable; medium acid; gradual, smooth boundary.

A3—15 to 21 inches, very dark brown (7.5YR 2/2) loamy fine sand; weak, medium and coarse, subangular blocky structure; very friable; medium acid; gradual, smooth boundary.

B1—21 to 27 inches, very dark brown to dark brown (7.5YR 2/2 to 3/2) heavy loamy fine sand; weak, medium, subangular blocky structure; very friable; medium acid; gradual, smooth boundary.

B2—27 to 35 inches, dark-brown (7.5YR 3/2), heavy loamy fine sand; weak, medium, subangular blocky structure; very friable; medium acid; gradual, smooth boundary.

C1—35 to 42 inches, yellowish-brown (10YR 5/6) fine sand; single grain; loose; medium acid; gradual, smooth boundary.

C2—42 inches +, yellowish-brown to dark-brown (10YR 5/4 to 7.5YR 4/4) medium sand; single grain; loose; medium acid.

The thickness of the solum ranges from 24 to 36 inches.

HUNTSVILLE SERIES

In the Huntsville series are well drained to moderately well drained soils. They belong to the Alluvial great soil group. These soils formed in deep, dark-colored, silty alluvium, washed from uplands that were mantled with loess. They are on the broad flood plains of major streams and on the narrow bottoms of smaller streams. In Pepin County these soils are mostly on narrow bottoms.

These soils formed in positions similar to those occupied by the Arenzville soils and in alluvium of similar texture, but they have a darker colored A horizon.

The following describes a representative profile of a Huntsville silt loam in a cultivated field (NE¼NE¼ sec. 20, T. 25 N., R. 14 W.):

Ap—0 to 8 inches, very dark brown (10YR 2/2) silt loam; weak, medium to fine, subangular blocky structure; very friable; abundant roots; numerous wormcasts; mildly alkaline; clear, smooth boundary.

A12—8 to 14 inches, very dark brown (10YR 2/2) silt loam; weak, thick, platy structure that breaks to weak, fine, subangular blocky; very friable, abundant roots; mildly alkaline; gradual, smooth boundary.

A3—14 to 20 inches, dark-brown (10YR 3/3) silt loam; weak, medium, platy structure; friable; plentiful roots; mildly alkaline; gradual, smooth boundary.

C1—20 to 42 inches, dark-brown (10YR 3/4) silt loam; weak, thick, platy structure; friable; plentiful roots; mildly alkaline; gradual, smooth boundary.

C2—42 inches +, dark yellowish-brown (10YR 3/4 to 4/4) stratified silt and very fine sand; mildly alkaline.

The A horizon ranges from 12 to 36 inches in thickness. There are thin layers of fine sand in places throughout the profile. In places there is a thin layer of sandy overwash on the surface. This soil is slightly mottled in places.

JACKSON SERIES

The Jackson series consists of deep soils that are moderately well drained. These soils belong to the Gray-Brown Podzolic great soil group. They formed on stream terraces in silt that was more than 42 inches thick. The native vegetation was a deciduous forest made up mainly of oak, hard maple, and hickory.

The Jackson soils are associated with the well-drained Bertrand soils and the somewhat poorly drained Curran soils. All of these soils have similar parent materials.

The following describes a representative profile of a Jackson silt loam in a cultivated field (SW¼NE¼ sec. 15, T. 25 N., R. 14 W.):

Ap—0 to 8 inches, very dark grayish-brown to dark-gray (10YR 3/2 to 4/1) silt loam; moderate, medium, granular structure; very friable; slightly acid; clear, smooth boundary.

A2—8 to 11 inches, dark-gray to dark grayish-brown (10YR 4/1 to 4/2) silt loam; moderate, thin, platy structure; very friable; slightly acid; clear, smooth boundary.

B1—11 to 16 inches, dark yellowish-brown (10YR 3/4) silt loam; weak, medium, platy structure, in place, that breaks to moderate, very fine, subangular blocky; moderately vesicular; friable; very dark grayish-brown and very dark brown (10YR 3/2 and 2/2) coats of organic matter on the peds; medium acid; clear, smooth boundary.

B2—16 to 32 inches, dark-brown (10YR 4/3) silty clay loam; moderate, fine and medium, subangular blocky structure; moderately vesicular; firm when moist, and slightly hard when dry; very dark grayish-brown (10YR 3/2) stains from organic matter and a few bleached silt coats on the peds; many, fine, distinct mottles of strong brown to brown (7.5YR 4/6 to 5/4); medium acid; clear, smooth boundary.

B3—32 to 37 inches, yellowish-brown (10YR 5/4) light silty clay loam; weak, medium, subangular blocky structure; firm when moist, and slightly hard when dry; many, fine, distinct mottles of dark brown (7.5YR 4/4) and a few, large, prominent mottles of yellowish red and dark reddish brown (5YR 3/4 and 4/6); medium acid; gradual, smooth boundary.

C—37 inches +, brown to yellowish-brown (10YR 5/3 to 5/4) silt loam; friable; massive; many, distinct, medium mottles of yellowish red to yellowish brown (5YR 4/6 to 10YR 5/6); medium acid.

The color of the Ap horizon is generally very dark grayish brown (10YR 3/2), but in places it is very dark gray (10YR 3/1) or dark gray (10YR 4/1). The position and degree of mottling in the profile vary slightly. The thickness of the solum ranges from 32 to 42 inches. In places these soils are underlain by stratified sand at a depth of more than 42 inches.

JUDSON SERIES

The soils in this series are well drained. They belong to the Brunizem great soil group but are intergrading toward Alluvial soils. These soils formed in deep, dark-colored, silty alluvium. The alluvium washed or rolled, because of erosion or soil creep, from uplands covered with loess and underlain by limestone and sandstone. The areas are small. They are in draws, at the ends of draws, and along the foot slopes of steep soils.

These soils are darker colored than the Chaseburg soils, which occupy similar positions. Unlike the nearby Lindstrom soils of the uplands, the Judson soils lack a textural B horizon. The parent materials of the Judson soils show less particle sorting than the parent materials of the Huntsville soils.

The following describes a representative profile of a Judson silt loam in a cultivated field (NE¼NE¼ sec. 36, T. 25 N., R. 13 W.):

Ap—0 to 7 inches, very dark brown (10YR 2/2) silt loam; weak, fine, subangular blocky structure; very friable; neutral; abrupt, smooth boundary.

A3—7 to 16 inches, very dark brown (10YR 2/2) silt loam; weak, medium, platy structure that breaks to weak, very fine and fine, subangular blocky; friable; neutral; clear, smooth boundary.

C1—16 to 27 inches, very dark grayish-brown to dark grayish-brown (10YR 3/2 to 4/2) silt loam; weak, thick, platy structure that breaks to weak, fine, subangular blocky; very friable; medium acid; clear, smooth boundary.

C2—27 inches +, dark grayish-brown (10YR 4/2) silt loam; weak, very thick, platy structure that breaks to weak, medium, subangular blocky; friable; strongly acid.

The color of the A horizon ranges from black to very dark brown (10YR 2/1 to 2/2), and the thickness ranges from 12 to 36 inches. In places there is a thin layer of sandy overwash and of pebbles or small stones on the surface.

LINDSTROM SERIES

The soils of the Lindstrom series are deep and silty and are well drained. They belong to the Brunizem great soil group. These soils formed under prairie in silty materials, mainly loess, on valley slopes.

The parent material in which these soils formed is similar to that of Seaton and Fayette valley soils, and these soils occupy similar positions. They have a thicker, darker A horizon than those soils.

The following describes a representative profile of a Lindstrom silt loam in a cultivated field (SW¼NW¼ sec. 17, T. 24 N., R. 14 W.):

Ap—0 to 8 inches, very dark brown to black (10YR 2/2 to 2/1) silt loam; moderate, medium, granular structure; very friable; roots abundant; clear, smooth boundary.

A12—8 to 12 inches, very dark brown to black (10YR 2/2 to 2/1) silt loam; moderate, medium, granular structure that grades to weak, thin, platy in the lower part; very friable; roots abundant; slightly acid; gradual, smooth boundary.

B1—12 to 17 inches, dark-brown (10YR 3/3) silt loam; moderate, fine and medium, subangular blocky structure; light-gray (10YR 7/2), moist, fine, bleached silt coats on the peds; highly vesicular; friable; roots plentiful; many wormholes and root channels; medium acid; gradual, smooth boundary.

B21—17 to 25 inches, dark-brown to dark yellowish-brown (10YR 3/3 to 3/4) light silty clay loam; moderate, medium, subangular blocky structure; light-gray (10YR 7/2), fine, bleached silt coats on the peds; highly vesicular; friable; roots plentiful; many wormholes and root channels; a few, small, sandstone fragments; medium acid; gradual, smooth boundary.

B22—25 to 35 inches, dark yellowish-brown (10YR 3/4) light silty clay loam; moderate, fine and medium, subangular blocky structure; light-gray (10YR 7/2), bleached silt coats on the peds; highly vesicular; firm; roots plentiful; many wormholes and channels; slightly acid; gradual, smooth boundary.

B3—35 to 42 inches, dark-brown to dark yellowish-brown (10YR 4/3 to 3/4) light silty clay loam; weak, medium, subangular blocky structure; firm; roots plentiful; a few, medium, distinct mottles of yellowish brown and grayish brown (10YR 5/6 and 5/2); no roots in the lower part of this horizon; slightly acid; gradual, smooth boundary.

C—42 inches +, dark yellowish-brown (10YR 4/4), friable silt loam; massive.

The A horizon is generally very dark brown or black (10YR 2/2 or 2/1). In cultivated areas, however, material from the subsoil has been mixed in the A horizon in places, and there the A horizon is very dark grayish brown (10YR 3/2). In places the surface layer and the upper part of the solum contain small amounts of coarse-textured material that washed or rolled from higher lying areas of sandstone outcroppings.

MEDARY SERIES

The soils of the Medary series are well drained to moderately well drained. They belong to the Gray-Brown Podzolic great soil group. These soils formed on stream terraces in thick deposits of silt and clay. The upper part of the solum formed in loess, and the lower part, in reddish lacustrine silt and clay. The original vegetation was a forest of hardwoods.

These soils are associated with the poorly drained to very poorly drained Zwingle soils and have similar parent materials. Their parent materials are finer textured and more reddish than those of the Bertrand and Jackson soils.

The following describes a representative profile of a Medary silt loam in a cultivated field (SE¼SW¼ sec. 18, T. 23 N., R. 14 W.):

Ap—0 to 8 inches, very dark grayish-brown to very dark gray (10YR 3/2 to 3/1) silt loam; moderate, fine, granular structure; friable; neutral; clear, smooth boundary.

A21—8 to 11 inches, dark grayish-brown (10YR 4/2) silt loam; weak, thin, platy structure; friable; neutral; gradual, smooth boundary.

A22—11 to 13 inches, dark-brown (7.5YR 4/2) heavy silt loam; strong, thin and medium, platy structure; thin, fine, gray silt coats on the surfaces of the plates; firm; neutral; clear, smooth boundary.

IIB1—13 to 18 inches, reddish-brown (5YR 4/3) silty clay loam; moderate, medium and thick, platy structure in place that breaks to strong, fine, angular blocky; thin, fine, bleached silt coats on the vertical faces of the blocks; firm when moist, and slightly sticky when wet; a few, fine, faint mottles; slightly acid; gradual, smooth boundary.

IIB21—18 to 25 inches, reddish-brown (5YR 4/4) silty clay; strong, fine, angular blocky structure; thin, patchy, bleached silt coats on the vertical faces of the blocks, and thin, low-contrast clay films surrounding the blocks; very firm when moist, and sticky when wet; a few, fine, dark stains of manganese beneath the clay coats; medium acid; gradual, smooth boundary.

IIB22—25 to 29 inches, dark reddish-gray (5YR 4/2) silty clay; strong, fine, angular blocky structure; thick, continuous clay films on the blocks; dark stains of manganese more numerous than in the B2 horizon; very firm when moist, and sticky when wet; common, fine, distinct mottles in the lower part of this horizon; slightly acid; clear, smooth boundary.

IIB3—29 to 36 inches, dark-brown (7.5YR 5/2) silty clay loam; weak, very thick, platy structure in place that breaks to moderate, fine, angular blocky; firm when moist, and slightly sticky when wet; common, medium, prominent mottles of dark brown to dark yellowish brown (7.5YR 4/4 to 10YR 4/4) and of brownish yellow to olive yellow (10YR 6/6 to 2.5Y 6/6); mildly alkaline; gradual, smooth boundary.

IIIC—36 inches +, grayish-brown (10YR 5/2) silt; weak, medium and thick, platy structure; friable; moderately alkaline.

The thickness of the deposit of loess ranges from 12 to 24 inches. The lacustrine materials are made up mainly of silt and clay, but in places they contain thin strata of fine sand. Mottling in most places is slight or is lacking.

MERIDIAN SERIES

The soils in the Meridian series are well drained. They belong to the Gray-Brown Podzolic great soil group. These soils formed in sandy and loamy outwash on stream terraces. They are underlain by loose, stratified sand at a depth between 24 and 36 inches. The original vegetation was a deciduous forest made up mainly of oak.

These soils are associated with the Gotham soils, but they have a finer textured B horizon than those soils and a thinner, lighter colored A horizon. In places the Meridian soils are near the sandy Plainfield soils. They are also near the Dakota soils and formed in parent materials similar to that of those soils, but they have a thinner, lighter colored A horizon.

The following describes a representative profile of a Meridian fine sandy loam in a cultivated field (NW¼SW¼ sec. 24, T. 25 N., R. 13 W.):

Ap—0 to 8 inches, very dark grayish-brown to dark grayish-brown (10YR 3/2 to 4/2) fine sandy loam; weak, fine, granular and moderate, medium, subangular blocky structure; very friable; neutral; clear, smooth boundary.

A2—8 to 11 inches, dark grayish-brown (10YR 4/2) fine sandy loam; moderate, medium, platy structure; very friable; slightly acid; clear, smooth boundary.

B2—11 to 25 inches, dark yellowish-brown (10YR 4/4) loam; moderate, medium, subangular blocky structure; firm, slightly hard when dry; moderately vesicular; thin, dark-brown (10YR 3/3) clay films on the surfaces of peds; medium acid; gradual, smooth boundary.
B3—25 to 28 inches, yellowish-brown (10YR 5/4) fine sandy loam; weak, medium, subangular blocky structure; very friable; medium acid; gradual, smooth boundary.
IIC—28 inches +, yellowish-brown (10YR 5/4) sand; single grain; loose.

The surface layer ranges from very dark grayish brown to dark grayish brown (10YR 3/2 to 4/2). The texture of the subsoil ranges from heavy sandy loam to loam. In places the sandy substratum contains thin strata of finer textured materials.

MOROCCO SERIES

The Morocco series is made up of somewhat poorly drained, nearly level soils. These soils formed in deep, sandy outwash on stream terraces. They belong to the Regosol great soil group but are intergrading toward Low-Humic Gley soils. The original vegetation was a forest of hardwoods.

These soils are associated with the excessively drained Plainfield soils and the moderately well drained Dillon soils.

The following describes a representative profile of a Morocco loamy fine sand in a cultivated field (NW¼NE¼ sec. 17, T. 25 N., R. 11 W.):

Ap—0 to 8 inches, very dark grayish-brown to dark-brown (10YR 3/2 to 3/3) loamy fine sand; weak, coarse, subangular blocky structure; very friable; medium acid; abrupt, smooth boundary.
A3—8 to 13 inches, brown (10YR 5/3) loamy fine sand; weak, medium, subangular blocky structure; very friable; common, medium, distinct mottles of dark yellowish brown to light brownish gray (10YR 4/4 to 6/2); strongly acid; clear, smooth boundary.
C1—13 to 23 inches, brown to grayish-brown (10YR 5/3 to 5/2) loamy fine sand; weak, medium, subangular blocky structure; very friable; common, medium, distinct mottles of dark yellowish brown to light brownish gray (10YR 4/4 to 6/2); strongly acid; clear, smooth boundary.
C2—23 to 36 inches, pale-brown (10YR 6/3) fine sand; single grain; loose; strongly acid; gradual, diffuse boundary.
C3—36 inches +, light yellowish-brown to yellowish-brown (10YR 6/4 to 5/4) fine sand; single grain; loose; medium acid.

There are slight variations in the position of the mottles in the profile and in the intensity of mottling.

NORDEN SERIES

The Norden series consists of moderately deep, well-drained soils of the uplands. These soils formed under a forest made up mainly of oaks. They belong to the Gray-Brown Podzolic great soil group. These soils are underlain by greenish, glauconitic sandstone. Depth to the sandstone ranges from 20 to 42 inches.

The Norden soils are associated with the shallower Urne soils, and they are also associated with the Hixton, Gale, Northfield, and Boone soils. The sandstone that underlies the Norden soils is different from that underlying the Northfield, Hixton, and Gale soils, which is nonglauconitic.

The Norden fine sandy loams are sloping to hilly. They are near the finer textured Norden soils and are also near the variants from the normal Norden series.

The following describes a representative profile of a Norden fine sandy loam in a cultivated field (NE¼NE¼ sec. 9, T. 25 N., R. 11 W.):

Ap—0 to 8 inches, dark-brown (10YR 3/3) fine sandy loam; weak, medium, granular structure; very friable; medium acid; clear, smooth boundary.
B1—8 to 13 inches, dark-brown (7.5YR 4/4) fine sandy loam to very fine sandy loam; moderate, fine and medium, subangular blocky structure; very friable; strongly acid; clear, smooth boundary.
B2—13 to 28 inches, light olive-brown, (2.5Y 5/6) loam; moderate, fine, subangular blocky structure; firm; strongly acid; gradual, smooth boundary.
B3—28 to 36 inches, light olive-brown (2.5Y 5/4) very fine sandy loam; week, medium, subangular blocky structure; friable; strongly acid; gradual, smooth boundary.
IIR—36 inches +, partly weathered, greenish, fine-grained sandstone.

In areas of Norden fine sandy loams, the horizons vary considerably in color, depending on the composition of the parent sandstone and on how much the sandstone has weathered. The Ap horizon typically is dark grayish brown (10YR 4/2), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3), but in places, it is greenish or reddish. The thin, undisturbed A1 horizon is darker than normal in places. In places the subsoil is fine sandy loam. The solum ranges from 20 to 36 inches in thickness.

The Norden loams formed on rolling to hilly uplands in residuum that was less than 42 inches thick. They are associated with the shallow Urne soils and with the Norden fine sandy loams and silt loams. In depth they are similar to the Hixton soils, which formed in yellowish, nonglauconitic sandstone.

The following describes a representative profile of a Norden loam in an undisturbed area (NW¼SE¼ sec. 35, T. 25 N., R. 11 W.):

A1—0 to 2 inches, black (10YR 2/1) loam; weak, medium, granular structure; very friable; neutral; clear, smooth boundary.
A2—2 to 12 inches, dark grayish-brown (10YR 4/2) loam to very fine sandy loam; weak, thin, platy structure; very friable; slightly acid; clear, smooth boundary.
B1—12 to 18 inches, dark yellowish-brown (10YR 4/4) very fine sandy loam; moderate, fine, subangular blocky structure; friable; medium acid; gradual, smooth boundary.
B2—18 to 27 inches, olive-brown to dark yellowish-brown (2.5Y 4/4 to 10YR 4/4) gritty silt loam; moderate, fine and medium, subangular blocky structure; firm, slightly hard; medium acid; gradual, smooth boundary.
B3—27 to 36 inches, olive-brown (2.5Y 4/4) very fine sandy loam to silt loam; weak, medium, subangular blocky structure; slightly hard when dry, firm when moist; medium acid; gradual, smooth boundary.
IIR—36 inches +, partly weathered, light olive-brown (2.5Y 5/4 and 5/6) glauconitic sandstone; the strata vary in color and texture and range from sandstone to siltstone; material easily crushed.

In areas of Norden loam that have been cultivated, the surface layer ranges from dark grayish brown to very dark grayish brown (10YR 4/2 to 3/2). The thickness of the solum ranges from 24 to 36 inches. Depth to bedrock ranges from 28 to 42 inches.

Norden silt loams are on rolling to hilly uplands. The A horizon and the upper part of the B horizon formed in loess, and the remainder of the profile formed in residuum from sandstone. Norden silt loams are associated with the shallow Urne soils and with the Norden fine sandy loams and loams. They are similar to the Gale soils but are underlain by glauconitic sandstone. The Gale soils are underlain by yellowish, nonglauconitic sandstone.

The following describes a representative profile of a Norden silt loam in an undisturbed area (NW¼SW¼ sec. 22, T. 25 N., R. 14 W.):

A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, crumb structure; very friable; many, coarse, fibrous roots; neutral; clear, wavy boundary.

A21—4 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; weak, very thin, platy structure; very friable; many, coarse, fibrous roots; medium acid; abrupt, wavy boundary.

A22—6 to 10 inches, grayish-brown (10YR 5/2) silt loam; weak, very thin, platy structure; very friable; strongly acid; fibrous roots common; clear, wavy boundary.

B1—10 to 16 inches, dark-brown (10YR 4/3) silt loam; moderate, medium and thin, platy structure that, if disturbed, breaks readily to moderate, very fine, subangular blocky; vesicular; friable; strongly acid; a few, coarse and a few, fibrous roots; clear, smooth boundary.

B21—16 to 23 inches, dark-brown (10YR 4/3) heavy silt loam; moderately strong, fine, angular blocky structure; thin coats of bleached silt on the faces of most peds; strongly acid; a few, coarse roots; clear, smooth boundary.

B22—23 to 27 inches, dark-brown (10YR 4/3) light silty clay loam; strong, coarse, subangular blocky peds that break readily, if disturbed, to moderately strong, medium, angular blocky; continuous coats of bleached silt along the primary vertical cleavage planes; most inner faces of the peds of the compound structural form have dark-brown (10YR 3/3) coats and occasional clay films; a few, coarse roots; strongly acid; clear, smooth boundary.

B23—27 to 30 inches, yellowish-brown (10YR 5/6) silty clay loam; moderately strong, medium, angular blocky structure; dark-brown (10YR 3/3) clay films less than 1 millimeter thick on many faces of the peds; firm; medium acid; clear, smooth boundary.

B3—30 to 34 inches, dark-brown (10YR 3/3) clay loam; weak, medium, subangular blocky structure; the structural peds have yellowish-brown (10YR 5/6) interiors and thick, dark-brown (10YR 3/3) coats; the faces of the peds are coated with continuous clay films that are 1 to 5 millimeters thick and are thickest along vertical cleavage planes; firm; slightly acid; gradual, smooth boundary.

IIC—34 to 41 inches, light olive-brown (2.5YR 5/4), fine-textured residuum from glauconitic sandstone and siltstone; an occasional olive (5Y 4/4) lens rich in glauconite; massive to very weak, thick, platy structure; neutral; gradual, smooth boundary.

IIR—41 to 48 inches +, pale-olive (5Y 6/3) sandstone; intermittent, green (5G 4/10) lenses of glauconitic material; the sandstone is interlayered with an occasional lens of siltstone; indurated and thinly bedded; neutral.

In areas of Norden silt loam that have been cultivated, the A horizon generally ranges from dark grayish brown to very dark grayish brown (10YR 4/2 to 3/2). The B horizon is 20 to 30 inches thick. It is silt loam or silty clay loam and has moderate or strong structure. The amount of glauconitic material in the B horizon varies somewhat, but one-third to one-half of the B horizon normally contains material weathered from the glauconitic sandstone. Because of this glauconitic material, the lower part of the B horizon has a greenish color in places. In some places in the B3 horizon, the clay films have a color and texture that resemble those in limestone residuum. Depth to the underlying sandstone ranges from 36 to 42 inches.

NORDEN SERIES, DARK SURFACE VARIANT

The soils of this variant from the normal Norden series are moderately deep and are well drained. These rolling soils formed under prairie on uplands in residuum from fine-grained, greenish sandstone of the Franconia formation. They belong to the Brunizem great soil group.

These soils are associated with soils of the Norden series. They differ mainly in having a thicker, darker surface layer.

The following describes a representative profile of a Norden fine sandy loam, dark surface variant, in a cultivated field (NE¼NW¼ sec. 15, T. 25 N., R. 12 W.):

Ap—0 to 8 inches, very dark brown (10YR 2/2) fine sandy loam; moderate, medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A12—8 to 11 inches, black (10YR 2/1) fine sandy loam; moderate, medium, granular structure; very friable; medium acid; clear, wavy boundary.

B2—11 to 18 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; moderate, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B3—18 to 24 inches, yellowish-brown (10YR 5/4 to 5/6) fine sandy loam; moderate, thick, platy structure; very friable; partly weathered, fine-grained chips of sandstone; medium acid; clear, irregular boundary.

IIR—24 inches +, yellowish-brown to olive (10YR 5/6 to 5Y 4/4), fine-grained sandstone that contains layers of shale and siltstone and varying amounts of glauconite; the various layers in the sandstone range from slightly acid to strongly acid.

Depth to bedrock ranges from 15 to 36 inches.

NORTHFIELD SERIES

The soils in the Northfield series are gently sloping and are well drained. They belong to the Gray-Brown Podzolic great soil group. These soils formed in residuum, 12 to 24 inches thick, that weathered from fine-grained, platy sandstone. They are on low ridges in the uplands. The original vegetation was a deciduous forest made up mainly of oak.

These soils are associated with the Boone, Hixton, and Gale soils. The sandstone underlying the Northfield soils is different from that underlying those soils. The Northfield soils are finer textured than the Boone soils. They have a thinner solum than the Gale soils or the moderately deep Hixton soils. Also, they lack the silty parent materials of the Gale soils.

The following describes a representative profile of a Northfield very fine sandy loam in a cultivated field (NW¼SW¼ sec. 12, T. 25 N., R. 12 W.):

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) very fine sandy loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—9 to 12 inches, dark grayish-brown (10YR 4/2) very fine sandy loam; moderate, medium, platy structure; very friable; slightly acid; clear, smooth boundary.

B2—12 to 14 inches, dark-brown (10YR 4/3) very fine sandy loam; moderate, thick, platy structure; friable; medium acid; clear, smooth boundary.

B3—14 to 18 inches, dark-brown to yellowish-brown (10YR 4/3 to 5/4) very fine sandy loam; weak, thick, platy structure; friable; medium acid; clear, smooth boundary.

IIR—18 inches +, yellowish-brown (10YR 5/4), platy, resistant, sandstone bedrock.

The surface layer ranges from very dark grayish brown to dark grayish brown (10YR 3/2 to 4/2). Depth to bedrock ranges from 12 to 24 inches.

ORION SERIES

The Orion soils are light colored and are somewhat poorly drained. They belong to the Alluvial great soil group, but they are intergrading toward Low-Humic Gley soils. These soils formed in silty alluvium on narrow stream bottoms and on broad flood plains. The alluvium was washed from uplands that were mantled with loess. A darker, buried soil is in the profile at a depth of more than 18 inches. The original vegetation was a mixture of grasses, sedges, reeds, elms, willows, and other water-tolerant plants.

These soils are near the well drained to moderately well drained Arenzville soils, which formed in similar alluvium.

The following describes a representative profile of an Orion silt loam (NW¼NW¼ sec. 15, T. 25 N., R. 14 W.):

A11—0 to 18 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; very friable; many, fine, prominent mottles of reddish brown (5YR 4/4); neutral; clear, smooth boundary.
A12—18 to 32 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, platy structure that breaks to weak, fine, granular; very friable; many, fine, prominent mottles of reddish brown (5YR 4/4); neutral; gradual, smooth boundary.
A13—32 inches +, very dark grayish-brown and grayish-brown (10YR 3/2 and 5/2) silt loam; moderate, thin, platy structure; very friable; neutral.

The color of the A11 and A12 horizons ranges from very dark grayish brown to dark gray (10YR 3/2 to 4/1). In places along streams the soils have a thin layer of sandy overwash. The arrangement and thickness of the horizons in the profile vary because of stratification. In a few places there are thin strata of fine sand in the profile. Depth to the dark-colored, buried soil ranges from 18 inches to several feet.

OTTERHOLT SERIES

This series is made up of undulating to gently rolling soils that are well drained. These soils belong to the Gray-Brown Podzolic great soil group. They formed on uplands in a mantle of loess, 42 to 60 inches thick. The loess was underlain by loam to clay loam till of Iowan age. The original vegetation was a deciduous forest made up mainly of hard maple and basswood. In this county the Otterholt soils have a loamy substratum.

These soils are associated with the somewhat poorly drained Almena soils, which formed from similar parent materials. They are similar to the Fayette and Seaton soils, but they are underlain by different material. Also, unlike those soils, the faces of peds in the B horizon of the Otterholt soils have thick, bleached silt coats.

The following describes a representative profile of an Otterholt silt loam, loamy substratum, in Pierce County, Wis., in an undisturbed area (NE¼NW¼ sec. 7, T. 25 N., R. 15 W.):

A1—0 to 4 inches, black to very dark gray (10YR 2/1 to 3/1) silt loam; weak, fine, granular structure; friable; medium acid; abrupt, smooth boundary.
A2—4 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, thin, platy structure; friable; strongly acid; abrupt, smooth boundary.
B1—9 to 13 inches, dark grayish-brown and dark-brown (10YR 4/2 and 4/3) silt loam; moderate, medium, platy structure that breaks, under slight pressure, to moderate, very fine, subangular blocky; friable; the structural peds have thick, light brownish-gray (10YR 6/2), bleached silt coats on the vertical and horizontal faces; very strongly acid; clear, smooth boundary.
B21—13 to 22 inches, dark-brown (10YR 4/3) heavy silt loam; weak, medium, platy structure that breaks, under slight pressure, to moderate, very fine, subangular blocky; firm; the structural peds have medium, light brownish-gray (10YR 6/2), bleached silt coats on the horizontal and vertical faces; very strongly acid; clear, smooth boundary.
B22—22 to 32 inches, dark-brown (10YR 4/3) heavy silt loam; weak, thick, platy structure that breaks, under slight pressure, to moderate, fine, angular and subangular blocky; firm; the structural peds have thick, light brownish-gray (10YR 6/2), bleached silt coats and pockets on the vertical faces and somewhat thinner coats on the horizontal faces; very strongly acid; clear, smooth boundary.
B23—32 to 38 inches, dark-brown to dark yellowish-brown (10YR 4/3 to 4/4) heavy silt loam; weak, thick, platy structure that breaks, under slight pressure, to moderate, fine, subangular blocky; firm; the structural peds have medium, light brownish-gray (10YR 6/2), bleached silt coats on the horizontal and vertical faces; very strongly acid; clear, smooth boundary.
B3—38 to 42 inches, dark-brown (10YR 4/3) silt loam; weak, very thick, platy structure that breaks, under slight pressure, to weak, medium, subangular blocky; friable; the structural peds have thin, light-colored, bleached silt coats on the vertical faces; strongly acid; clear, smooth boundary.
C1—42 to 53 inches, dark-brown (10YR 4/3) silt loam; generally massive but weak, thick, platy structure in places; strongly acid; clear, smooth boundary.
IIC2—53 inches +, yellowish-brown (10YR 5/4) gritty clay loam till; massive; medium acid.

These soils vary chiefly in degree of degradation and in depth of loess over till. In places most or all of the B1 horizon has been replaced, through degradation, by bleached silt giving rise to an A2 horizon that is as much as 10 inches thick and is grayish brown (10YR 5/2). In places there are thin clay films on the faces of the peds in the B horizon. Depth of the loess over till ranges from 42 to 60 inches.

The color of the surface layer in cultivated areas ranges from very dark grayish brown to dark grayish brown (10YR 3/2 to 4/2). The solum ranges from 36 to 55 inches in thickness. In some places the C horizon formed in loess. In others the B horizon extends to the D horizon of till.

The till that underlies the Otterholt soils varies in color and in texture. It is yellowish brown or brown and ranges from loam to clay loam. The till is acid, except for a few small areas that have been influenced by local limerock.

PLAINFIELD SERIES

The soils in this series are excessively drained. They belong to the Regosol great soil group. These soils formed in deep, sandy outwash on stream terraces. The original vegetation was a forest of hardwoods.

These soils are associated with Plainfield loamy fine sand, mottled subsoil variant. They are also near the somewhat poorly drained Morocco soils and the very poorly drained Dillon soils. They formed in materials similar to those of the Sparta soils, but they have a thinner, lighter colored surface layer. The Plainfield soils have a lighter colored surface layer than the Gotham soils and lack a weakly developed textural B horizon that is typical of those soils.

The following describes a representative profile of

Plainfield loamy fine sand in a cultivated field (NE¼NW¼ sec. 4, T. 25 N., R. 11 W.):

- Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) loamy fine sand; weak, very fine, granular structure; very friable; medium acid; clear, smooth boundary.
- C1—9 to 17 inches, dark-brown (10YR 4/3) loamy sand; weak, medium, subangular blocky structure that breaks to single grain if disturbed; very friable; medium acid; gradual, smooth boundary.
- C2—17 to 26 inches, dark yellowish-brown (10YR 4/4) fine sand; single grain; loose; strongly acid; gradual, smooth boundary.
- C3—26 to 42 inches, yellowish-brown (10YR 5/4) fine sand; single grain; loose; strongly acid; gradual, smooth boundary.
- C4—42 inches +, light yellowish-brown (10YR 6/4) fine sand; single grain; loose; strongly acid.

The surface soil ranges from very dark grayish brown to dark grayish brown (10YR 3/2 to 4/2). In places, at a depth below 3 feet, there are one or more thin layers that are finer textured than the material in the C3 horizon. These strata are as much as 4 inches thick.

PLAINFIELD SERIES, MOTTLED SUBSOIL VARIANT

The soils of this variant from the normal Plainfield series are nearly level and are moderately well drained. They belong to the Regosol great soil group. These soils formed in deep, sandy outwash on stream terraces. The original vegetation was a forest of hardwoods.

These soils are near soils of the Plainfield series, which are excessively drained. They are also near the somewhat poorly drained Morocco soils and the very poorly drained Dillon soils. Their surface layer is thinner and lighter colored than that of the Sparta soils, and their subsoil, unlike that of Sparta soils, is mottled. The Plainfield soils also have a thinner and lighter colored surface layer than the Watseka soils.

The following describes a representative profile of a Plainfield loamy fine sand, mottled subsoil variant, in a cultivated field (SW¼SW¼ sec. 4, T. 25 N., R. 11 W.):

- Ap—0 to 8 inches, very dark gray (10YR 3/1) loamy fine sand; weak, very fine, granular structure; very friable; strongly acid; clear, smooth boundary.
- A3—8 to 12 inches, very dark grayish-brown (10YR 3/2) loamy fine sand; weak, medium, subangular blocky structure; very friable; strongly acid; gradual, smooth boundary.
- C1—12 to 18 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, medium, subangular blocky structure that breaks to single grain; loose; a few, fine, faint mottles; very strongly acid; gradual, smooth boundary.
- C2—18 to 24 inches, brown (10YR 5/3) fine sand; single grain; loose; a few, fine, faint mottles that grade to common, fine, distinct mottles of dark brown to yellowish brown (10YR 4/3 to 5/8) at the lower boundary; very strongly acid; gradual, smooth boundary.
- C3—24 to 36 inches, brown (10YR 5/3) fine sand; single grain; loose; common, medium, prominent mottles of dark reddish brown and pinkish gray (5YR 3/4 to 6/2); very strongly acid; gradual, smooth boundary.

This soil varies mainly in the position and degree of mottling in the profile and in the color of the surface layer. In some places internal drainage is slightly better than described. Here, the mottling is less intense, and the surface layer is dark grayish brown to very dark grayish brown (10YR 4/2 to 3/2). In places at a depth below 3 feet, there are a few, thin layers that are finer textured than the material in the C3 horizon.

RICHWOOD SERIES

This series is made up of deep, well-drained soils that belong to the Brunizem great soil group. These soils formed on terraces in silty deposits that were more than 42 inches thick. The original vegetation was prairie grasses.

These soils are associated with the moderately well drained Toddville soils and the somewhat poorly drained Rowley soils. They formed in deeper silt than the Waukegan soils, which are underlain by loose sand at a depth between 24 and 42 inches.

The following describes a representative profile of a Richwood silt loam in a cultivated field (SW¼SW¼ sec. 23, T. 23 N., R. 15 W.):

- Ap—0 to 8 inches, black (10YR 2/1) silt loam; moderate, medium, granular structure; neutral; abrupt, smooth boundary.
- A1—8 to 12 inches, very dark gray (10YR 3/1) silt loam; moderate, thin and medium, platy structure; neutral; clear, smooth boundary.
- B1—12 to 18 inches, dark yellowish-brown (10YR 3/4) light silty clay loam; weak, thick, platy structure that breaks to moderate, fine, subangular blocky; friable; very dark grayish-brown (10YR 3/2), organic coats on the peds; slightly acid; clear, smooth boundary.
- B21—18 to 26 inches, dark yellowish-brown (10YR 3/4) silty clay loam; moderate, medium, subangular blocky structure; firm; light-gray (10YR 7/2), bleached silt coats and very dark brown (10YR 2/2), organic coats on the peds; medium acid; clear, smooth boundary.
- B22—26 to 34 inches, dark grayish-brown to dark-brown (10YR 4/2 to 4/3) light silty clay loam; weak, medium, subangular blocky structure; friable; light-gray (10YR 7/2) bleached silt coats; medium acid; gradual, wavy boundary.
- C—34 to 60 inches +, dark yellowish-brown to yellowish-brown (10YR 4/4 to 5/4) silt loam; massive; friable; a few, faint mottles of yellowish brown (10YR 5/6); slightly acid.

The A horizon of these soils is 10 to 20 inches thick. Loose sand is at a depth of more than 42 inches in places.

ROWLEY SERIES

The soils in this series are deep and are somewhat poorly drained. They belong to the Brunizem great soil group. These soils formed on stream terraces in silty deposits more than 42 inches thick. The original vegetation was grasses, sedges, reeds, and other water-tolerant plants.

These soils are associated with the moderately well drained Toddville soils and the well drained Richwood soils, but they are in slightly lower positions.

The following describes a representative profile of a Rowley silt loam in a cultivated field (NE¼SE¼ sec. 36, T. 25 N., R. 13 W.):

- Ap—0 to 8 inches, black (10YR 2/1) silt loam; moderate, fine and medium, granular structure; friable; roots abundant; neutral; abrupt, smooth boundary.
- A12—8 to 12 inches, black (10YR 2/1) silt loam; moderate, medium, granular structure in place, but breaks to weak, very fine, subangular blocky; roots abundant; neutral; clear, smooth boundary.
- A3—12 to 16 inches, very dark gray (10YR 3/1) silt loam; weak, medium, platy structure; slightly vesicular; many, fine, distinct mottles of grayish brown and yellowish brown (10YR 5/2 and 5/8); very friable; roots abundant; slightly acid; clear, smooth boundary.

B21—16 to 21 inches, dark grayish-brown (10YR 4/2) silty clay loam; weak, medium and thick, platy structure; moderately vesicular; firm when moist, and slightly hard when dry; many, medium, distinct mottles of grayish brown and yellowish brown (10YR 5/2 and 5/8); roots plentiful; medium acid; clear, wavy boundary.

B22—21 to 32 inches, grayish-brown (10YR 5/2) silty clay loam; moderate, fine and medium, subangular blocky structure; friable when moist, and slightly hard when dry; many, medium, distinct mottles of yellowish brown (10YR 5/8); roots plentiful; medium acid; clear, wavy boundary.

B3g—32 to 38 inches, grayish-brown (2.5Y 5/2) light silty clay loam; weak, fine, subangular blocky structure; friable when moist, and slightly hard when dry; many, medium, prominent mottles of dark brown (7.5YR 4/4); a few roots; medium acid, clear, wavy boundary.

Cg—38 inches +, grayish-brown (2.5Y 5/2) light silty clay loam; massive; many, medium, prominent mottles of dark brown (7.5YR 4/4); manganese concretions plentiful; a few roots; organic stains in old root channels; slightly acid.

The predominant color of the B horizon ranges from dark grayish brown to brown (10YR 4/2 to 5/3). These soils are underlain by sand or silt at a depth of more than 42 inches.

SEATON SERIES

This series is made up of deep, well-drained soils that belong to the Gray-Brown Podzolic great soil group. These soils formed in deposits of coarse-textured loess, 42 or more inches thick, on undulating to rolling uplands underlain by limestone and sandstone. The original vegetation was a deciduous forest of oak, hard maple, and hickory.

Seaton silt loams, uplands, are associated with the Fayette, Norden, Gale, Dubuque, and Downs soils. They formed in coarser textured loess than the Fayette soils and have a coarser textured B horizon. The material underlying the Seaton soils is at a greater depth than that underlying the Norden and Gale soils, which are underlain by sandstone, or than that underlying the Dubuque soils, which are underlain by limestone residuum and limestone. The Seaton soils formed in coarser loess than the Downs soils, but they are in similar positions. In cultivated areas their surface layer is lighter colored than that in the Downs soils, and in undisturbed areas it is thinner.

Seaton silt loams, valleys, are near the upland Seaton silt loams and are similar to them, but their subsoil and substratum are somewhat coarser textured. Also, they have less structural development in the B horizon, have a few fragments of sandstone and limestone in the solum, and in some places sand is mixed in the surface layer.

The following describes a representative profile of a Seaton silt loam, uplands, in an undisturbed area (NW¼ SW¼ sec. 34, T. 25 N., R. 14 W.):

A00—2 inches or less of leaf litter.

A1—0 to 4 inches, black to very dark brown (10YR 2/1 to 2/2) silt loam; moderate, fine, crumb structure; very friable; numerous, very fine, fibrous roots; neutral; clear, wavy boundary.

A21—4 to 7 inches, very dark grayish-brown to dark grayish-brown (10YR 3/2 to 4/2) silt loam; weak, thin, platy structure; dark-colored tongues of organic material and worm casts extend into this horizon from the A1 horizon; very friable; common, very fine, fibrous roots; slightly acid; clear, smooth boundary.

A22—7 to 9 inches, dark-brown (10YR 4/3) silt loam; weak, medium and thin, platy structure; friable; common, very fine, fibrous roots; slightly acid; abrupt, smooth boundary.

B1—9 to 15 inches, dark-brown (10YR 4/3) silt loam; weak, medium and thin, platy structure that breaks, if disturbed, to weak, very fine, subangular blocky; very thin, patchy, dark yellowish-brown (10YR 3/4) clay films on the surfaces of the plates at vertical intervals of approximately one-quarter inch in depth; friable; common, fine, fibrous roots; slightly acid; clear, smooth boundary.

B21—15 to 23 inches, dark yellowish-brown (10YR 3/4) silt loam; moderate, medium, subangular blocky and weak, medium, platy structure; thin, patchy, bleached silt coats of pale brown (10YR 6/3); peds have dark yellowish-brown (10YR 3/4) interiors and dark-brown (10YR 4/3) coats on their surfaces; friable; a few fibrous and a few coarse roots; slightly acid to medium acid; gradual, smooth boundary.

B22—23 to 31 inches, dark-brown (10YR 4/3) silt loam; moderate, medium, subangular blocky structure; thin patchy, clay films on the surfaces of the peds and in the linings of small rootholes and wormholes; peds have dark-brown (10YR 4/3) interiors and dark yellowish-brown (10YR 3/4) coats on their surfaces; a few fibrous and a few coarse roots; friable; strongly acid; gradual, smooth boundary.

C1—31 to 39 inches, dark-brown (10YR 4/3) silt loam; massive to very weak, medium, platy structure; friable; a few coarse roots; slightly acid to medium acid; clear, smooth boundary.

C2—39 to 50 inches, dark-brown (10YR 4/3) silt loam that is somewhat finer textured than that in the C1 horizon; very weak, medium, platy structure that breaks, under pressure, to very weak, medium, subangular blocks; friable; medium acid; gradual, smooth boundary.

C3—50 to 72 inches, dark-brown (10YR 4/3) silt loam; very weak, medium, platy structure; friable; medium acid; clear, smooth boundary.

IIR—72 inches +, indurated, thin-bedded dolomitic limestone.

The color of the Ap horizon ranges from very dark grayish brown to dark grayish brown (10YR 3/2 to 4/2), and that of the A1 horizon from very dark grayish brown to black (10YR 3/2 to 2/1). The thickness of the solum ranges from 30 to 50 inches. In the B horizon the content of clay ranges from 18 to 24 percent.

SPARTA SERIES

The Sparta series is made up of deep, excessively drained soils. These soils belong to the Regosol great soil group but are intergrading toward the Brunizem great soil group. They formed under prairie in sandy outwash derived partly from sandstone. These soils are on broad stream terraces of the Chippewa and Mississippi Rivers.

The Sparta soils are associated with the Hubbard, Burkhardt, Gotham, and Watseka soils. They are similar to the Hubbard soils, but they lack a weakly developed B horizon, which is typical of those soils. Unlike the Burkhardt soils, they lack a textural B horizon and have no gravel in the C horizon. They have a thicker, darker colored A horizon than the Gotham soils, and no illuvial or coherent B horizon. In contrast to the Watseka soils, the Sparta lack mottling. The Sparta soils have a thicker, darker surface layer than the Plainfield soils.

The following describes a representative profile of a Sparta loamy fine sand in a cultivated field (NE¼SW¼ sec. 17, T. 25 N., R. 13 W.):

A11—0 to 18 inches, very dark brown (10YR 2/2) loamy fine sand; weak, medium, subangular blocky structure; very friable; neutral; clear, wavy boundary.

A12—18 to 24 inches, very dark grayish-brown to dark-brown (10YR 3/2 to 3/3) loamy fine sand; weak, medium, subangular blocky structure; very friable; slightly acid; clear, wavy boundary.
C1—24 to 38 inches, dark-brown (10YR 3/4) fine sand; single grain; loose; medium acid; gradual, smooth boundary.
C2—38 inches +, yellowish-brown (10YR 5/4 to 5/6) fine sand; single grain; loose; medium acid.

The color of the surface layer is typically black or very dark brown (10YR 2/1 or 2/2). It is very dark grayish brown (10YR 3/2), however, in areas where part of the surface layer has been removed through erosion or where lighter colored material has been laid down on the surface by wind. In places there are a few pebbles in the profile.

TODDVILLE SERIES

The soils in the Toddville series are nearly level or gently sloping and are moderately well drained. They belong to the Brunizem great soil group. These soils formed under prairie on stream terraces in deposits of silt. The silt is more than 42 inches thick.

These soils are associated with the well-drained Richwood soils and the somewhat poorly drained Rowley soils. They have a thicker, darker surface layer than the Jackson soils, and they lack the A2 horizon that is typically in those soils.

The following describes a representative profile of a Toddville silt loam (SW¼NE¼ sec. 31, T. 25 N., R. 12 W.):

Ap—0 to 7 inches, very dark brown to black (10YR 2/2 to 2/1) silt loam; moderate, fine, subangular blocky structure that breaks to moderate, medium and fine, granular; very friable; neutral; abrupt, smooth boundary.
A12—7 to 11 inches, very dark brown to black (10YR 2/2 to 2/1) silt loam; moderate, medium, granular structure; very friable; neutral; clear, wavy boundary.
A3—11 to 18 inches, very dark brown to very dark gray (10YR 2/2 to 3/1) silt loam; weak, thick, platy structure that breaks to moderate, fine, subangular blocky; very friable; slightly acid; gradual, smooth boundary.
B1—18 to 24 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, subangular blocky structure; very dark, grayish-brown (10YR 3/2) coats on the blocks; firm; medium acid; clear, wavy boundary.
B2—24 to 29 inches, dark-brown (10YR 4/3) silty clay loam; moderate, medium and fine, subangular blocky structure; a few, fine, faint mottles and dark grayish-brown (10YR 4/2) coats; firm; strongly acid; clear, wavy boundary.
B3—29 to 35 inches, dark-brown (10YR 4/3) light silty clay loam; moderate, medium, subangular blocky structure; many, small, distinct mottles and coats of dark grayish brown (10YR 4/2); firm; medium acid; clear, wavy boundary.
C—35 inches +, dark-brown (10YR 4/3) silt loam; massive; friable; mottlings more abundant than in the B3 horizon; medium acid.

In places these soils are underlain by loose, stratified sand at a depth of more than 42 inches.

URNE SERIES

In the Urne series are rolling to hilly, shallow, excessively drained soils of uplands. These soils belong to the Lithosol great soil group. They formed in thin residuum weathered from greenish glauconitic sandstone of the Franconia formation.

The Urne soils are associated with the Norden, Northfield, Hixton, and Boone soils. They are underlain by sandstone similar to that of the Norden soils, but their profile is generally thinner. Also, they lack the textural B horizon typical of the Norden, Northfield, and Hixton soils. The sandstone underlying the Norden soils is different than that underlying the Northfield, Hixton, and Boone soils.

The following describes a representative profile of an Urne fine sandy loam in an undisturbed area (NW¼SE¼ sec. 17, T. 25 N., R. 12 W.)

A1—0 to 6 inches, very dark grayish-brown (2.5Y 3/2) fine sandy loam; weak, fine, subangular blocky and weak, medium, granular structure; very friable; a few, fine sandstone chips; mildly alkaline; clear, smooth boundary.
C1—6 to 11 inches, dark grayish-brown to very dark grayish-brown (2.5Y 4/2 to 3/2) very fine sandy loam; weak, thick, platy structure; very friable; a few, fine sandstone chips; mildly alkaline; gradual, smooth boundary.
C2—11 to 24 inches, olive-brown (2.5Y 4/4) very fine sandy loam; weak, medium and thick, platy structure; very friable; many sandstone chips; mildly alkaline; gradual, smooth boundary.
IIR—24 inches +, soft, shaly, greenish, consolidated, fine-grained sandstone.

Depth to consolidated sandstone ranges from 9 to 24 inches. In cultivated fields the surface layer is greenish in many places because material from the substratum is exposed through erosion or tillage.

WALLKILL SERIES

The Wallkill series is made up of poorly drained soils. The soils formed in light-colored, silty alluvium that overlies muck or peat. These soils belong to the Alluvial great soil group. The silty material has washed onto the areas from adjacent uplands and terraces. The Wallkill soils form a margin between peat and muck soils and soils of uplands or terraces.

These soils, unlike the Orion and other Alluvial soils, overlie organic deposits.

The following describes a representative profile of Wallkill silt loam (NW¼SE¼ sec. 24, T. 25 N., R. 11 W.):

A11—0 to 9 inches, dark-gray (10YR 4/1) silt loam; the upper part of this horizon has moderate, medium, platy structure, but in the lower part it has moderate, medium, subangular blocky structure; layered effect because of deposition by water; very friable; many, medium, distinct to prominent mottles of yellowish brown (10YR 5/6), reddish brown (5YR 4/4), and reddish gray (5YR 5/2); roots plentiful; neutral; clear, smooth boundary.
A12—9 to 22 inches, dark-gray to gray (10YR 4/1 to 5/1) silt loam; moderate, medium, platy structure; very friable; many, medium, distinct to prominent mottles of yellowish brown (10YR 5/6), reddish brown (5YR 4/4), and reddish gray (5YR 5/2); a few roots; contains small, woody fragments, probably tamarack, and has streaks and tongues of mucky peat throughout; slightly acid; clear, smooth boundary.
IIC—22 inches +, black (N 2/0) mucky peat; weak, thick, platy structure in place; friable; contains many, fine, dark grayish-brown (10YR 4/2), fibrous, organic remains and old sedge root channels running vertically throughout; vertical tongues and streaks of yellowish-brown (10YR 5/6) and grayish-brown (2.5Y 5/2) silt in the upper part of this horizon; many, small pieces of wood, probably tamarack, scattered throughout; peat breaks readily to a mucky consistence if disturbed when moist, and dries to large, fibrous blocks in spoil banks along drainage ditches; moderately alkaline.

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Depth to muck or peat ranges from 18 to 42 inches. The color of the mineral deposit is variable because of slight differences in internal drainage and because of differences in stratification and in the sources of the sediments.

WATSEKA SERIES

The soils in the Watseka series are deep and sandy. They are moderately well drained to somewhat poorly drained soils on stream terraces. These soils belong to the Brunizem great soil group but are intergrading toward Regosols. They are on the lower parts of broad terraces along the Chippewa and Mississippi Rivers.

These soils are associated with the Sparta soils, which are well drained. They have less mottling than the very poorly drained Dillon soils.

The following describes a representative profile of Watseka loamy fine sand (NW¼NW¼ sec. 10, T. 25 N., R. 12 W.):

A11—0 to 11 inches, black (10YR 2/1) loamy fine sand; weak, coarse, subangular blocky structure that breaks to weak, fine, granular; friable; medium acid; gradual, smooth boundary.

A12—11 to 18 inches, very dark gray (10YR 3/1) loamy fine sand; weak, coarse, subangular blocky structure that breaks readily to weak, fine, granular; roots plentiful; strongly acid; gradual, wavy boundary.

C1—18 to 24 inches, brown (10YR 5/3) sand; single grain; loose; common, medium, distinct mottles of dark yellowish brown and yellowish brown (10YR 4/4 and 5/6); there are dark reddish-brown, iron-enriched areas, approximately 4 inches in diameter, within this horizon; strongly acid; gradual, smooth boundary.

C2—24 inches +, light brownish-gray (10YR 6/2), moist sand.

These soils vary somewhat in the location and intensity of mottling. The iron-enriched areas described in the C1 horizon are lacking in places.

WAUKEGAN SERIES

The Waukegan series is made up of moderately deep, well-drained soils of the Brunizem great soil group. These soils formed on stream terraces in silty material that overlies loose, stratified sand. Originally, the vegetation was prairie grasses.

These soils are associated with the Richwood and Dakota soils. They are shallower over sand than the Richwood soils and have a silty texture rather than a loamy texture like that of the Dakota soils.

The following describes a representative profile of a Waukegan silt loam in a cultivated field that has been limed (SE¼SE¼ sec. 6, T. 25 N., R. 13 W.):

Ap—0 to 8 inches, very dark gray to black (10YR 3/1 to 2/1) silt loam; weak, medium, subangular blocky structure that breaks to moderate, medium, granular; very friable; mildly alkaline; abrupt, smooth boundary.

B1—8 to 14 inches, dark-brown (10YR 4/3) silt loam; weak, medium, platy structure that breaks to weak, fine and medium, subangular blocky; friable; moderately vesicular; tongues and streaks of staining from organic matter carried down from the surface; mildly alkaline; gradual, wavy boundary.

B2—14 to 24 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; moderate, medium, subangular blocky structure; friable; moderately vesicular; tongues and streaks of staining from organic matter carried down from the surface; medium acid; gradual, wavy boundary.

B3—24 to 32 inches, dark yellowish-brown (10YR 4/4) loam; moderate, fine and medium, subangular blocky structure; friable; strongly acid; gradual, smooth boundary.

IIC—32 to 36 inches, dark-brown (10YR 4/3) fine sand; single grain; loose; lenses of sandy loam and loamy fine sand and balls of sandy loam at a depth below 36 inches; medium acid.

The color of the surface layer is generally black (10YR 2/1), very dark gray (10YR 3/1), or very dark brown (10YR 2/2), but in some eroded fields it is very dark grayish brown (10YR 3/2). In places these soils have an A3 horizon that is dark grayish brown to dark brown (10YR 4/2 to 4/3). Areas of Waukegan silt loam in section 25 of Durand Township and in sections 30 and 32 of Lima Township contain enough fine and very fine sand to have a somewhat gritty texture. Depth to loose sand ranges from 24 to 42 inches, but it is generally about 32 inches. In places the sand contains a few pebbles.

ZWINGLE SERIES

The soils of the Zwingle series are nearly level and are somewhat poorly drained. They belong to the Gray-Brown Podzolic great soil group, but they are intergrading toward Low-Humic Gley soils. These soils formed on stream terraces. The upper part of the solum formed in 12 to 24 inches of loess, and the lower part, in reddish-brown and gray silt and clay laid down in slack water. The original vegetation was made up of elms, willows, and other water-tolerant trees.

The Zwingle soils are near the darker colored, very poorly drained variants from the normal Zwingle series. They are also near the well drained to moderately well drained Medary soils. Their parent material contains much more clay than that of the somewhat poorly drained Curran soils, and it is generally reddish brown.

The following describes a representative profile of Zwingle silt loam in a cultivated field (SW¼SE¼ sec. 18, T. 23 N., R. 14 W.):

Ap—0 to 8 inches, very dark gray to dark gray (10YR 3/1 to 4/1) silt loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A21—8 to 10 inches, dark-gray (10YR 4/1) silt loam; moderate, thin, platy structure; friable; slightly acid; clear, abrupt boundary.

A22—10 to 12 inches, brown (10YR 5/3) silt loam; strong, thin, platy structure; friable; common, medium, faint mottles of yellowish brown and grayish brown (10YR 5/4 and 5/2); the surfaces of the plates are thinly coated with gray; medium acid; clear, smooth boundary.

B1g—12 to 18 inches, grayish-brown (2.5Y 5/2) light silty clay loam; moderate, medium, platy structure in place, but breaks readily to moderate, very fine, angular blocky; firm when moist, and slightly sticky when wet; structural blocks have thin, gray coats and thin, dark-gray clay films; common, medium, prominent mottles of dark brown and dark reddish brown (7.5YR 4/4 and 5YR 3/4); medium acid; clear, smooth boundary.

B21g—18 to 28 inches, brown (7.5YR 5/2) silty clay; weak, coarse, prismatic structure that breaks to strong, fine, angular blocky; very hard when dry, and plastic when wet; thick, dark-gray (10YR 4/1) clay coats on the structural blocks; common, medium, prominent mottles of dark brown and grayish brown (7.5YR 4/4 and 2.5Y 5/2); medium acid; clear, smooth boundary.

B22—28 to 33 inches, reddish-brown (5YR 4/3) silty clay; weak, coarse, prismatic structure and weak, thick, platy structure that breaks to strong, fine, angular blocky; very hard when dry, and plastic when wet; medium acid; clear, smooth boundary.

B3g—33 to 38 inches, grayish-brown (10YR 5/2) silty clay loam; moderate, weak, coarse, prismatic structure and very thick, platy structure that breaks to strong, medium, angular blocky; hard when dry, and plastic when wet; thin, discontinuous, reddish-brown (5YR 4/4) clay coats on structural blocks; common, medium, prominent mottles of dark brown and grayish brown (7.5YR 4/4 and 2.5Y 5/2); slightly acid; clear, smooth boundary.

C—38 inches +, grayish-brown (10YR 5/2) silt; weak, medium and thick, platy structure; slightly hard when dry, and slightly sticky when wet; neutral.

In places the substratum consists of alternate layers of silt and clay, and it may contain thin layers of fine sand.

ZWINGLE SERIES, POORLY DRAINED VARIANT

The soils of this variant from the normal Zwingle series are very poorly drained. They belong to the Humic Gley great soil group. These soils formed on stream terraces, partly in loess and partly in thick deposits of silt and clay laid down in slack water. These soils are in level to slightly depressed areas. The original vegetation was made up of grasses, sedges, reeds, and other water-tolerant plants. These soils are associated with the soils of the Zwingle series, which are lighter colored and are somewhat poorly drained. They are also associated with the well drained to moderately well drained Medary soils.

The following describes a representative profile of Zwingle silt loam, poorly drained variant, in a cultivated field (SE¼SW¼ sec. 18, T. 23 N., R. 14 W.):

Ap—0 to 8 inches, black (10YR 2/1) silt loam; weak, fine, subangular blocky structure; friable; slightly acid; abrupt, smooth boundary.

A12—8 to 15 inches, black to very dark gray (10YR 2/1 to 3/1) light silty clay loam; weak, fine and very fine, granular structure; friable; medium acid; gradual, smooth boundary.

C1g—15 to 25 inches, reddish-gray and grayish-brown (5YR and 2.5Y 5/2) silty clay loam; moderate, thick, platy structure, in place, but breaks to moderate, fine, subangular blocky; firm when moist, and slightly sticky when wet; neutral; gradual, smooth boundary.

C2g—25 to 42 inches, grayish-brown (2.5Y 5/2) silty clay loam; thin lenses of reddish-brown (5YR 4/3) silty clay; weak, very thick, platy structure, in place, but breaks to moderate, medium, subangular blocky; firm when moist, and slightly sticky when wet; a few, dark stains from organic matter and thin clay coats line the channels formed by roots; mildly alkaline; gradual smooth boundary.

C3g—42 inches +, grayish-brown (2.5Y 5/2) layers of silt loam, silty clay loam, and silty clay; massive; slightly sticky; moderately alkaline.

The A horizon ranges from 8 to 15 inches in thickness, and the structure of the Ap horizon is granular in places. The thickness, position, and number of reddish clayey layers are variable.

General Nature of the County [6]

In this section the general geographic features of the county are described. Also described are the climate, the settlement and development of the county, and the more outstanding features of the agriculture.

[6] By PAUL CARROLL, soil scientist, Soil Conservation Service.

Physiography, Drainage, and Geology

Pepin County is mostly in the western upland geographic province of Wisconsin. A smaller part is in the lower lying central plain of the State and extends along the Chippewa River into the central part of the county. In general, the western upland is a plateau, capped with limestone, in which streams have cut deep, steep-sided valleys. The terrain is some of the most rugged in the State. In contrast, the central plain, which is generally north and east of Durand, consists of smooth to undulating uplands and of areas of sandy and gravelly outwash underlain by eroded, weak Cambrian sandstone.

The most striking topographic features in the county are along the Mississippi, Chippewa, and Eau Galle Rivers, which are the major streams that drain the county. The great trench, or gorge, of the Mississippi River, west of Lake Pepin, is bounded on both sides by steep bluffs that rise 300 to 500 feet above the level of the stream. The valley bottom along the lower reaches of the Chippewa River in Pepin County is deep and wide. In most places this valley is bounded by uplands that rise abruptly to a height between 200 and 400 feet or more above the sandy flood plain of the river.

Lake Pepin, along the southwestern boundary of the county, was formed after a large amount of detritus, or outwash, had accumulated and made a dam at the point where the Chippewa River flows into the Mississippi River. This outwash was laid down by floods during glacial periods. It was too coarse, and there was too great an amount of it, to be carried away by the Mississippi River. Consequently, it formed a dam on the north side of the Mississippi River and forced the main current of that river to flow on the opposite side of the flood plain from where it originally flowed. In time, a comparatively still body of water formed behind the dam.

Throughout most of its course, the Eau Galle River flows through a narrow, steep-walled valley, but in Pepin County the valley is broader. Where the Eau Galle River joins the Chippewa River, its valley is about 1 mile wide. The Eau Galle River is subject to violent flash floods during some seasons. Controlling the floodwaters is a major problem for those who live along the lower reaches of the river. The large amount of water that pours from the mouth of the river, however, causes little damage along the main stream of the Chippewa River.

Along all the major streams in the county, several levels of terraces and steep escarpments rise above the present flood plains. The terraces were formed by the entrenchment of these major streams, which cut deep into the old flood plains. A striking example is the high terrace west of the mouth of the Chippewa River, where the terrace breaks to the river in a single escarpment that is 90 to 95 feet high. A few miles farther west, 45 or more feet above the level of the Mississippi River, is a broad terrace that is the site of the present town of Pepin.

Besides the Mississippi, Chippewa, and Eau Galle Rivers, other streams that drain the county are Bear, Arkansaw, and Plum Creeks, which flow into the Chippewa River. In addition, Bogus and Lost Creeks flow south into Lake Pepin.

It is probable that Bear Creek once provided the main channel for the Buffalo River, which now flows southward in Buffalo County. The headwaters of the Buffalo River formerly were a part of Bear Creek and flowed westward to the Chippewa River (*5*). One theory, advanced as the reason for the change in the course of the Buffalo River, is that, during the glacial period, the mouth of Bear Creek was blocked by glacial drift and outwash and the water was forced to take a southward course. Another theory is that a smaller, northward-flowing tributary, through the process of headwater erosion, intercepted the Buffalo River. The fact that the mouth of the Buffalo River, where it enters the Mississippi River, is lower than that of Bear Creek, where it enters the Chippewa River, supports this theory. The approximate border of the southward extension of glacial drift, however, just overlies the mouth of Bear Creek, and this supports the theory of glacial diversion.

The relief and the soils of the county have been influenced greatly by the kind of bedrock. Prairie du Chien dolomite and Upper Cambrian (Croixian) sandstone—Trempealeau, Franconia, and Dresbach—make up the larger part of the bedrock (fig. 11). The dolomite is more resistant to weathering than the softer, underlying sandstone.

The uplands of the rolling, dissected cuesta north of the village of Pepin and west of the village of Arkansaw are underlain by Prairie du Chien dolomite and by various formations of Cambrian sandstone. The dolomite slopes southward with a drop of about 9 feet per mile (*5*), but the relief is not smooth. The cuesta has been dissected by streams and is a maze of ridges and narrow coulees. Most of the uplands north and west of the Chippewa River, a small area south of Durand, and the central part of Albany Township are underlain by Prairie du Chien dolomite.

Just west of the Chippewa River in Pepin County, the dolomite has eroded away and the underlying sandstone is exposed in an east-facing escarpment. This east-facing escarpment of the Prairie du Chien cuesta extends in a general north and south direction for 20 to 25 miles in St. Croix, Dunn, and Pepin Counties. It is a moderately irregular escarpment and has ridges that extend from 3 to 5 miles between stream valley embayments. Where these ridges are still capped by dolomite, the tops are narrow, craggy, and castellated and the valleys are V-shaped. Where the ridges are capped by sandstone, the crests are broad and well rounded and the valleys are a mile or more in width.

The remainder of the county, beyond the escarpment, is on the central plain. Here, the area is underlain by beds of weak Cambrian sandstone and the topography is smoother than in the uplands. The underlying bedrock is greenish, glauconitic sandstone of the Franconia formation. It is the parent material of the Norden and Urne soils.

Almost all of Pepin County was covered by the ice sheet during the Wisconsin glaciation. Only Albany Township and most of Lima Township are within the Driftless Area. It probably was during the first substage of the Wisconsin glaciation that till and outwash were deposited over parts of Pepin County (*5*, *9*). As the glacier advanced into the county from the northwest, it deposited a fairly thin layer of till over the area. This till is now fairly well weathered and has a brownish color. Generally, it is strongly leached and is therefore acid. Glacial drift deposited in the uplands of western Pepin County probably leveled the areas and made the region less rugged than before. For example, the outline of the east-facing escarpment of the Prairie du Chien cuesta where glaciation occurred is much less rugged than the same escarpment to the southeast in the Driftless Area.

Most areas of the county are covered with a mantle of loess. The loess is Peorian and was laid down by winds during the Wisconsin glaciation (*6*). It is generally 3 to 5 feet or more thick, but it is thinner in places. The deepest deposits are on the more gently sloping areas. Deposits of loess overlie till and bedrock, but where the loess overlies till there is generally a layer of pebbles or cobbles that separate the till from the silt. The loess consists of medium- to coarse-textured silt. Areas of coarse-textured silt are most extensive, probably because the material has been reworked by wind or because the silt was deposited near the source of the sediments. Soils of the Dubuque, Fayette, and Seaton series are among those formed mainly in loess.

On the terraces and outwash plains adjoining the Chippewa River and its tributaries, the materials are mostly deposits of glacial sand and gravel. The largest area is northeast of the city of Durand. A mantle of silt and sand that was laid down by wind overlies the materials on the terraces in many places.

Climate [7]

Table 8, compiled from records of the U.S. Weather Bureau at Menomonie, Dunn County, Wis., which is just north of Pepin County, gives climatic data that are typical for the climate of Pepin County. The data given are more nearly representative of the climate of the valleys in Pepin County than the climate of the hills. The daily and annual ranges in temperature are greater in the valleys than on the slopes because cold air collects in the valleys and lowers the minimum temperature. The slopes tend to moderate extremes in temperature. Precipitation is generally greater and is more intensive on the hilltops than in the valleys.

In addition to the average temperatures given in table 8, temperatures are given in terms of degree days (*7*). The number of degree days is the difference between the average temperature for a given day and 65° F. It is a measure of the amount of heat needed to keep the temperature that day at 65° F. For example, a day that has an average temperature of 50° would be counted as 15 degree days. A knowledge of accumulated degree days for a stated time is helpful in calculating the amount of fuel needed for heating buildings and for determining the rate of growth and the maturity date of crops.

[7] Prepared by MARVIN BURLEY, State climatologist for Wisconsin, Weather Bureau, U.S. Department of Commerce.

Figure 11.—Cross section showing the geology and the associated soils in Pepin County.

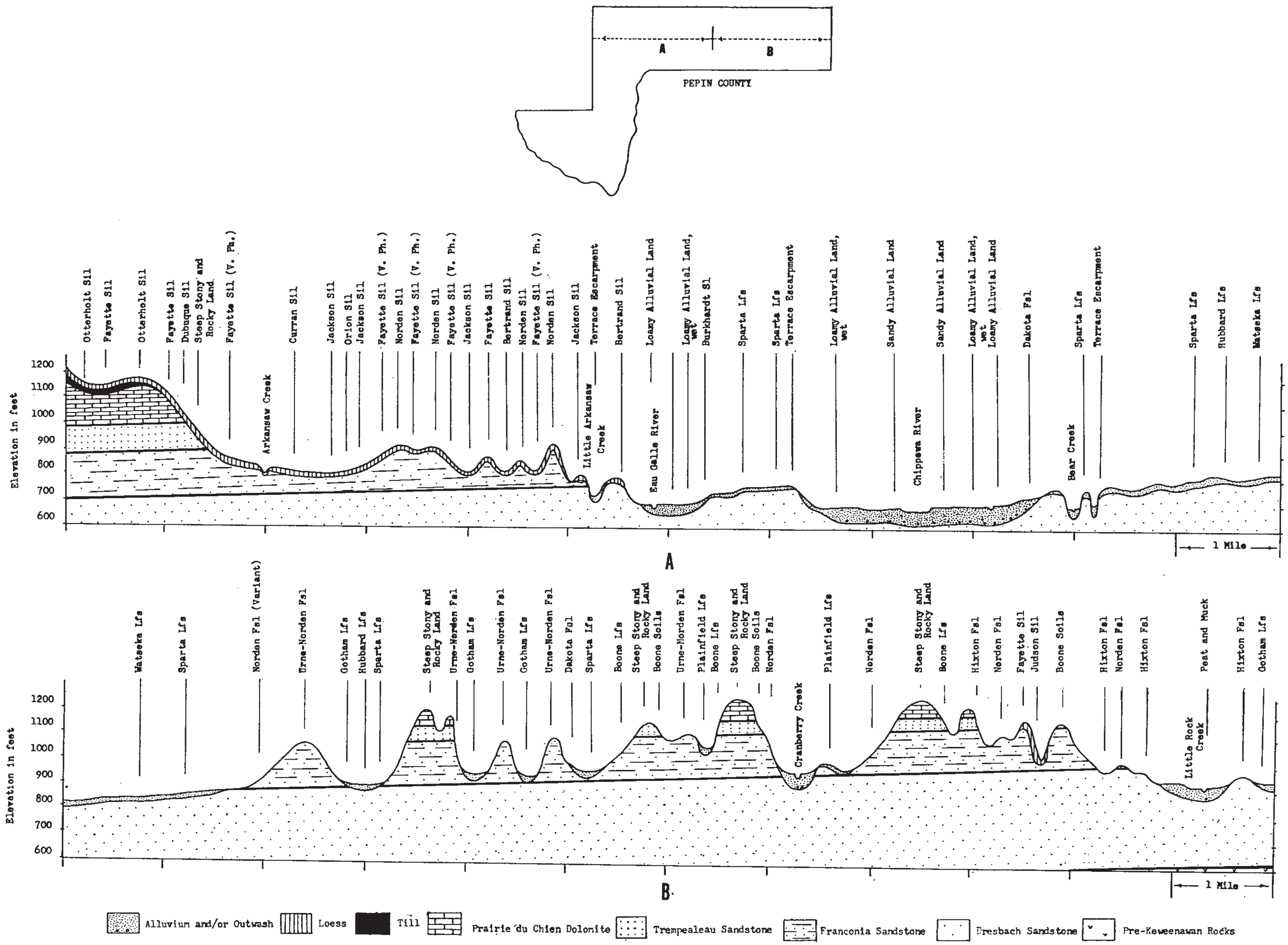

TABLE 8.—*Temperature and precipitation*

[Elevation

Month	Temperature							Average degree days
	Average daily maximum	Average daily minimum	Average monthly	Record high	Year	Record low	Year	
	°F.	°F.	°F.	°F.		°F.		Number
January	24. 4	5. 3	14. 9	54	1944	−40	1951	1, 550
February	27. 9	7. 7	17. 8	55	1954	−28	1951	1, 320
March	39. 7	19. 4	29. 6	81	1946	−26	1948	1, 100
April	58. 1	34. 0	46. 1	93	1952	11	1939	570
May	71. 0	45. 3	58. 2	97	1939	25	[3] 1954	260
June	79. 7	55. 8	67. 8	98	[3] 1956	29	1945	80
July	84. 4	59. 8	72. 1	100	[3] 1948	42	[3] 1947	20
August	82. 7	58. 4	70. 6	101	1947	39	1958	20
September	73. 0	49. 0	61. 0	96	[3] 1948	25	1942	180
October	62. 3	38. 6	50. 5	88	[3] 1953	15	1952	460
November	41. 4	24. 5	33. 0	75	1944	− 8	1956	960
December	29. 0	12. 5	20. 8	58	1951	−28	1951	1, 370
Year	56. 1	34. 2	45. 2	101	1947	−40	1951	7, 890

[1] Based on climatological summary compiled by the U.S. Weather Bureau, Menomonie, Wis., 1961. Average and extremes for period 1938–59. Average length of record is 22 years.

The climate of Pepin County is continental. The winters are generally long and cold. The summers are warm and have several hot, humid periods. Spring and fall are generally short and are marked by many sharp changes in temperature. The area is in the path of pressure systems that move down from Canada and of those that move across the country from southwest to northeast. Variations in temperature are wide from season to season and from year to year. In the last 20 years, for example, there were 33 days in 1947 and 1949 when the temperature was 90° or higher, and in 1951 there were only 4 days when the temperature was that high. During the same period, the number of days when the temperature was zero or lower ranged from 49 days in 1955 to 19 days in 1944 and 1954. Table 9 shows the occurrence, by months, of extremes in temperature and in precipitation.

About 65 percent of the annual rainfall normally comes during the months of May through September, when the main crops are grown. In summer the probability of 1 inch or more of rain falling in a 7-day period is greatest the last 3 weeks of June; it is probable that that amount of rain will fall during the specified period more often than 4 years in 10. The next greatest period of probable rainfall is the first week in August. The driest part of the summer generally is during the middle of August. The probability of a 7-day period with only a trace of moisture is 2 years in 10. About once in 2 years, intensive rainfall occurs at the rate of about 1.25 inches in 1 hour, 1.95 inches in 6 hours, and 2.60 inches in 24 hours. The average number of days in a year having 0.01 inch or more of precipitation is 113, but in 2 out of 3 years the number of days having 0.01 inch or more of precipitation ranges from 102 to 124.

The amount of snowfall in a season varies widely. The range is from more than 100 inches to less than 20 inches. The average date when the first snowfall of 1 inch or more occurs is November 19. The chance that 1 inch or more of snow will fall by October 24 is 1 year in 10, and the chance that 1 inch or more will fall by December 16 is 9 years in 10. Snow cover of 1 inch or more can be expected 25 percent of the time in November, 60 percent of the time in December, 90 percent of the time in January and February, 60 percent of the time in March, and 5 percent of the time in April. The ground is covered by 10 inches or more of snow on an average of 25 percent of the time from December through March.

TABLE 9.—*Monthly extremes in temperature and precipitation, Menomonie, Dunn County, Wis.*

Month	Two years in 10, month will have at least 4 days with—		One year in 10, month will have—	
	Maximum temperature equal to or higher than	Minimum temperature equal to or lower than	Precipitation less than	Precipitation more than
	°F.	°F.	Inches	Inches
January	39	−18	0. 18	1. 62
February	45	−14	. 22	2. 09
March	64	−2	. 66	4. 16
April	79	21	. 94	4. 37
May	87	31	1. 74	8. 84
June	91	44	2. 37	7. 25
July	95	50	1. 45	7. 07
August	95	45	2. 06	5. 16
September	90	33	. 69	6. 59
October	79	24	. 27	3. 49
November	60	4	. 39	2. 92
December	45	−11	. 14	2. 19

at Menomonie, Dunn County, Wis.[1]

780 feet]

Precipitation									Average days precipitation is 0.10 inch or more	Average days temperature is—			
Average	Greatest daily	Year	Snow, sleet							Maximum of 90° and above	Maximum of 32° and below	Minimum of 32° and below	Minimum of zero and below
			Average	Maximum monthly	Year	Greatest daily	Year						
Inches	*Inches*		*Inches*	*Inches*		*Inches*			*Number*	*Number*	*Number*	*Number*	*Number*
0. 71	0. 82	1946	8. 5	26. 5	1950	11. 0	1952		2	0	23	31	11
. 90	1. 07	1948	9. 7	27. 0	1953	9. 5	1948		3	0	19	28	9
1. 77	1. 70	1951	11. 7	45. 5	1951	12. 0	1940		5	0	8	26	3
2. 75	4. 08	1954	2. 4	14. 3	1945	7. 0	1945		6	[2]	[2]	14	0
4. 09	3. 24	1938	. 2	2. 5	1946	2. 5	1946		7	1	0	3	0
4. 84	3. 60	1939	0	0	------	0	------		7	3	0	0	0
4. 06	3. 79	1959	0	0	------	0	------		7	7	0	0	0
3. 67	3. 73	1955	0	0	------	0	------		6	6	0	0	0
3. 29	5. 19	1942	. 1	2. 0	1942	2. 0	1942		5	2	[2]	1	0
1. 76	2. 58	1949	. 5	4. 8	1959	4. 0	1938		4	0	[2]	9	0
1. 53	1. 60	1948	5. 3	15. 1	1956	11. 3	1957		4	0	8	23	1
1. 16	1. 06	1945	10. 6	37. 0	1950	10. 0	1945		3	0	19	30	6
30. 53	5. 19	1942	49. 0	45. 5	1951	12. 0	1940		59	19	77	165	30

[2] Less than one-half day.
[3] Also on earlier dates, months, or years.

Thunderstorms occur on an average of 41 days a year in this county, but in individual years the range of occurrence is from 22 to 59 days. Hail falls as often as 7 days in a single year, but on an average there are 2 days a year when hail occurs. Occasionally, violent windstorms associated with thunderstorms or squall lines pass over the area. Only one tornado has been recorded in Pepin County since 1916.

Records on wind, sunshine, and relative humidity are not available for Pepin County, but the data in the following paragraphs, from records kept at La Crosse and at Minneapolis, Minn., are representative of conditions in the county.

From November through April, the prevailing winds are from the northwest, but the winds are southerly the rest of the year. The strongest winds occur in April and November, when their velocity averages 12 or 13 miles per hour; the months of July and August are the least windy, and then the average velocity is 8 or 9 miles per hour. On the average, the windspeed is less than 4 miles per hour 10 percent of the time, 4 to 12 miles per hour 60 percent of the time, and 13 to 31 miles per hour 30 percent of the time. Windspeed averages more than 31 miles per hour less than 1 percent of the time. The most destructive winds are generally from a westerly direction.

An average of about 40 percent of possible sunshine is received during November and December, and 60 percent or more is received from May through September. During the rest of the year, the sun shines between 50 and 60 percent of the daylight hours.

The approximate variations in relative humidity for the seasons of the year are given in table 10. The relative humidity is generally higher in winter and in fall than at other times.

The average date of the last freezing temperature in spring is about May 10, and the first in fall is about September 29. The growing season, which is the number of days between the last freezing temperature in spring and the first in fall, averages 142 days.

The probabilities of freezing temperatures are shown in table 11. The data given are more nearly representative of freezing temperatures in the valleys of Pepin County than of those in the hills. The probable dates that the several minimum temperatures will occur average about 1 week earlier in spring and 1 week later in fall at the higher elevations than in the valleys. As a result, the growing season in the higher areas is as much as 2 weeks longer than in the valleys.

TABLE 10.—*Approximate variations of relative humidity for the seasons of the year*

Percentage of relative humidity	Time in winter	Time in spring	Time in summer	Time in fall
	Percent	*Percent*	*Percent*	*Percent*
Less than 50	5	20	20	15
50 to 79	55	50	50	55
More than 79	40	30	30	30

Settlement and Development

The land for Pepin County was acquired through a treaty with the Sioux Indians in 1837. At first the area was part of Dunn County, but in 1858 the present boundaries were set. The name of the county was taken from Lake Pepin, which was probably named for an early French explorer.

In 1841 the first permanent settlement was made near the present site of the village of Pepin. From this area

TABLE 11.—*Probabilities of last freezing temperatures in spring and first in fall*

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
2 years in 10 later than	April 8	April 15	April 26	May 7	May 20
4 years in 10 later than	March 31	April 8	April 19	April 30	May 13
6 years in 10 later than	March 25	April 1	April 12	April 24	May 7
8 years in 10 later than	March 18	March 24	April 5	April 17	April 30
Fall:					
2 years in 10 earlier than	November 4	October 27	October 14	September 29	September 19
4 years in 10 earlier than	November 12	November 4	October 22	October 6	September 26
6 years in 10 earlier than	November 18	November 10	October 28	October 13	October 2
8 years in 10 earlier than	November 26	November 18	November 5	October 21	October 9

settlers moved up the Chippewa River into other parts of the county. Pepin became a permanent settlement in 1854, and in 1855 the town of Durand was laid out. The next year, settlers from Sweden established the village of Stockholm.

At the time of the first census in 1860, the population of the county was 2,392. By 1900 the population had reached a high of 7,905, but in 1960 it had declined to 7,332.

The first settlers established creameries, feed-grinding mills, and carding mills along the small streams. Lumbering was important, but the county lacked commercial quantities of white pine, and many of the streams were too small to provide adequate power for large sawmills. Many of the logs for the lumber industry were rafted down the Chippewa River from other areas.

Local transportation was by wagon or by boat on the Mississippi and Chippewa Rivers until 1882, when the railroad was extended into the county. In the early years Durand was used by farmers as a center for marketing their wheat, which was then the main crop.

Agriculture

Early agriculture in the county consisted mainly of growing wheat. The production of wheat declined after about 1880, and dairying became the main source of income on the farms. As a result, the acreage in corn, oats, tame hay, and pasture increased.

The more outstanding features of the present agriculture of the county are discussed in the following pages. Statistics used are mainly from reports published by the U.S. Bureau of the Census.

Land use

In 1959, 136,931 acres, or about 90.3 percent of the total acreage, was in farms. The farmland, by use, and the acreage used for each purpose in that year, follow:

	Acres
Cropland, total	75,390
Harvested	61,158
Used only for pasture	9,703
Not harvested or pastured	4,529
Woodland, total	45,754
Pastured	22,110
Not pastured	23,644
Other land pastured (not cropland and not woodland)	8,340
Other land (house lots, roads, wasteland, and so on)	7,447

The county has a lower proportion of farmland in crops than the average for the State because it contains many large areas of steep land and of wet bottom land not suitable for agriculture.

According to a study made in 1959 to learn the soil and water conservation needs of the county, the pattern of land use will continue to be about the same. The study indicates that by 1975 the acreage in cropland will decrease by about 3.5 percent, and the acreage in woodland by 6.7 percent, and that the land used for forage crops or for pasture will increase by slightly more than 1 percent. It also indicates about 7 percent of the total land now available for agriculture will be lost because of urban expansion, the building of roads, and the use of areas for water impoundments.

Types and sizes of farms

There were 673 farms in Pepin County in 1959. Of these, 128 were miscellaneous or unclassified. The rest are listed according to the major source of income as follows:

	Number
Dairy farms	460
Livestock farms other than dairy or poultry	45
Poultry farms	10
General farms	15
Field crops	15

The average-sized farm in 1959 was 203.5 acres, but in 1950 it was 168.8 acres. As the size of farms in the county increased, the number of farms decreased. The record number was in 1900, when there were 1,054 farms.

About 82.4 percent of the income was from the sale of livestock and livestock products in 1959. Of this, about 58.4 percent was from the sale of dairy products, 31.8 percent was from the sale of livestock other than dairy and poultry, and 9.8 percent was from the sale of poultry and poultry products. On the general farms about half the income was derived from crops, and the remainder from livestock. The income from field crops was mostly from grain sold for cash.

Crops

Hay crops, corn, and oats are grown widely in the county to provide feed for the livestock. Special crops are snap beans, potatoes, and green peas. They are grown on a few farms for sale to processing plants.

Tame hay was grown on more than 19,234 acres, or 25.5 percent of the total cropland, in 1959. The kind of hay grown has changed significantly in recent years. The acreage in clover and timothy has decreased, and that in alfalfa and alfalfa mixtures has increased. Alfalfa alone and alfalfa mixed with bromegrass or other grasses accounted for more than 81.5 percent of the acreage of hay harvested in 1959.

Alfalfa generally gives higher yields of good-quality forage than clover or timothy. It also is effective in controlling erosion. It needs a fertile, well-drained soil, and it requires lime, potash, and phosphate to yield well. Seeding is generally done in April along with oats or some other nurse crop.

Most of the hay crop is harvested dry, but some is harvested for silage. If cut for silage, the first and coarser growth of hay is harvested before good hay-curing weather. The better quality, second cutting is cured for hay, and sometimes a third cutting can be harvested.

The acreage used for corn is next largest to that used for hay crops. In 1959 corn was grown on 18,227 acres, or on about 24.2 percent of the cropland. About 84.3 percent of the acreage of corn is cut for grain, and the rest is cut for silage. Most all of it is used on the farm to provide feed for livestock in winter. In 1959, the average yield per acre was 67.5 bushels.

Most of the corn is grown on the more nearly level, fertile soils of the county. The soil is plowed in fall or early in spring and prepared for seeding in May. The corn is cultivated during the summer and is harvested in October or November, depending on the weather. Generally, corn is cut for silage when the kernels begin to dent. If there has been an early frost, however, the crop is harvested as soon after the first frost as possible.

Oats were grown on about 14,417 acres, or on about 19.4 percent of the cropland in 1959. The average yield was 46.4 bushels per acre in that year. Oats are grown mainly as a nurse crop for hay. The fields used for oats are often plowed in fall. Early in spring, the seedbed is prepared, and the oats are generally seeded in April.

After the oats mature, they are harvested by using a binder or combine. Most of the crop is ground, mixed with concentrates, and fed on the farm. The straw is baled and used as bedding. In some places oats are used as a supplementary hay crop and are cut green.

Soybeans were grown on more than 5,874 acres in 1959. Most of the grain from this crop is used as feed, but some is used for hay or other purposes.

Rye, wheat, buckwheat, barley, and flax are also grown. The acreage used for these crops, however, is fairly small.

Pastures

About 29.3 percent of the land in farms, or 40,153 acres, was in pasture in 1959. This acreage consisted of cropland used for pasture and of other open areas not suitable for plowing that are used for permanent pasture. In addition, 22,110 acres of woodland was pastured, or 55.1 percent of the total land in pasture.

In recent years emphasis has been on establishing better pastures. As a result, some of the wooded areas formerly used for pasture are now fenced and protected from fire and grazing. Yields of permanent pasture have been increased by renovating the fields. This practice consists of seeding steep areas to grasses and legumes but, at the same time, protecting them from erosion.

When an area is renovated, the old sod is worked with a field cultivator, or similar tool, until a good seedbed is obtained. The residue from the sod that remains on the surface protects and binds the soil and helps absorb runoff. After the seedbed is prepared, lime and fertilizer are applied according to the needs indicated by soil tests. Generally, renovation is most successful if begun in fall prior to seeding.

Many areas that were too steep or eroded for continued use without being improved have been brought back to profitable use by renovating them. This has helped to increase the returns from dairying and has improved the areas for trees and wildlife. Because of renovating, many farmers now have a large enough acreage in permanent pasture and no longer need to use their woodland for pasture. Consequently, the wooded areas and areas used for wildlife have improved.

Farm tenure

About 72.5 percent of the farms in the county were operated by full owners in 1959. In that year tenants operated about 8.5 percent of the farms, and part owners operated 18.6 percent. Managers operated 0.4 percent of the farms. About 20 percent of the farmers who own and operate their own farms also rent additional land.

The number of farms operated by tenants was highest in 1940, when it was 22.8 percent, but the number has since declined. The proportion of tenancy, however, has been near the average for the State since 1900.

Conservation programs

The need to conserve natural resources has been strongly emphasized since the early 1930's. In 1933 camps of the Civilian Conservation Corps were located in and near Pepin County. Workers from these camps completed a number of dams and planted trees to help control erosion. In 1940 the Pepin County Soil Conservation District was organized to promote soil conservation.

Pasture improvement, contour stripcropping, and woodland improvement are most widely used in this county to conserve the soils (fig. 12). According to a study of soil and water conservation needs made in 1959, about 44 percent of the harvested cropland in the county receives adequate conservation treatment or does not require conservation practices. The remaining acreage needs stripcropping or related practices that provide protection from erosion.

The improvement in pastures has helped in many other kinds of soil conservation farming. Renovated pastures provide more forage than those that have not been renovated. Therefore, farmers who renovate their pastures can utilize the remaining less sloping land on their farms more efficiently for feed grains and silage. Grazing of woodlots, steep marginal lands, and swamps has decreased considerably in the county. As a result, the trees in woodlots have improved, the vegetation in wildlife areas provides better food and cover for wildlife, and runoff and

Figure 12.—**Typical landscape of stripcropped fields in Pepin County; the area is near Stockholm.**

erosion are reduced. An undergrowth of aspen, birch, pin cherry, and other hardwoods now grows in woodlots that are protected from fire and grazing and gives good cover for wildlife. Deer and other game animals have increased.

Other practices used extensively in the county to conserve the soils consist of establishing diversions, constructing grassed waterways, planting trees, and improving the areas for wildlife. In addition, many structures have been built to control gullies. Recent programs established to conserve the soil and to protect the watershed have helped the farmer bear the high cost of building the fairly large structures needed in many places to control gullies. Much of the topography of the county is rolling and rough. Consequently, the farms in the valleys are frequently damaged by flooding if gullies are not checked. In many areas farmers have organized local watershed groups to help work out problems in soil conservation.

An increasing number of farmers are placing their farms under a complete soil conservation program. In 1959, 406 farms, or about 60 percent of the farms in the county, were operating under land use practices.

Literature Cited

(1) American Association of State Highway Officials.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., illus.

(2) Gevorkiantz, S. R., and Scholtz, H. F.
1948. TIMBER YIELDS AND POSSIBLE RETURNS FROM THE MIXED-OAK FARMWOODS OF SOUTHWESTERN WISCONSIN. Pub. No. 521, U.S. Dept. Agr., Forest Serv., in coop. with Wis. Dept. Cons. and Univ. of Wis., 72 pp., illus.

(3) Hays, O. E., McCall, A. G., and Bell, F. G.
1949. INVESTIGATIONS IN EROSION CONTROL AND THE RECLAMATION OF ERODED LAND AT THE UPPER MISSISSIPPI VALLEY CONSERVATION EXPERIMENT STATION NEAR LA CROSSE, WIS., 1933–43. U.S. Dept. Agr. Tech. Bul. 973, 87 pp., illus.

(4) Leighton, Morris M., and Willman, H. B.
1950. LOESS FORMATIONS OF THE MISSISSIPPI VALLEY. Jour. of Geol., v. 58, No. 6, 599–623, illus. (Reprinted 1950 as Report of Investigations of Ill. State Geol. Survey—No. 149.)

(5) Martin, Lawrence.
1932. THE PHYSICAL GEOGRAPHY OF WISCONSIN. Wis. Geol. and Nat. Hist. Survey Bul. No. 36 [Ed. Ser. No. 4], 608 pp., illus.

(6) MUCKENHIRN, R. J., AND OTHERS.
1955. LOESS-DERIVED GRAY-BROWN PODZOLIC SOILS IN THE UPPER MISSISSIPPI RIVER VALLEY. Agr. Expt. Sta., Bul. No. 587 North Cent. Reg. Pub. 46, 80 pp., illus. Univ. of Ill.

(7) THOM, H. C. S.
1954. THE RATIONAL RELATIONSHIP BETWEEN HEATING DEGREE DAYS AND TEMPERATURE. Monthly Weather Rev. 82: 1–6, illus.

(8) THORP, JAMES.
1948. HOW SOILS DEVELOP UNDER GRASS. U.S. Dept. Agr. Ybk.: 352–358, illus.

(9) THWAITES, FREDERIK TURVILLE.
1956. OUTLINE OF GLACIAL GEOLOGY. 134 pp., illus.

(10) UNITED STATES DEPARTMENT OF AGRICULTURE.
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handb. No. 18, 503 pp., illus.

(11) UNITED STATES DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE.
[1958.] MANUAL OF SEPTIC-TANK PRACTICE. Pub. Health Serv. Pub. No. 526, 85 pp., illus.

(12) WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS.
1953. THE UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. No. 3-357, v. 1.

(13) WILDE, S. A., AND OTHERS.
1949. SOILS OF WISCONSIN IN RELATION TO SILVICULTURE. Wis. Conserv. Dept., Madison, Wis. Pub. No. 525, 171 pp., illus.

Glossary

Acidity. See Reaction.

AC soil. A soil that has only A and C horizons in the profile and no clearly developed B horizon; lacks a subsoil.

Aggregate, soil. A single mass or cluster consisting of many individual soil particles held together, such as a prism, crumb, or granule.

Alluvium. Soil or rock material, such as gravel, sand, silt, or clay, deposited by a stream.

Available moisture capacity. The capacity of a soil to hold moisture that plants can use. It is the difference between the amount of water in a soil at field capacity and the amount in the same soil when plants begin to wilt. Commonly expressed as inches of water per inch of soil depth.

Bottom land. Nearly level land on the bottom of a valley that has a stream flowing through it. Subject to flooding and often referred to as a flood plain.

Calcareous soil. A soil that contains enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) when treated with cold, dilute hydrochloric acid.

Catena. A group of soils developed from similar parent materials but that have different characteristics because of differences in relief and drainage.

Chert. Irregular shaped, angular fragments of crystalline quartz rock weathered from cherty limestone.

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.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Consistence, soil. The property of soil material that is expressed by the resistance of the individual particles to separating from one another (cohesion) or by the ability of a soil mass to undergo a change in shape without breaking (plasticity). The consistence varies with the content of moisture. Thus, a soil aggregate or clod may be hard when dry and plastic when wet. Terms used to describe consistence are—

Friable. When moist, easily crushed by hand and coheres when pressed together. Friable soils are easily tilled.

Firm. When moist, crushes under moderate pressure, but resistance is distinctly noticeable. Firm soils are likely to be difficult to till.

Hard. When dry, is moderately resistant to pressure; can be broken in the hands without difficulty but is barely breakable between thumb and forefinger.

Loose. Noncoherent when moist or dry. Loose soils are generally coarse textured and are easily tilled.

Plastic. When wet, retains an impressed shape and resists being deformed; plastic soils are high in clay and are difficult to till.

Soft. Weakly coherent and fragile; when dry, breaks to powder or individual grains under slight pressure.

Contour stripcropping. Growing crops in strips that follow the contour or that are parallel to terraces or diversions; strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Diversion. A broad-bottomed ditch that serves to divert runoff water so that it will flow around the slope to a safe outlet.

Dolomite. A rock that contains a high proportion of calcium and magnesium carbonates. Limestone that is high in calcium and magnesium carbonates is commonly called dolomitic limestone.

Dune. A mound or ridge of loose sand piled up by wind.

Erosion. The wearing away of the land surface by wind, moving water, or ice, and by such processes as landslides and creep.

Escarpment. A long, steep ridge of land or rock that resembles a cliff. It faces in one general direction and separates two areas of more nearly level land.

Glacial drift. Rock material transported by glacial ice and then deposited; also includes the assorted and unassorted materials deposited by streams flowing from glaciers.

Glacial outwash. Cross-bedded gravel, sand, and silt deposited by melt water as it flowed from glacial ice.

Glacial till. Unstratified glacial drift that consists of clay, silt, sand, gravel, and boulders transported and deposited by glacial ice.

Horizon, soil. A layer of soil, approximately parallel to the soil surface, that has characteristics produced by soil-forming processes. The relative positions of the several soil horizons in the soil profile and their nomenclature follow:

Horizon A. The master horizon consisting of (1) one or more mineral horizons of maximum organic accumulation; or (2) surface or subsurface horizons that are lighter in color than the underlying horizon and that have lost clay minerals, iron, and aluminum with resultant concentration of the more resistant minerals; or (3) horizons belonging to both of these categories.

Horizon B. The master horizon of altered material characterized by (1) an accumulation of clay, iron, or aluminum, with accessory organic materials; or (2) blocky or prismatic structure together with other characteristics, such as stronger colors, unlike those of the A horizons or the underlying horizons of nearly unchanged material; or (3) characteristics of both these categories. Commonly, the lower limit of the B horizon corresponds to the lower limit of the solum.

Horizon C. A mineral layer, excluding bedrock, that is either like or unlike the material from which the solum is presumed to have formed, relatively little affected by pedogenic processes, and lacking properties of A or B but including materials modified by weathering outside the zone of major biological activity.

Horizon R. Underlying consolidated bedrock, such as granite, sandstone, or limestone. If presumed to be like the parent rock from which the adjacent overlying layer was formed, the symbol R is used alone. If presumed to be unlike the overlying material, the R is preceded by a Roman numeral, which denotes lithologic discontinuity.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Loess. Geological deposits of fairly uniform, fine material, mostly silt, presumably transported by wind.

Massive. Large uniform masses of cohesive soil, in some places with ill-defined and irregular breakage, as in some of the fine-textured alluvial soils; structureless.

Morphology, soil. The physical constitution of the soil, including the texture, structure, consistence, color, and other physical and chemical properties of the various soil horizons that make up the soil profile.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils generally indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few*, *common*, and *many;* size—*fine*, *medium*, and *coarse;* contrast—*faint*, *distinct*, and *prominent*.

Muck. Well-decomposed, organic soil material developed from peat. Generally, muck has a higher mineral or ash content than peat and the original plant parts cannot be identified.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 3/2 is a color with the hue of 10YR, the value of 3, and a chroma of 2.

Neutral soils. See Reaction.

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which the soil has formed. Horizon C of the soil profile.

Peat. Unconsolidated soil material, largely undecomposed organic matter, that has accumulated where there has been excess moisture.

Ped. An individual natural soil aggregate, such as a crumb, prism, or block, in contrast to a clod, which is a mass of soil brought about by digging or other disturbance.

Perched water table. See water table.

Permeability, soil. The quality of a soil that enables it to transmit air and water. The following relative classes of soil permeability refer to estimated rates of movement of water in inches per hour through saturated undisturbed cores under a one-half inch head of water:

	Inches per hour
Very slow	Less than 0.05
Slow	0.05 to 0.20
Moderately slow	0.20 to 0.80
Moderate	0.80 to 2.50
Moderately rapid	2.50 to 5.00
Rapid	5.00 to 10.00

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See also Horizon, soil.

Reaction. The degree of acidity or alkalinity of soil expressed in pH values or in words, as follows:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5–5.0
Strongly acid	5.1–5.5
Medium acid	5.6–6.0
Slightly acid	6.1–6.5
Neutral	6.6–7.3
Mildly alkaline	7.4–7.8
Moderately alkaline	7.9–8.4
Strongly alkaline	8.5–9.0
Very strongly alkaline	9.1 and higher

Relief. Elevations and inequalities of the land surface, considered collectively.

Renovation of pastures. Method for restoring soils used for pasture or hay to higher productivity by cultivating carefully, generally with a field cultivator or similar tool, so that the tillage will not cause erosion. The soil is then limed, fertilized, and reseeded with a suitable mixture of grasses and legumes.

Root-collar weevil. An insect that damages trees by girdling them at or below the ground line.

Sand. Mineral particles that range from 0.05 millimeter (0.002 inch) to 2.0 millimeters (0.078 inch) in diameter; also, a soil that contains 85 percent or more of sand-size particles and in which the percentage of silt, plus 1½ times the percentage of clay, does not exceed 15. The particles are larger than those of silt or clay.

Sand blow. A localized area of extreme wind erosion in a sandy soil.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

Solum, soil. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soils consists of the A and B horizons.

Structure, soil. The arrangement of the soil particles into lumps, granules, or other aggregates. Structure is described by grade (weak, moderate, or strong), that is, the distinctness and durability of the aggregates; by the size of the aggregates (very fine, fine, medium, coarse, or very coarse); and their shape (platy, prismatic, columnar, blocky, granular, or crumb). A soil is described as structureless if there are no observable aggregates. Structureless soils may be massive (coherent) or single grain (noncoherent).

Blocky, angular. Aggregates are block shaped; they may have flat or rounded surfaces that join at sharp angles.

Blocky, subangular. Aggregates have some rounded and some plane surfaces; vertices are rounded.

Columnar. Aggregates are prismatic and are rounded at the upper ends.

Crumb. Generally soft, small, porous aggregates, irregular, but tending toward a spherical shape.

Granular. Roughly spherical, firm, small aggregates that may be either hard or soft but that are generally firmer than crumb and lack the distinct faces of blocky structure.

Platy. Soil particles are arranged around a plane that is generally horizontal.

Prismatic. Soil particles are arranged around a vertical line; aggregates have flat, vertical faces.

Subbase material. The layer of material used in the pavement system between the subgrade and the base course. It lies directly under the base layer and is, in turn, underlain by the subgrade.

Subgrade material. The prepared and compacted soil material below the pavement system; called the "basement soil."

Subsoil. Technically, the B horizon of soils that have a distinct profile; roughly, that part of the profile that is below the plow layer and above the unweathered layers below.

Substratum. Any layer lying beneath the solum, or true soil; the C or D horizon.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace, stream. An area that is fairly level and formerly was the flood plain of a stream but now lies above the present flood plain; the area is generally underlain by stratified stream sediments.

Terracing. Construction of shallow, nearly level ditches that have broad slopes suitable for farming; used for controlling runoff water on sloping land.

Texture, soil. The relative proportion of sand, silt, and clay particles in a soil. The basic textural classes in increasing proportions 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 subdivided by specifying "coarse," "fine," or "very fine."

Tilth. The condition of a soil or seedbed, in relation to the growth of plants, with special reference to soil structure.

Topsoil. Soil or soil material, presumably fertile, that is ordinarily rich in organic matter and is suitable as a surface for roadbanks, embankments, and ditches.

Upland. Land that lies above the stream terraces and that is underlain by bedrock at a fairly shallow depth; generally all areas that are not on terraces or bottom lands.

Vesicular. Having small openings or pores within the structural aggregates.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Weathering. The physical and chemical disintegration and decomposition of rocks and minerals. Soil is the result of weathering and other chemical, physical, and biological alterations that have changed the upper part of the earth's crust through various periods of time.

White grub. The larva of the June beetle, which damages young trees by feeding on the roots.

Wilting coefficient (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere. At wilting point the percentage of water available to plants approximates the minimum content of moisture in the soil at a depth below that affected by surface evaporation.

GUIDE TO MAPPING UNITS

[See table 6, p. 64, for the acreage and proportionate extent of the soils, and table 1, p. 19, for the estimated yields. To find the engineering properties of the soils, see the section beginning on p. 31. Dashes show that Riverwash was not placed in a woodland group, because it is not suited to trees]

Map symbol	*Soil name*	*Page*	*Capability unit*		*Woodland group*	
			Symbol	*Page*	*Number*	*Page*
AmB2	Almena silt loam, 2 to 6 percent slopes, moderately eroded	67	IIe-3	9	8	29
Ar	Arenzville silt loam	67	IIw-2	10	1	24
BeA	Bertrand silt loam, 0 to 2 percent slopes	67	I-1	8	1	24
BeB	Bertrand silt loam, 2 to 6 percent slopes	68	IIe-1	8	1	24
BeB2	Bertrand silt loam, 2 to 6 percent slopes, moderately eroded	68	IIe-1	8	1	24
BeC	Bertrand silt loam, 6 to 12 percent slopes	68	IIIe-1	10	1	24
BeC2	Bertrand silt loam, 6 to 12 percent slopes, moderately eroded	68	IIIe-1	10	1	24
BeC3	Bertrand silt loam, 6 to 12 percent slopes, severely eroded	68	IVe-1	14	1	24
BeD2	Bertrand silt loam, 12 to 20 percent slopes, moderately eroded	68	IVe-1	14	2	25
BeD3	Bertrand silt loam, 12 to 20 percent slopes, severely eroded	68	VIe-1	16	2	25
BnB	Boone loamy fine sand, 2 to 6 percent slopes	69	IVs-1	15	5	28
BnB2	Boone loamy fine sand, 2 to 6 percent slopes, eroded	69	IVs-1	15	5	28
BnC	Boone loamy fine sand, 6 to 12 percent slopes	69	VIs-1	18	5	28
BnC2	Boone loamy fine sand, 6 to 12 percent slopes, eroded	69	VIs-1	18	5	28
BnD2	Boone loamy fine sand, 12 to 30 percent slopes, eroded	69	VIIs-1	18	6	28
BsD3	Boone soils, 12 to 30 percent slopes, severely eroded	69	VIIs-1	18	6	28
BsF	Boone soils, 30 to 60 percent slopes	69	VIIs-1	18	6	28
BuA	Burkhardt sandy loam, 0 to 2 percent slopes	70	IIIs-1	13	3	26
BuB	Burkhardt sandy loam, 2 to 6 percent slopes	70	IIIs-1	13	3	26
BuB2	Burkhardt sandy loam, 2 to 6 percent slopes, moderately eroded	70	IIIs-1	13	3	26
BuC3	Burkhardt sandy loam, 6 to 12 percent slopes, severely eroded	70	VIs-1	18	3	26
CaA	Chaseburg silt loam, 0 to 2 percent slopes	70	I-1	8	1	24
CaB	Chaseburg silt loam, 2 to 6 percent slopes	71	IIe-1	8	1	24
Cu	Curran silt loam	71	IIw-1	10	8	29
DaA	Dakota fine sandy loam, 0 to 2 percent slopes	71	IIIs-1	13	3	26
DaB	Dakota fine sandy loam, 2 to 6 percent slopes	72	IIIs-1	13	3	26
DaB2	Dakota fine sandy loam, 2 to 6 percent slopes, moderately eroded	72	IIIs-1	13	3	26
DbA	Dakota loam, 0 to 2 percent slopes	72	IIs-1	10	9	30
DbB	Dakota loam, 2 to 6 percent slopes	72	IIe-2	9	9	30
DbB2	Dakota loam, 2 to 6 percent slopes, moderately eroded	72	IIe-2	9	9	30
DbC2	Dakota loam, 6 to 12 percent slopes, moderately eroded	72	IIIe-3	11	9	30
Dc	Dillon fine sandy loam	72	IVw-1	15	7	28
DdB	Downs silt loam, 2 to 6 percent slopes	73	IIe-1	8	1	24
DdB2	Downs silt loam, 2 to 6 percent slopes, moderately eroded	73	IIe-1	8	1	24
DdC2	Downs silt loam, 6 to 12 percent slopes, moderately eroded	73	IIIe-1	10	1	24
DeB2	Downs silt loam, benches, 2 to 6 percent slopes, moderately eroded	73	IIe-1	8	1	24
DeC2	Downs silt loam, benches, 6 to 12 percent slopes, moderately eroded	73	IIIe-1	10	1	24
DeD	Downs silt loam, benches, 12 to 20 percent slopes	73	IVe-1	14	2	25
DeD2	Downs silt loam, benches, 12 to 20 percent slopes, moderately eroded	74	IVe-1	14	2	25
DeD3	Downs silt loam, benches, 12 to 20 percent slopes, severely eroded	74	VIe-1	16	2	25
DeE2	Downs silt loam, benches, 20 to 30 percent slopes, moderately eroded	74	VIe-1	16	2	25
DfB2	Dubuque silt loam, 2 to 6 percent slopes, moderately eroded	74	IIe-2	9	1	24
DfC	Dubuque silt loam, 6 to 12 percent slopes	75	IIIe-3	11	1	24
DfC2	Dubuque silt loam, 6 to 12 percent slopes, moderately eroded	75	IIIe-3	11	1	24
DfD	Dubuque silt loam, 12 to 20 percent slopes	75	IVe-2	14	2	25
DfD2	Dubuque silt loam, 12 to 20 percent slopes, moderately eroded	75	IVe-2	14	2	25
DfE	Dubuque silt loam, 20 to 30 percent slopes	75	VIe-1	16	2	25
DfE2	Dubuque silt loam, 20 to 30 percent slopes, moderately eroded	75	VIe-1	16	2	25
DfF	Dubuque silt loam, 30 to 45 percent slopes	75	VIIe-1	18	2	25
DpB	Dubuque silt loam, deep, 2 to 6 percent slopes	75	IIe-1	8	1	24
DpB2	Dubuque silt loam, deep, 2 to 6 percent slopes, moderately eroded	76	IIe-1	8	1	24
DpC	Dubuque silt loam, deep, 6 to 12 percent slopes	76	IIIe-2	11	1	24
DpC2	Dubuque silt loam, deep, 6 to 12 percent slopes, moderately eroded	76	IIIe-2	11	1	24
DpD	Dubuque silt loam, deep, 12 to 20 percent slopes	76	IVe-1	14	2	25
DpD2	Dubuque silt loam, deep, 12 to 20 percent slopes, moderately eroded	76	IVe-1	14	2	25
DpE	Dubuque silt loam, deep, 20 to 30 percent slopes	76	VIe-1	16	2	25
DpE2	Dubuque silt loam, deep, 20 to 30 percent slopes, moderately eroded	76	VIe-1	16	2	25
DsC3	Dubuque soils, 6 to 12 percent slopes, severely eroded	76	IVe-2	14	1	24
DtD3	Dubuque soils, deep, 12 to 20 percent slopes, severely eroded	76	VIe-1	16	2	25
DtE3	Dubuque soils, deep, 20 to 30 percent slopes, severely eroded	76	VIIe-1	18	2	25
Ec	Ettrick silt loam, coarse silt substratum	77	IIIw-1	12	8	29
GaC	Gale silt loam, 6 to 12 percent slopes	78	IIIe-3	11	1	24
GaC2	Gale silt loam, 6 to 12 percent slopes, moderately eroded	78	IIIe-3	11	1	24
GaD	Gale silt loam, 12 to 20 percent slopes	78	IVe-2	14	2	25
GaD2	Gale silt loam, 12 to 20 percent slopes, moderately eroded	78	IVe-2	14	2	25
GaD3	Gale silt loam, 12 to 20 percent slopes, severely eroded	78	VIe-1	16	2	25
GaE	Gale silt loam, 20 to 30 percent slopes	78	VIe-1	16	2	25
GaE2	Gale silt loam, 20 to 30 percent slopes, moderately eroded	78	VIe-1	16	2	25
GaE3	Gale silt loam, 20 to 30 percent slopes, severely eroded	79	VIIe-1	18	2	25
GaF	Gale silt loam, 30 to 40 percent slopes	79	VIIe-1	18	2	25

GUIDE TO MAPPING UNITS—Continued

Map symbol	Soil name	Page	Capability unit: Symbol	Capability unit: Page	Woodland group: Number	Woodland group: Page
GoA	Gotham loamy fine sand, 0 to 2 percent slopes	79	IVs-1	15	5	28
GoB	Gotham loamy fine sand, 2 to 6 percent slopes	79	IVs-1	15	5	28
GoB2	Gotham loamy fine sand, 2 to 6 percent slopes, moderately eroded	79	IVs-1	15	5	28
GoC	Gotham loamy fine sand, 6 to 12 percent slopes	79	VIs-1	18	5	28
GoC2	Gotham loamy fine sand, 6 to 12 percent slopes, moderately eroded	79	VIs-1	18	5	28
HfB2	Hixton fine sandy loam, 2 to 6 percent slopes, moderately eroded	80	IIIs-1	13	3	26
HfC	Hixton fine sandy loam, 6 to 12 percent slopes	80	IVe-3	14	3	26
HfC2	Hixton fine sandy loam, 6 to 12 percent slopes, moderately eroded	80	IVe-3	14	3	26
HfD	Hixton fine sandy loam, 12 to 20 percent slopes	80	VIe-2	17	4	27
HfD2	Hixton fine sandy loam, 12 to 20 percent slopes, moderately eroded	80	VIe-2	17	4	27
HfE	Hixton fine sandy loam, 20 to 30 percent slopes	80	VIIe-1	18	4	27
HfE2	Hixton fine sandy loam, 20 to 30 percent slopes, moderately eroded	80	VIIe-1	18	4	27
HfE3	Hixton fine sandy loam, 20 to 30 percent slopes, severely eroded	81	VIIe-1	18	4	27
HfF	Hixton fine sandy loam, 30 to 45 percent slopes	81	VIIe-1	18	4	27
HfF2	Hixton fine sandy loam, 30 to 45 percent slopes, moderately eroded	81	VIIe-1	18	4	27
HfF3	Hixton fine sandy loam, 30 to 45 percent slopes, severely eroded	81	VIIe-1	18	4	27
HmA	Hubbard loamy fine sand, 0 to 3 percent slopes	81	IVs-1	15	5	28
Hv	Huntsville silt loam	82	IIw-2	10	9	30
JaA	Jackson silt loam, 0 to 2 percent slopes	82	I-1	8	1	24
JaB	Jackson silt loam, 2 to 6 percent slopes	82	IIe-1	8	1	24
JaB2	Jackson silt loam, 2 to 6 percent slopes, moderately eroded	82	IIe-1	8	1	24
JaC	Jackson silt loam, 6 to 12 percent slopes	82	IIIe-1	10	1	24
JaC2	Jackson silt loam, 6 to 12 percent slopes, moderately eroded	83	IIIe-1	10	1	24
JaC3	Jackson silt loam, 6 to 12 percent slopes, severely eroded	83	IVe-1	14	1	24
JuA	Judson silt loam, 0 to 2 percent slopes	83	I-1	8	9	30
JuB	Judson silt loam, 2 to 6 percent slopes	83	IIe-1	8	9	30
JuC	Judson silt loam, 6 to 12 percent slopes	83	IIIe-1	10	9	30
LsC	Lindstrom silt loam, 6 to 12 percent slopes	84	IIIe-1	10	9	30
LsC2	Lindstrom silt loam, 6 to 12 percent slopes, moderately eroded	84	IIIe-1	10	9	30
LsD	Lindstrom silt loam, 12 to 20 percent slopes	84	IVe-1	14	9	30
LsD2	Lindstrom silt loam, 12 to 20 percent slopes, moderately eroded	84	IVe-1	14	9	30
LsE	Lindstrom silt loam, 20 to 30 percent slopes	84	VIe-1	16	9	30
LsE2	Lindstrom silt loam, 20 to 30 percent slopes, moderately eroded	84	VIe-1	16	9	30
Lv	Loamy alluvial land	84	IIIw-3	13	8	29
Lw	Loamy alluvial land, wet	85	Vw-2	16	8	29
Lx	Loamy wet terrace land	85	IIIw-1	12	7	28
Ly	Loamy very wet terrace land	85	IVw-1	15	7	28
MdA	Medary silt loam, 0 to 2 percent slopes	85	IIe-3	9	1	24
MdB	Medary silt loam, 2 to 6 percent slopes	86	IIe-3	9	1	24
MeA	Meridian fine sandy loam, 0 to 2 percent slopes	86	IIIs-1	13	3	26
MeB	Meridian fine sandy loam, 2 to 6 percent slopes	86	IIIs-1	13	3	26
MeB2	Meridian fine sandy loam, 2 to 6 percent slopes, moderately eroded	86	IIIs-1	13	3	26
MeC	Meridian fine sandy loam, 6 to 12 percent slopes	86	IVe-3	14	3	26
MeC2	Meridian fine sandy loam, 6 to 12 percent slopes, moderately eroded	86	IVe-3	14	3	26
MeC3	Meridian fine sandy loam, 6 to 12 percent slopes, severely eroded	86	VIe-2	17	3	26
MeD2	Meridian fine sandy loam, 12 to 20 percent slopes, moderately eroded	86	VIe-2	17	4	27
Mo	Morocco loamy fine sand	87	IVw-1	15	7	28
NfB2	Norden fine sandy loam, 2 to 6 percent slopes, moderately eroded	88	IIe-2	9	3	26
NfC	Norden fine sandy loam, 6 to 12 percent slopes	88	IIIe-3	11	3	26
NfC2	Norden fine sandy loam, 6 to 12 percent slopes, moderately eroded	88	IIIe-3	11	3	26
NfC3	Norden fine sandy loam, 6 to 12 percent slopes, severely eroded	88	IVe-3	14	3	26
NfD	Norden fine sandy loam, 12 to 20 percent slopes	88	IVe-2	14	4	27
NfD2	Norden fine sandy loam, 12 to 20 percent slopes, moderately eroded	88	IVe-2	14	4	27
NfD3	Norden fine sandy loam, 12 to 20 percent slopes, severely eroded	88	VIe-2	17	4	27
NfE	Norden fine sandy loam, 20 to 30 percent slopes	88	VIe-2	17	4	27
NfE2	Norden fine sandy loam, 20 to 30 percent slopes, moderately eroded	89	VIe-2	17	4	27
NgB2	Norden fine sandy loam, dark surface variant, 2 to 6 percent slopes, moderately eroded.	91	IIIs-1	13	3	26
NgC2	Norden fine sandy loam, dark surface variant, 6 to 12 percent slopes, moderately eroded.	91	IVe-3	14	3	26
NoD2	Norden loam, 12 to 20 percent slopes, moderately eroded	89	IVe-2	14	2	25
NoE	Norden loam, 20 to 30 percent slopes	89	VIe-1	16	2	25
NoE2	Norden loam, 20 to 30 percent slopes, moderately eroded	89	VIe-1	16	2	25
NrB	Norden silt loam, 2 to 6 percent slopes	89	IIe-2	9	1	24
NrB2	Norden silt loam, 2 to 6 percent slopes, moderately eroded	89	IIe-2	9	1	24
NrC	Norden silt loam, 6 to 12 percent slopes	89	IIIe-3	11	1	24
NrC2	Norden silt loam, 6 to 12 percent slopes, moderately eroded	89	IIIe-3	11	1	24
NrC3	Norden silt loam, 6 to 12 percent slopes, severely eroded	89	IVe-2	14	1	24
NrD	Norden silt loam, 12 to 20 percent slopes	90	IVe-2	14	2	25
NrD2	Norden silt loam, 12 to 20 percent slopes, moderately eroded	90	IVe-2	14	2	25
NrD3	Norden silt loam, 12 to 20 percent slopes, severely eroded	90	VIe-1	16	2	25
NrE	Norden silt loam, 20 to 30 percent slopes	90	VIe-1	16	2	25
NrE2	Norden silt loam, 20 to 30 percent slopes, moderately eroded	90	VIe-1	16	2	25
NrE3	Norden silt loam, 20 to 30 percent slopes, severely eroded	90	VIIe-1	18	2	25
NsF	Norden silt loam and loam, 30 to 40 percent slopes	90	VIIe-1	18	2	25

GUIDE TO MAPPING UNITS—Continued

Map symbol	Soil name	Page	Capability unit: Symbol	Capability unit: Page	Woodland group: Number	Woodland group: Page
NsF2	Norden silt loam and loam, 30 to 40 percent slopes, moderately eroded	90	VIIe-1	18	2	25
NvB	Northfield very fine sandy loam, 2 to 6 percent slopes	91	IIIe-4	12	3	26
NvB2	Northfield very fine sandy loam, 2 to 6 percent slopes, moderately eroded	91	IIIe-4	12	3	26
Or	Orion silt loam	92	IIw-2	10	8	29
OsB	Otterholt silt loam, loamy substratum, 2 to 6 percent slopes	92	IIe-1	8	1	24
OsB2	Otterholt silt loam, loamy substratum, 2 to 6 percent slopes, moderately eroded	92	IIe-1	8	1	24
OsC2	Otterholt silt loam, loamy substratum, 6 to 12 percent slopes, moderately eroded	92	IIIe-1	10	1	24
Pa	Peat and muck, deep	93	IIIw-2	12	10	30
Pb	Peat and muck, shallow	93	Vw-1	16	10	30
PfA	Plainfield loamy fine sand, 0 to 2 percent slopes	93	IVs-1	15	5	28
PfB	Plainfield loamy fine sand, 2 to 6 percent slopes	93	IVs-1	15	5	28
PfB2	Plainfield loamy fine sand, 2 to 6 percent slopes, eroded	93	IVs-1	15	5	28
PfC	Plainfield loamy fine sand, 6 to 12 percent slopes	94	VIs-1	18	5	28
PfC2	Plainfield loamy fine sand, 6 to 12 percent slopes, eroded	94	VIs-1	18	5	28
PfD	Plainfield loamy fine sand, 12 to 20 percent slopes	94	VIIs-1	18	6	28
PfD2	Plainfield loamy fine sand, 12 to 20 percent slopes, eroded	94	VIIs-1	18	6	28
PmA	Plainfield loamy fine sand, mottled subsoil variant, 0 to 2 percent slopes	94	IVs-1	15	7	28
RcA	Richwood silt loam, 0 to 2 percent slopes	95	I-1	8	9	30
RcB	Richwood silt loam, 2 to 6 percent slopes	95	IIe-1	8	9	30
Re	Riverwash	95	VIIIs-1	19		
Ro	Rowley silt loam	95	IIw-1	10	8	29
Sa	Sandy alluvial land	95	VIIs-2	18	7	28
SeB	Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes	96	IIe-1	8	1	24
SeB2	Seaton and Fayette silt loams, uplands, 2 to 6 percent slopes, moderately eroded	96	IIe-1	8	1	24
SeC	Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes	96	IIIe-1	10	1	24
SeC2	Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, moderately eroded	96	IIIe-1	10	1	24
SeC3	Seaton and Fayette silt loams, uplands, 6 to 12 percent slopes, severely eroded	96	IIIe-1	10	1	24
SeD	Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes	96	IVe-1	14	2	25
SeD2	Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, moderately eroded	97	IVe-1	14	2	25
SeD3	Seaton and Fayette silt loams, uplands, 12 to 20 percent slopes, severely eroded	97	VIe-1	16	2	25
SeE	Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes	97	VIe-1	16	2	25
SeE2	Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, moderately eroded	97	VIe-1	16	2	25
SeE3	Seaton and Fayette silt loams, uplands, 20 to 30 percent slopes, severely eroded	97	VIIe-1	18	2	25
SfB	Seaton and Fayette silt loams, valleys, 2 to 6 percent slopes	97	IIe-1	8	1	24
SfC	Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes	97	IIIe-1	10	1	24
SfC2	Seaton and Fayette silt loams, valleys, 6 to 12 percent slopes, moderately eroded	97	IIIe-1	10	1	24
SfD	Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes	98	IVe-1	14	2	25
SfD2	Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, moderately eroded	98	IVe-1	14	2	25
SfD3	Seaton and Fayette silt loams, valleys, 12 to 20 percent slopes, severely eroded	98	IVe-1	14	2	25
SfE	Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes	98	VIe-1	16	2	25
SfE2	Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, moderately eroded	98	VIe-1	16	2	25
SfE3	Seaton and Fayette silt loams, valleys, 20 to 30 percent slopes, severely eroded	98	VIIe-1	18	2	25
Sh	Sparta fine sand and Dune land	99	VIIs-1	18	6	28
SpA	Sparta loamy fine sand, 0 to 2 percent slopes	99	IVs-1	15	5	28
SpB	Sparta loamy fine sand, 2 to 6 percent slopes	99	IVs-1	15	5	28
SpB2	Sparta loamy fine sand, 2 to 6 percent slopes, eroded	99	IVs-1	15	5	28
SpC	Sparta loamy fine sand, 6 to 12 percent slopes	99	VIs-1	18	5	28
SpC2	Sparta loamy fine sand, 6 to 12 percent slopes, eroded	99	VIs-1	18	5	28
SpD2	Sparta loamy fine sand, 12 to 20 percent slopes, eroded	99	VIIs-1	18	6	28
St	Steep stony and rocky land	100	VIIs-1	18	4	27
Tm	Terrace escarpments, loamy	100	VIIe-1	18	2	25
Tn	Terrace escarpments, sandy	100	VIIs-1	18	6	28
ToA	Toddville silt loam, 0 to 2 percent slopes	100	I-1	8	9	30
ToB	Toddville silt loam, 2 to 6 percent slopes	100	IIe-1	8	9	30
UfF	Urne fine sandy loam, 30 to 45 percent slopes	101	VIIe-1	18	4	27
UfF2	Urne fine sandy loam, 30 to 45 percent slopes, moderately eroded	101	VIIe-1	18	4	27
UfF3	Urne fine sandy loam, 30 to 45 percent slopes, severely eroded	101	VIIe-1	18	4	27
UnB2	Urne and Norden fine sandy loams, 2 to 6 percent slopes, moderately eroded	101	IIIs-1	13	3	26
UnC2	Urne and Norden fine sandy loams, 6 to 12 percent slopes, moderately eroded	101	IVe-3	14	3	26
UnC3	Urne and Norden fine sandy loams, 6 to 12 percent slopes, severely eroded	101	VIe-2	17	3	26
UnD	Urne and Norden fine sandy loams, 12 to 20 percent slopes	101	VIe-2	17	4	27
UnD2	Urne and Norden fine sandy loams, 12 to 20 percent slopes, moderately eroded	101	VIe-2	17	4	27
UnD3	Urne and Norden fine sandy loams, 12 to 20 percent slopes, severely eroded	102	VIIe-1	18	4	27
UnE	Urne and Norden fine sandy loams, 20 to 30 percent slopes	102	VIIe-1	18	4	27
UnE2	Urne and Norden fine sandy loams, 20 to 30 percent slopes, moderately eroded	102	VIIe-1	18	4	27
UnE3	Urne and Norden fine sandy loams, 20 to 30 percent slopes, severely eroded	102	VIIe-1	18	4	27
Wa	Wallkill silt loam	102	IIw-2	10	10	30
Wf	Watseka loamy fine sand	102	IVs-1	15	5	28
WkA	Waukegan silt loam, 0 to 2 percent slopes	103	IIs-1	10	9	30
WkB	Waukegan silt loam, 2 to 6 percent slopes	103	IIe-2	9	9	30
WkB2	Waukegan silt loam, 2 to 6 percent slopes, moderately eroded	103	IIe-2	9	9	30
WkC2	Waukegan silt loam, 6 to 12 percent slopes, moderately eroded	103	IIIe-3	11	9	30
Zg	Zwingle silt loam	103	IIw-1	10	8	29
Zw	Zwingle silt loam, poorly drained variant	104	IIw-1	10	8	29

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