SOIL SURVEY OF
Dunn County, Wisconsin

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Wisconsin Research Division
of the
College of Agriculture and Life Sciences
University of Wisconsin

Major fieldwork for this soil survey was completed in 1969. Soil names and descriptions were approved in 1970. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1969. This survey was made cooperatively by the Soil Conservation Service and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the Dunn County Soil and Water Conservation District. Fieldwork was partly financed by Dunn County.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Dunn County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the management group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the descriptions of the capability units.

Foresters and others can refer to the section "Use of the Soils for Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Developers of campground and other recreational facilities can refer to the section "Use of the Soils for Recreation" for information about the various uses of the soils for recreation.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Dunn County may 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."

Cover: Contour strips of corn and alfalfa on Seaton silt loam. Trees in the background are on Steep stony rock land.

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SOIL SURVEY OF DUNN COUNTY, WISCONSIN

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE WISCONSIN RESEARCH DIVISION OF THE COLLEGE OF AGRICULTURE AND LIFE SCIENCES, UNIVERSITY OF WISCONSIN

DUNN COUNTY is in the northwestern part of Wisconsin (fig. 1). It has a land area of 545,792 acres. Of this, about 260,865 acres is used for crops, about 51,993 acres is in pasture, and about 108,911 acres is in woodland. The rest is used for homesteads, towns, lakes, and roads. Menomonie, the largest town, is the county seat. It is also the site of Stout State University.

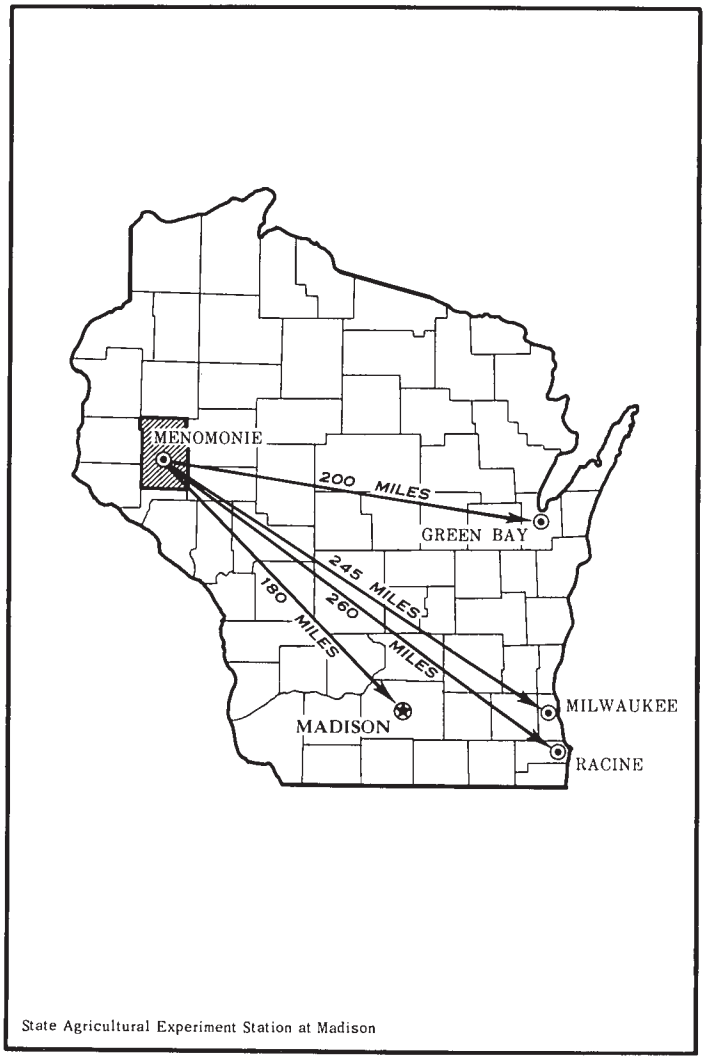

Figure 1.—**Location of Dunn County in Wisconsin.**

Although dairying is the major source of farm income, beef-cattle farming is also important. The principal crops grown for livestock feed are corn, oats, and alfalfa. Bromegrass, timothy, and red clover are sometimes grown with the alfalfa. Milk processing plants are located in Menomonie, Connorsville, Knapp, Boyceville, and Colfax. Extensive acreages of soybeans are grown and small acreages of cucumbers, peas, and snap beans. Turkey raising is becoming common in some of the sandy areas in the northern part of the county. The turkeys are processed at a large plant in adjoining Barron County. A large commercial apple orchard is in the town of Weston.

Only about 25 percent of the rural population work on the farms full time. The rest live on the smaller farms and commute to off-the-farm jobs. More than 100 people are employed by a garment factory in Menomonie.

Dunn County is drained by two major streams. The Chippewa River flows across the southeast corner. The Red Cedar River enters the county at the northeast corner and flows southwesterly to a point about midway of the southern boundary of the county, where it empties into the Chippewa River.

Dunn County has many recreational areas. The Red Cedar and Chippewa Rivers and Lakes Menomonie and Tainter provide fishing. The extensive bottom lands along these streams, together with other wooded areas, provide hunting.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Dunn County, where they are located, and how they can be used. The soil scientists went into the county knowing they would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug 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 into the parent material that has not been changed much by leaching or by action of plant roots.

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 nationwide, uniform procedures. The soil series and the soil phase are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series (*12*).[1] 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 observed and mapped. Dakota and Plainfield, 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 those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Dakota loam, 0 to 2 percent slopes, is one of several phases within the Dakota series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. 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 phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such mapping unit shown on the soil map of Dunn County is the soil complex.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Urne-Norden loams, 2 to 6 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Alluvial land, loamy, is a land type in Dunn County.

A soil variant is a soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but of such limited known area that creation of a new series is not believed to be justified. Boaz silt loam, dark variant, is an example.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others; then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Dunn County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

Soil associations and delineations on the general soil map in this soil survey do not always agree or join fully with general soil maps of the adjacent counties published at an earlier date. Differences are brought about by better knowledge about soils and modifications and refinements in soil series concepts. In addition, the uses

[1] Italic numbers in parentheses refer to Literature Cited, p. 115.

of the general soil map have expanded in recent years; thus, a more precise and detailed map is required to accommodate the needed interpretations.

The eight soil associations in Dunn County are described on the following pages.

1. Steep stony rock land-Seaton association

Stones and outcrops of limestone and sandstone and nearly level to steep, well-drained soils that have a silt loam subsoil underlain by silty deposits; on uplands

This association is in the southwestern part of the county. The landscape is one of broad upland ridgetops bordering steep valley slopes that grade downward to less sloping valley benches and bottom land.

This association makes up about 6 percent of the county. It is about 56 percent Steep stony rock land, 31 percent Seaton soils, and 13 percent Dunbarton, Dubuque, Tell, Boaz, and Arenzville soils.

Steep stony rock land is on valley sides. It consists of a shallow, loamy soil mantle over limestone and sandstone. In many places rock crops out. Most north- and east-facing slopes are timbered. Some south- and west-facing slopes are in native drought-resistant grasses and shrubs.

Seaton soils are on upland ridgetops and valley slopes and are well drained. They formed in deep silt. They have a plow layer of very dark grayish-brown silt loam and a subsoil of dark yellowish-brown heavy silt loam that extends to a depth of 35 to 48 inches. Beneath the subsoil is 2 to 10 feet of friable silt loam. Bedrock is sandstone or limestone.

Dunbarton and Dubuque soils are on ridgetops. Tell, Boaz, and Arenzville soils are in the valley.

All but Steep stony rock land and some areas on botton land is suited to all crops commonly grown in the county. Controlling erosion and maintaining soil tilth and fertility are the main concerns in cultivated areas.

2. Otterholt-Almena association

Gently sloping and sloping, well-drained and somewhat poorly drained soils that have a silt loam subsoil underlain by glacial till; on uplands

This association is along the western border of the county. The landscape is one of broad upland ridges that are dissected by shallow drainageways and depressions.

This association makes up about 4 percent of the county. It is about 55 percent Otterholt soils, 10 percent Almena soils, and 35 percent Santiago, Renova, Amery, Arland, and the wet variant of the Almena soils.

Otterholt soils are well drained. They formed in a deep layer of windblown silt over glacial till. The surface layer is very dark grayish-brown silt loam about 7 inches thick, and the subsurface layer is about 6 inches of dark grayish-brown silt loam. The subsoil is dark-brown silt loam about 23 inches thick.

Almena soils are similar to Otterholt soils, but they are somewhat poorly drained and do not warm up so early in spring. The surface layer is 8 inches of very dark grayish-brown silt loam, and the subsurface layer is dark grayish-brown silt loam mottled with dark yellowish brown.

Most of the association is cultivated and is suited to all crops commonly grown in the county. Uncultivated areas are used for pasture or woodland. Controlling erosion and maintaining soil fertility are the main concerns of management. A seasonal high water table is a concern in areas of Almena soils.

3. Seaton-La Farge association

Nearly level to steep, well-drained soils that have a silt loam and silty clay loam subsoil underlain by sandstone or silt loam; on uplands

This association occupies two areas. One of these is an elongated area, west of the Red Cedar River, that extends roughly from State Highway 72 northward to a point a few miles north of the village of Knapp. The other is a small area north of the village of Colfax in the northeastern part of the county. The landscape is one of dominantly nearly level to steep soils on narrow upland ridges, valley slopes, and benches.

This association makes up about 8 percent of the county. It is about 45 percent Seaton soils, 30 percent La Farge soils, and about 25 percent Northfield, Norden, Urne, Tell, and Meridian soils.

Seaton soils are on upland ridgetops and valley sides. These are gently sloping to steep soils that formed in deep silt. They have a subsoil of heavy silt loam underlain by a thick layer of friable silt loam.

La Farge soils occupy upland ridgetops and valley sides. These are gently sloping to steep soils that formed in silt somewhat less deep than the parent material of Seaton soils. They have a surface layer of dark-brown silt loam and a subsoil of dark yellowish-brown light silty clay loam. Fine-grained glauconitic sandstone begins at a depth of 20 to 40 inches.

The soils of this association are well suited to all the crops grown in the county. Natural fertility is high to medium. The principal hazard is water erosion. Contour stripcropping, diversions, sodded waterways, and long crop rotations are some of the practices used to control erosion.

4. Urne-Elkmound association

Moderately steep to very steep, well-drained soils that have a loam and very fine sandy loam subsoil underlain by sandstone; on uplands

This association is mainly in the eastern part of the county. The landscape is one of moderately steep to very steep upland ridges and narrow, nearly level to gently sloping stream terraces and bottom lands.

This association makes up about 45 percent of the county. About 60 percent of the association consists of Urne-Elkmound complexes. The remaining 40 percent consists mainly of Norden, Northfield, Eleva, Billett, and Shiffer soils.

Both Urne and Elkmound soils formed in a mantle of loamy residuum over sandstone. The residuum ranges from less than 20 inches to 36 inches in thickness.

Urne soils have a surface layer of very dark brown loam and a subsoil of dark brown loam and very fine sandy loam. They are underlain by weakly cemented sandstone at a depth of about 22 inches.

Elkmound soils have a surface layer, about 7 inches thick, of very dark grayish-brown loam and a subsoil

of dark yellowish-brown loam. They are underlain by sandstone at a depth of about 14 inches.

Most of this association is used for pasture or woodland. Maintaining fertility of the soils and good stands of pasture plants are the main concerns in pastured areas. Protection from grazing is needed in most of the wooded areas.

5. Dakota-Meridian-Shiffer association

Nearly level to sloping, well-drained to somewhat poorly drained soils that have a loam or sandy loam subsoil underlain by sand or sand and gravel outwash; on uplands

This association is in the east-central part of the county. It is a narrow, irregularly shaped area extending northward nearly to the village of Sand Creek and southward to Fall City.

This association makes up about 8 percent of the county. It is about 30 percent Dakota soils, 20 percent Meridian soils, 15 percent Shiffer soils, and 35 percent Lows, Billett, Chetek, and Burkhardt soils.

Dakota soils are well drained. They formed under prairie grasses and have a thicker and darker colored surface layer than that of Meridian soils. Their surface layer is very dark brown loam about 10 inches thick. The subsoil is dark-brown loam in the upper part and sandy loam in the lower part. The underlying material is sand and gravel.

Meridian soils are well drained. They have a surface layer of very dark grayish-brown loam, about 8 inches thick, and a subsurface layer of dark grayish-brown fine sandy loam. The upper part of the subsoil is dark-brown heavy loam, and the lower part is dark-brown sandy loam. The underlying material is yellowish-brown sand.

Shiffer soils are somewhat poorly drained. They have a surface layer of very dark grayish-brown loam, about 9 inches thick, and a subsurface layer of grayish-brown loam. The upper part of the subsoil is brown and yellowish-brown loam, and the lower part is dark-brown sandy loam. The underlying material is stratified sand, loamy sand, and sandy loam.

The soils of this association are well suited to farming. Drought is a moderate hazard except in areas of Shiffer soils. Irrigation systems have been installed in a few areas of Dakota and Meridian soils, and the use of irrigation is increasing.

6. Plainfield-Plainbo association

Nearly level to sloping, excessively drained soils that have a loamy sand or sand subsoil underlain by sand or sandstone; on uplands

This association is mainly along the Chippewa, Red Cedar, and Hay Rivers in the central and southeastern parts of the county. It makes up about 21 percent of the county. It is about 38 percent Plainfield soils, 33 percent Plainbo soils, and 29 percent Morocco, Gotham, Hubbard, Newton, Markey, and Houghton soils.

Plainfield soils have a surface layer of very dark grayish-brown loamy sand about 7 inches thick. The subsoil is dark-brown loamy sand in the upper part and dark yellowish-brown loamy sand in the lower part. The underlying material is dark yellowish-brown sand and yellowish-brown fine sand that extends to a depth of 60 inches or more. Plainbo soils are similar to Plainfield soils but are underlain by sandstone at a depth of 20 to 40 inches.

Some of this association is cultivated, but much of it is wooded or is in grasses. Low available water capacity, low natural fertility, and the hazard of soil blowing are the main limitations if the soils of this association are used for crops. Some areas are irrigated and planted to corn. Soybeans and alfalfa are other common crops. Large acreages have been planted to Norway pine and white pine.

7. Lows-Campia association

Nearly level, poorly drained to well-drained soils that have a loam and silty clay loam subsoil underlain by sand and silty clay loam; on uplands

This association is on broad flats and depressions along streams. The largest area is northwest of Menomonie, adjacent to Highways 12 and 79. A smaller area is west of Lake Tainter along Lamb Creek.

This association makes up about 2 percent of the county. It is about 70 percent Lows soils, 10 percent Campia soils, and 20 percent Boaz and Shiffer soils.

Lows soils are poorly drained. They have a surface layer of very dark gray loam about 6 inches thick. The subsurface layer is light-gray loam. The subsoil is gray mottled loam, and the underlying material is gray sand. The water table is high. Natural fertility is medium.

Campia soils are well drained. They have a very dark grayish-brown surface layer about 9 inches thick and a subsurface layer of brown loam. The subsoil is dark-brown loam over silty clay loam. The underlying material is brown mottled silty clay loam.

The soils of this association can be used for crops, but in most places wetness delays spring planting and retards growth. Ditches have been constructed in some areas to improve drainage. In areas of Lows soils, limitations are severe if the soils are used for homesites or sewage disposal filter fields.

8. Alluvial land, wet-Boaz association

Nearly level sandy loams to silt loams and nearly level, poorly drained soils that have a silty clay loam subsoil; on flood plains

This association consists of alluvial soils along the major streams of the county. The largest areas are on bottom lands along the Chippewa, Red Cedar, and Eau Galle Rivers.

This association makes up about 6 percent of the county. It is about 40 percent Alluvial land, wet, and about 30 percent Boaz soils. The remaining 30 percent consists mainly of Alluvial land, sandy; Alluvial land, loamy; Riverwash; and the dark variant of the Boaz soils.

Boaz soils have a surface layer of very dark gray silt loam about 5 inches thick. The upper part of the subsoil is mottled dark grayish-brown silty clay loam and silt loam. The underlying material is mottled light brownish-gray silt loam.

Some of this association is cultivated, but crops are

commonly damaged by flooding. Limitations are severe if these soils are used for homesites or sewage disposal filter fields.

Descriptions of the Soils

This section describes the soil series and mapping units in Dunn County. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless it is otherwise stated, the colors given in the descriptions are those of a moist soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Alluvial land, loamy, for example, does not belong to a soil series, but nevertheless is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. At the end of each description of a mapping unit is the capability unit and the woodland, tree and shrub, wildlife, and recreation groups to which the mapping unit has been assigned. The page for the description of the interpretive groups can be found by referring to the "Guide to Mapping Units."

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent	Soil	Acres	Percent
Alluvial land, loamy	2,670	0.5	Dubuque silt loam, 6 to 12 percent slopes, eroded	1,220	0.2
Alluvial land, sandy	3,980	.7	Dubuque silt loam, 12 to 20 percent slopes, eroded	930	.2
Alluvial land, wet	8,160	1.5	Dubuque silt loam, 20 to 30 percent slopes, eroded	280	.1
Almena silt loam, 2 to 6 percent slopes	1,450	.3	Dunbarton silt loam, 2 to 6 percent slopes, eroded	150	(1)
Almena silt loam, wet variant	240	(1)	Dunbarton silt loam, 6 to 12 percent slopes, eroded	590	.1
Amery loam, 2 to 6 percent slopes	240	(1)	Dunbarton silt loam, 12 to 20 percent slopes, eroded	270	.1
Amery loam, 6 to 12 percent slopes, eroded	540	.1	Dunbarton silt loam, 20 to 30 percent slopes	620	.1
Amery loam, 12 to 20 percent slopes, eroded	1,050	.2	Dunnville loam	430	.1
Arenzville silt loam	5,560	1.0	Dunnville silt loam, silty subsoil variant	590	.1
Arland sandy loam, 6 to 12 percent slopes, eroded	360	.1	Eleva sandy loam, 2 to 6 percent slopes	630	.1
Arland sandy loam, 12 to 20 percent slopes, eroded	120	(1)	Eleva sandy loam, 6 to 12 percent slopes, eroded	2,000	.4
Billett sandy loam, 0 to 2 percent slopes	1,520	.3	Elkmound loam, 0 to 2 percent slopes	500	.1
Billett sandy loam, 2 to 6 percent slopes	5,200	1.0	Elkmound loam, 2 to 6 percent slopes	1,700	.3
Billett sandy loam, 6 to 12 percent slopes, eroded	2,080	.4	Elkmound loam, 6 to 12 percent slopes, eroded	3,970	.7
Billett sandy loam, mottled subsoil variant	2,110	.4	Gotham loamy fine sand, 0 to 2 percent slopes	5,180	.9
Boaz silt loam	6,140	1.1	Gotham loamy fine sand, 2 to 6 percent slopes	3,700	.7
Boaz silt loam, dark variant	1,680	.3	Gotham loamy fine sand, 6 to 12 percent slopes, eroded	630	.1
Brems loamy sand	950	.2	Gotham loamy fine sand, loamy substratum, 0 to 2 percent slopes	370	.1
Burkhardt sandy loam, 0 to 6 percent slopes	800	.1	Gotham loamy fine sand, loamy substratum, 2 to 6 percent slopes	960	.2
Burkhardt sandy loam, 6 to 12 percent slopes, eroded	500	.1	Gotham loamy fine sand, loamy substratum, 6 to 12 percent slopes, eroded	340	.1
Campia loam, 0 to 2 percent slopes	1,290	.2	Hixton loam, 2 to 6 percent slopes	400	.1
Caryville loam	1,880	.3	Hixton loam, 6 to 12 percent slopes, eroded	850	.2
Cathro muck	2,520	.5	Hixton loam, 12 to 20 percent slopes, eroded	900	.2
Chetek sandy loam, 0 to 2 percent slopes	900	.2	Hixton loam, mottled subsoil variant, 2 to 6 percent slopes	630	.1
Chetek sandy loam, 2 to 6 percent slopes	740	.1	Houghton peaty muck	12,300	2.3
Chetek sandy loam, 12 to 20 percent slopes, eroded	150	(1)	Hubbard loamy sand, 0 to 2 percent slopes	15,830	2.9
Chetek sandy loam, 20 to 30 percent slopes, eroded	150	(1)	Hubbard loamy sand, 2 to 6 percent slopes	8,860	1.6
Dakota sandy loam, 0 to 2 percent slopes	1,670	.3	Hubbard loamy sand, 6 to 12 percent slopes, eroded	1,190	.2
Dakota sandy loam, 2 to 6 percent slopes	1,770	.3			
Dakota loam, 0 to 2 percent slopes	9,900	1.8			
Dakota loam, 2 to 6 percent slopes	810	.1			
Dickinson sandy loam, 0 to 2 percent slopes	3,070	.6			
Dickinson sandy loam, 2 to 6 percent slopes	1,890	.3			
Dubuque silt loam, 2 to 6 percent slopes	690	.1			

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Acres	Percent	Soil	Acres	Percent
Hubbard loamy sand, loamy substratum	400	0. 1	Plainfield loamy sand, 0 to 2 percent slopes	23, 030	4. 2
Hubbard sand, hummocky	330	. 1	Plainfield loamy sand, 2 to 6 percent slopes	11, 350	2. 1
Kickapoo fine sandy loam	910	. 2	Plainfield loamy sand, 6 to 12 percent slopes, eroded	9, 610	1. 8
La Farge silt loam, 2 to 6 percent slopes	1, 170	. 2	Poskin silt loam	570	. 1
La Farge silt loam, 6 to 12 percent slopes, eroded	780	. 1	Renova silt loam, 2 to 6 percent slopes	430	. 1
La Farge silt loam, 6 to 12 percent slopes, severely eroded	320	. 1	Renova silt loam, 6 to 12 percent slopes, eroded	520	. 1
La Farge silt loam, 12 to 20 percent slopes, eroded	1, 350	. 2	Renova silt loam, 12 to 20 percent slopes, eroded	310	. 1
La Farge silt loam, 12 to 20 percent slopes, severely eroded	1, 280	. 2	Rib silt loam	820	. 1
La Farge silt loam, 20 to 30 percent slopes, eroded	8, 030	1. 5	Rib silt loam, moderately shallow variant	370	. 1
Lows loam	11, 440	2. 1	Riverwash	680	. 1
Markey muck	5, 110	. 9	Santiago silt loam, 2 to 6 percent slopes	830	. 2
Marshan silt loam	2, 720	. 5	Santiago silt loam, 6 to 12 percent slopes, eroded	550	. 1
Meridian loam, 0 to 2 percent slopes	6, 800	1. 2	Seaton silt loam, 2 to 6 percent slopes	6, 430	1. 2
Meridian loam, 2 to 6 percent slopes	3, 650	. 7	Seaton silt loam, 6 to 12 percent slopes, eroded	5, 380	1. 0
Meridian loam, 6 to 12 percent slopes, eroded	310	. 1	Seaton silt loam, 12 to 20 percent slopes, eroded	8, 790	1. 6
Morocco loamy sand	2, 060	. 4	Seaton silt loam, 20 to 30 percent slopes, eroded	7, 120	1. 3
Morocco sandy loam, loamy subsoil variant	1, 940	. 4	Seaton silt loam, benches, 0 to 2 percent slopes	1, 690	. 3
Newton loamy sand	5, 480	1. 0	Seaton silt loam, benches, 2 to 6 percent slopes	1, 120	. 2
Norden silt loam, 2 to 6 percent slopes	1, 880	. 3	Shiffer loam	6, 950	1. 3
Norden silt loam, 6 to 12 percent slopes, eroded	1, 620	. 3	Steep stony rock land	21, 290	4. 0
Norden silt loam, 12 to 20 percent slopes, eroded	1, 790	. 3	Stronghurst silt loam	5, 720	1. 0
Norden silt loam, 20 to 30 percent slopes, eroded	3, 300	. 6	Tell silt loam, 0 to 2 percent slopes	960	. 2
Northfield silt loam, 0 to 2 percent slopes	280	. 1	Tell silt loam, 2 to 6 percent slopes	470	. 1
Northfield silt loam, 2 to 6 percent slopes	1, 880	. 3	Tell silt loam, 6 to 12 percent slopes, eroded	390	. 1
Northfield silt loam, 6 to 12 percent slopes, eroded	420	. 1	Terrace escarpments, sandy	2, 690	. 5
Otterholt silt loam, 2 to 6 percent slopes	12, 370	2. 3	Terrace escarpments, loamy	2, 600	. 5
Otterholt silt loam, 6 to 12 percent slopes, eroded	2, 310	. 4	Terril loam	860	. 2
Palsgrove silt loam, deep, 2 to 6 percent slopes	1, 890	. 3	Urne-Elkmound loams, 12 to 20 percent slopes, eroded	67, 840	12. 4
Palsgrove silt loam, deep, 6 to 12 percent slopes, eroded	2, 600	. 5	Unre Elkmound loams, 20 to 40 percent slopes	80, 532	14. 7
Palsgrove silt loam, deep, 12 to 20 percent slopes, eroded	1, 150	. 2	Urne-Norden loams, 2 to 6 percent slopes	1, 470	. 3
Pillot silt loam	2, 930	. 5	Urne-Norden loams, 6 to 12 percent slopes, eroded	1, 120	. 2
Plainbo loamy sand, 2 to 6 percent slopes	8, 290	1. 5	Urne-Norden loams, 12 to 20 percent slopes, eroded	380	. 1
Plainbo loamy sand, 6 to 12 percent slopes, eroded	14, 830	2. 7	Urne-Norden loams, 20 to 30 percent slopes, eroded	1, 290	. 2
Plainbo loamy sand, 12 to 40 percent slopes	19, 980	3. 7	Urne-Norden loams, 30 to 45 percent slopes	990	. 2
			Wallkill silt loam	240	(1)
			Total	545, 792	100. 0

[1] Less than 0.05 percent.

Alluvial Land, Loamy

Alluvial land, loamy (0 to 2 percent slopes) (Ad) consists of loamy alluvial sediments on stream bottoms. The texture ranges from silt loam to sand. In some places small amounts of sand or gravel are on the surface and mixed with the soil. Generally, this land type is well drained to moderately well drained, but the soil is wet in a few places.

Included in the areas mapped are small areas of Arenzville, Boaz, and Caryville soils.

The available water capacity is medium, and permeability is moderate. Natural fertility is high. Surface runoff is slow, and flooding is common in spring and after heavy rains.

A few areas are used for corn or soybeans, but these crops are sometimes damaged by flooding. Most of the acreage is suited to pasture, woodland, wildlife habitat, and other less intensive uses. Capability unit IIIw–12; woodland group 3w5; tree and shrub group 3; wildlife group 7; recreation group 8.

Alluvial Land, Sandy

Alluvial land, sandy (0 to 2 percent slopes) (Ae) consists of deep sandy alluvium (fig. 2) on flood plains. This land type is near areas of Alluvial land, wet, but the soil material is coarser textured and better drained.

Alluvial land, sandy, is subject to frequent flooding, and the floodwaters stand for long periods at times. Several inches of sand may be deposited during these periods, and in places, enough sand is deposited to kill the vegetation. The soil material dries out rapidly after the water recedes.

Permeability is rapid, and the available water capacity is low. Drought is a severe hazard, and natural fertility is low. Plant growth is limited.

This land type is suited mainly to wildlife plantings,

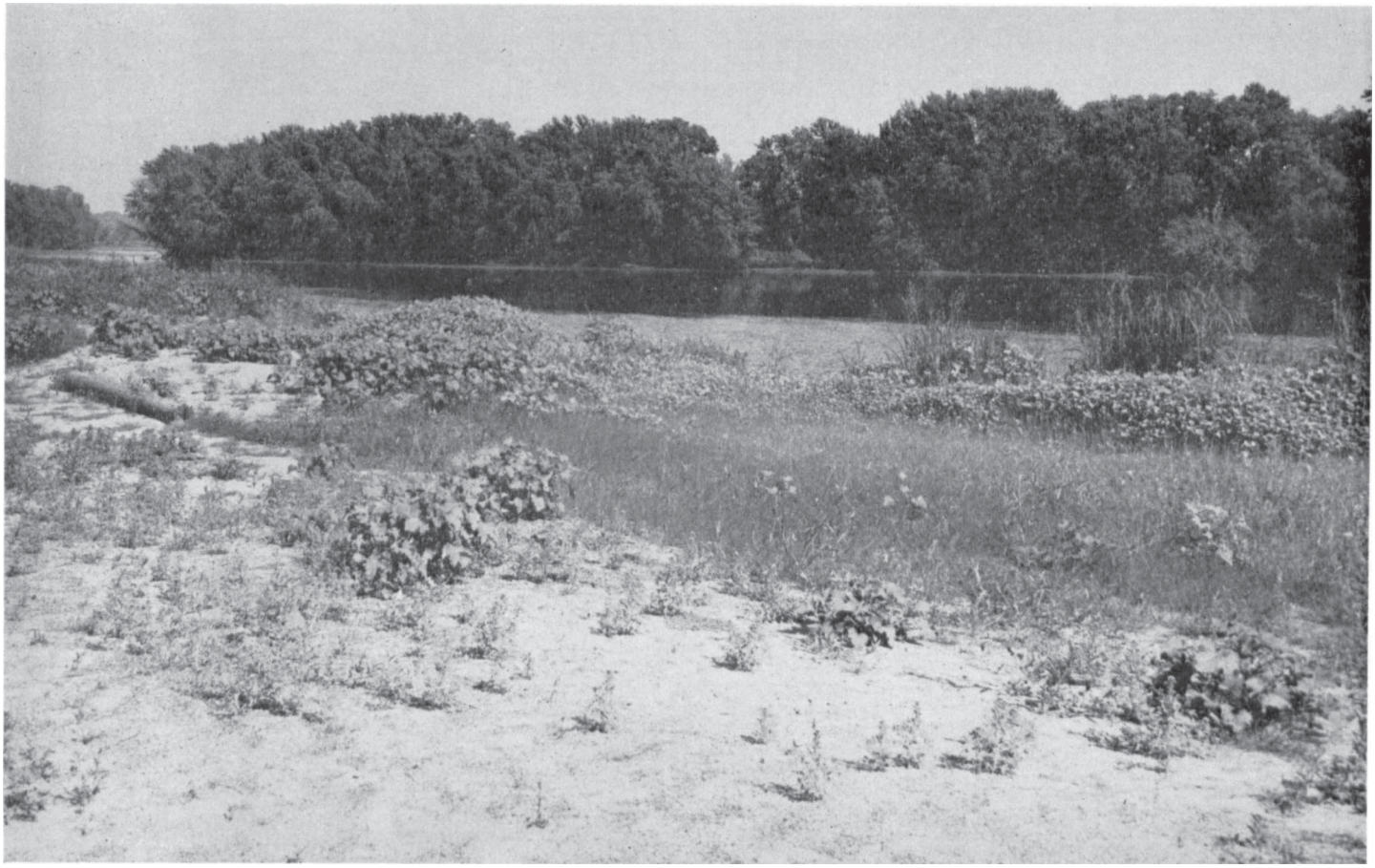

Figure 2.—**An area of Alluvial land, sandy, on the flood plain of the Chippewa River.**

trees, and pasture. Capability unit VIIs–9; woodland group 6s1; wildlife group 7; recreation group 8; not in a tree and shrub group.

Alluvial Land, Wet

Alluvial land, wet (0 to 2 percent slopes) (Af) consists of alluvial sediments in slight depressions on flood plains. The texture ranges from sandy loam to silt loam. The uppermost part of the soil material ranges from light grayish brown to black. The water table is at or near the surface during most of the year.

Some of the most extensive areas of this land type are on flood plains of the Chippewa River. Other areas are along the Red Cedar River and on creek bottoms throughout the county. All of the areas are commonly dissected by sloughs, oxbows, and dry stream channels. They are subject to frequent flooding and are sometimes inundated for several days. During such times additional soil material is deposited. Surface runoff is very slow.

The vegetation is bluegrass, sedges, willows, alders, river birches, soft maple, and other water-tolerant trees and plants. This land type is suited to woodland and wildlife habitat. Some areas are used for pasture. Capability unit Vw–14; woodland group 4w5; tree and shrub group 3; wildlife group 5b; recreation group 7.

Almena Series

The Almena series consists of deep, somewhat poorly drained, loamy soils on uplands. These soils are underlain by acid glacial till.

In a representative profile the surface layer is very dark grayish-brown silt loam about 8 inches thick. The subsurface layer is dark grayish-brown silt loam, about 10 inches thick, that contains distinct, dark-brown mottles. At a depth of about 18 inches is a layer, about 3 inches thick, that contains dark yellowish-brown mottles. The subsoil, about 15 inches thick, is dark grayish-brown heavy silt loam mottled with dark yellowish brown. The underlying material is about 24 inches thick and is dark grayish-brown silt loam mottled with dark yellowish brown. This layer is underlain by reddish-brown sandy clay loam that contains a few granitic cobblestones and some gravel.

The available water capacity is high, and permeability is moderate to moderately slow. Natural fertility is moderate, but the soils are slow to warm up in spring. Surface runoff is slow to medium.

525-315—75——2

Representative profile of Almena silt loam, 2 to 6 percent slopes, in a cultivated field, in an area where the slope is 5 percent and the soil has a south aspect; 20 feet south of center of County Highway X and one-third mile east of center of County Highway P; NE¼NW¼ sec. 18, T. 27 N., R. 14 W.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate, medium, subangular blocky structure; friable; neutral; abrupt, smooth boundary.

A21—8 to 15 inches, dark grayish-brown (10YR 4/2) silt loam; common, medium, faint, dark-brown (10YR 4/3) mottles; weak, coarse, prismatic structure parting to weak, medium, platy; light-gray (10YR 7/1) silt coatings on ped faces; friable; medium acid; clear, smooth boundary.

A22—15 to 18 inches, dark grayish-brown (10YR 4/2) silt loam; many, medium, faint, dark-brown (10YR 4/3) mottles; weak, coarse, prismatic structure parting to weak, medium, platy; light-gray (10YR 7/1) silt coatings on ped faces; friable; medium acid; clear, smooth boundary.

A&B 18 to 21 inches, grayish-brown (10YR 5/2 silt loam; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; light-gray (10YR 7/1) bleached silt tongues that make up more than 50 percent of the horizon and extend into the upper part of the B2t horizon; friable; medium acid; gradual, smooth boundary.

B2t—21 to 30 inches, dark grayish-brown (2.5Y 4/2) heavy silt loam that makes up less than 60 percent of the horizon; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; thin patchy clay films on ped faces; friable; medium acid; gradual, smooth boundary.

B3—30 to 36 inches, dark grayish-brown (2.5Y 4/2) silt loam; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; friable; medium acid; gradual, wavy boundary.

C1—36 to 60 inches, dark grayish-brown (2.5Y 4/2) silt loam; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, platy structure; friable; neutral; gradual, wavy boundary.

IIC2—60 to 100 inches, reddish-brown (5YR 4/4) sandy clay loam that contains a few granitic cobblestones and some gravel; massive; friable; medium acid.

The Ap horizon ranges from 6 to 9 inches in thickness. The light-gray tongues in the A&B horizon make up 50 to 60 percent of the horizon. In the B2t horizon about 40 to 60 percent of the soil mass has low-chroma colors. The C1 horizon ranges from 1 to 4 feet in thickness. The hue of the glacial till ranges from 7.5YR to 2.5YR. The texture of the till ranges from sandy clay loam to heavy loam.

Almena soils are somewhat poorly drained and have a mottled subsoil, unlike the associated Otterholt soils, which are well drained. They are underlain by glacial till rather than deep silt, as are the associated Stronghurst soils.

Almena silt loam, 2 to 6 percent slopes (AmB).—This soil occupies oblong-shaped depressions on uplands. In cultivated fields the surface layer is dark grayish brown; a few areas are darker brown.

Included with this soil in mapping are small areas of Santiago silt loam and Otterholt silt loam. Also included are less sloping areas and areas where internal drainage is more restricted.

Poor internal drainage is the chief management problem on this Almena soil. Spring planting must be delayed, and in wet years the excess moisture causes reduced crop yields.

This Almena soil is suited to pasture, hay crops, and grain. It is also suitable for trees and wildlife plantings. Capability unit IIw–2; woodland group 2w5; tree and shrub group 3; wildlife group 5a; recreation group 5.

Almena Series, Wet Variant

The wet variant of the Almena series consists of poorly drained, loamy soils in depressions and swales on glacial till plains. These soils have a high water table.

In a representative profile the surface layer is silt loam about 3 inches thick. In uncultivated areas the surface layer is very dark brown. The subsurface layer is dark-gray silt loam, about 2 inches thick, and is mottled with yellowish red. The subsoil is dark grayish-brown silt loam and gray loam about 26 inches thick. The underlying material is dark yellowish-brown gravelly sandy loam.

The available water capacity is high, and permeability is moderate to moderately slow. Natural fertility is high. Surface runoff is slow.

Representative profile of Almena silt loam, wet variant, in a pasture where the slope is 1 percent, 300 feet south of the Barron County line and 50 feet east of the St. Croix County line; NW¼NW¼ sec. 6, T. 31 N., R. 14 W.

A1—0 to 3 inches, very dark brown (10YR 2/2) silt loam; moderate, fine, subangular blocky structure; friable; strongly acid; clear, smooth boundary.

A2g—3 to 5 inches, dark-gray (10YR 4/1) silt loam; many, medium, prominent, yellowish-red (5YR 4/6) mottles; moderate, thin, platy structure; very friable; strongly acid; clear, smooth boundary.

B1g—5 to 12 inches, dark grayish-brown (2.5Y 4/2) silt loam; many, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable; strongly acid; clear, smooth boundary.

B2tg—12 to 26 inches, dark grayish-brown (2.5Y 4/2) heavy silt loam; fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; friable; strongly acid; clear, smooth boundary.

IIB3g—26 to 31 inches, gray (5Y 6/1) loam; common, coarse, prominent, yellowish-red (5YR 4/8) mottles; weak, coarse, subangular blocky structure; friable; strongly acid; clear, smooth boundary.

IIIC—31 to 60 inches, dark yellowish-brown (10YR 4/4) gravelly sandy loam; structureless; loose; strongly acid.

The surface layer ranges from 1 to 5 inches in thickness. In some places the surface is free of stones, and in others the surface is so stony that clearing is necessary before the soil can be used for crops. The surface layer ranges from black (10YR 2/1) to very dark brown (10YR 2/2). The underlying glacial drift ranges from gravelly sandy loam to loam in texture.

The wet variant soils of the Almena series are underlain by loam to gravelly sandy loam till, unlike the Rib soils, which are underlain by outwash sand and gravel.

Almena silt loam, wet variant (0 to 2 percent slopes) (An).—This soil occupies irregularly shaped tracts in upland depressions and in small swales near the heads of watercourses. The surface layer is black in uncultivated areas, but it is lighter colored in cropped areas.

Included with this soil in mapping are a few small areas of Almena silt loam, 2 to 6 percent slopes.

This wet variant of the Almena soils is used mainly

for small grain and hay. It is also suited to pasture, water-tolerant trees, and water-tolerant plantings for wildlife. Slow surface runoff and poor internal drainage are the chief management problems. Capability unit IIw–2; woodland group 2w5; tree and shrub group 3; wildlife group 5a; recreation group 5.

Amery Series

The Amery series consists of deep, well-drained, loamy soils on glacial till plains of the uplands.

In a representative profile the surface layer is dark grayish-brown loam about 7 inches thick. The subsurface layer is brown loam about 3 inches thick. Below this is about 4 inches of dark-brown loam. The subsoil is about 22 inches thick. The upper 4 inches is dark-brown loam, the next 12 inches is dark-brown heavy loam, and the lower 6 inches is reddish-brown sandy loam. The underlying material is strongly acid, reddish-brown sandy loam.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium to high.

Representative profile of Amery loam, 12 to 20 percent slopes, eroded, in a cultivated field, 600 feet south of center of road and 300 feet east of west line of NW¼ SW¼ sec. 16, T. 30 N., R. 14 W.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak, medium, subangular blocky structure; friable; medium acid; abrupt, smooth boundary.

A2—7 to 10 inches, brown (10YR 5/3) loam; weak, thin, platy structure; very friable; medium acid; clear, smooth boundary.

A&B—10 to 14 inches, dark-brown (7.5YR 4/4) loam; moderate, thick, platy structure parting to weak, medium, subangular blocky; friable; dark grayish-brown (10YR 4/2) tongues of loam extending from the A2 horizon through this layer; strongly acid; clear, smooth boundary.

B2t—14 to 26 inches, dark-brown (7.5YR 4/4) heavy loam; moderate, thick, platy structure parting to weak, medium, subangular blocky; thin patchy clay films; friable; strongly acid; gradual, smooth boundary.

B3t—26 to 32 inches, reddish-brown (5YR 5/4) sandy loam; moderate, coarse, subangular blocky structure; few thin clay films; firm; weakly cemented; strongly acid; clear, wavy boundary.

C—32 to 100 inches, reddish-brown (5YR 4/4) sandy loam; massive; friable; strongly acid.

The surface layer ranges from dark grayish brown (10YR 4/2) to very dark grayish brown (10YR 3/2) in color. The number of stones ranges from few to many. The underlying till ranges from loam to sandy loam in texture and from dark brown (7.5YR 4/4) to reddish brown (5YR 4/3) in color.

Amery soils are coarser textured than the associated Renova and Santiago soils.

Amery loam, 2 to 6 percent slopes (AsB).—This soil occupies irregularly shaped tracts on uplands in the western part of the county. The surface layer is dark grayish brown. In a few areas where slopes are concave, the surface layer is darker colored. This soil has a profile similar to the one described as representative of the series, but its surface layer is thicker and darker colored than that of the representative profile.

Included with this soil in mapping are small areas where slopes are less than 2 percent or more than 6 percent. Also included are small areas of Santiago silt loam and spots that are moderately eroded.

This Amery soil is suited to pasture, trees, and other less intensive uses. Corn, small grain, soybeans, alfalfa, and clover are the main crops. Erosion is the chief hazard. Erosion control and management that maintains the organic-matter content and fertility are needed. Capability unit IIe–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Amery loam, 6 to 12 percent slopes, eroded (AsC2).—In most places the surface layer of this soil is a mixture of the original surface layer and the subsoil. About half of the original surface layer has been lost through erosion. The present surface layer is lower in organic-matter content and fertility and more difficult to keep in good tilth than the uneroded surface layer.

Included with this soil in mapping are small areas where slopes are less than 6 percent or more than 12 percent and spots where the soil is slightly eroded or severely eroded. Also included are small areas of Santiago silt loam.

This Amery soil is suited to corn, small grain, soybeans, alfalfa, clover, pasture, trees, and wildlife plantings. Surface runoff is moderately rapid, and the erosion hazard is moderate. Management for erosion control is essential. Maintaining the organic-matter content and the fertility level is beneficial. Capability unit IIIe–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Amery loam, 12 to 20 percent slopes, eroded (AsD2).—This soil has the profile described as representative of the series. In most places the surface layer is a mixture of the original surface layer and the subsoil. About half of the original surface layer has been lost through erosion. The present surface layer is lower in organic-matter content and fertility and more difficult to keep in good tilth than the uneroded surface layer.

Included with this soil in mapping are small areas where the soil is slightly eroded or severely eroded and small areas of Chetek sandy loam, 12 to 20 percent slopes, eroded.

This Amery soil is suited to corn, small grain, alfalfa, clover, pasture, and trees. Surface runoff is rapid, and the erosion hazard is severe. Contour stripcropping, diversions, and sodded waterways reduce the erosion hazard in cultivated areas. Capability unit IVe–1; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Arenzville Series

The Arenzville series consists of deep, moderately well drained to well drained, loamy soils on bottom lands.

In a representative profile the surface layer is very dark grayish-brown silt loam about 9 inches thick. The underlying material is silt loam to a depth of 60 inches or more. The upper 22 inches is dark grayish brown, the next 11 inches is very dark gray, and the lower 18 inches is dark gray.

The available water capacity is high, and permeability is moderate. Natural fertility is high. Surface runoff is slow, and flooding is a hazard.

Representative profile of Arenzville silt loam, in a cultivated field, 50 feet north of the Pepin County line

and 1,500 feet east of the north-south town road; SW¼ SE¼ sec. 33, T. 26 N., R. 14 W.

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, very fine, subangular blocky structure; friable; neutral; abrupt, smooth boundary.

C—9 to 31 inches, dark grayish-brown (10YR 4/2) silt loam; weak, thin and very thin, platy structure; friable; neutral; abrupt, smooth boundary.

A1b—31 to 42 inches, very dark gray (10YR 3/1) silt loam; weak, fine, subangular blocky structure; very friable; neutral; abrupt, smooth boundary.

Cb—42 to 60 inches, dark-gray (10YR 4/1) silt loam; common, medium, prominent mottles of dark brown (7.5YR 4/4); weak, thin, platy structure; friable; neutral.

The profile varies in color because it is stratified with varying sediments. In places it is covered with a thin layer of sandy overwash and contains thin layers of sand. It is rarely mottled within 18 inches of the surface. The A1b horizon is at a depth of 20 to 36 inches. It ranges from very dark grayish brown (10YR 3/2) to black (10YR 2/1) in color.

The Arenzville soils in this county have a slightly lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of these soils.

Arenzville soils resemble Boaz soils, but they are moderately well drained to well drained, whereas those soils are poorly drained to somewhat poorly drained. Arenzville soils are finer textured throughout the profile than Kickapoo soils.

Arenzville silt loam (0 to 2 percent slopes) (At).—This soil occupies long, narrow areas 15 to 500 acres in size on stream bottoms. In some places it is cut by several shallow stream channels. In most places the surface layer is dark brown to dark grayish brown.

Small areas of Boaz silt loam and Kickapoo fine sandy loam are included with this soil in mapping.

This Arenzville soil is suited to corn, grain, and alfalfa. It is flooded occasionally, and runoff is slow. Nearly all the acreage is cropped. Capability unit IIw–11; woodland group 2o1; tree and shrub group 1; wildlife group 7; recreation group 8.

Arland Series

The Arland series consists of moderately deep, well-drained, loamy soils on upland ridges. These soils formed partly in a thin layer of glacial till and partly in material weathered from the underlying sandstone.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 5 inches thick. The subsurface layer is brown sandy loam about 1 inch thick. The subsoil is about 21 inches thick. The upper 4 inches is reddish-brown sandy loam, the next 13 inches is reddish-brown heavy sandy loam, and the lower part is reddish-brown gravelly loamy sand. The underlying material is yellow fine sand, about 11 inches thick, that is underlain by sandstone bedrock.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. Drought is a moderate hazard.

Representative profile of Arland sandy loam, 12 to 20 percent slopes, eroded, in an idle area where the slope is 19 percent, 25 feet east of center of County Highway Q and 300 feet south of center of east-west town road; NE¼SW¼ sec. 17, T. 30 N., R. 14 W.

A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) sandy loam; moderate, medium, crumb structure; friable; slightly acid; clear, smooth boundary.

A2—5 to 6 inches, brown (10YR 5/3) sandy loam; moderate, medium, platy structure; friable; medium acid; clear, smooth boundary.

B1—6 to 10 inches, reddish-brown (5YR 5/3) sandy loam; moderate, thick, platy structure parting to moderate and strong, medium, subangular blocky; friable; strongly acid; clear, smooth boundary.

B2t—10 to 23 inches, reddish-brown (5YR 4/4) heavy sandy loam; moderate, medium, subangular blocky structure; thin patchy clay films on ped surfaces; friable; strongly acid; clear, smooth boundary.

IIB3—23 to 27 inches, reddish-brown (5YR 4/4) gravelly loamy sand; weak, coarse, subangular blocky structure; very friable; strongly acid; clear, smooth boundary.

IIC—27 to 38 inches, yellow (10YR 7/6) fine sand; single grain; loose; strongly acid; abrupt, smooth boundary.

R—38 to 60 inches, sandstone bedrock.

The A horizon ranges from sandy loam to silt loam in texture. The number of glacial stones and pebbles, both on the surface and in the solum, ranges from a few to many. The solum ranges from 22 to 38 inches in thickness. The underlying till ranges from sandy clay loam to loam or sandy loam in texture.

Arland soils are similar to Amery soils, but have residual sand or sandstone beneath the solum. Like the Hixton soils, they overlie sandstone, but they differ from those soils in having formed in reddish-brown glacial till over sandstone. They lack a component of glauconite in the underlying sandstone, which the Norden soils have. All these soils are underlain by sandstone at depths of 22 to 38 inches.

Arland sandy loam, 6 to 12 percent slopes, eroded (AuC2).—This soil occupies irregularly shaped tracts 3 to 15 acres in size. The profile is similar to the one described as representative of the series, but 6 to 8 inches of the original surface layer has been lost through erosion. Also, the surface layer is low in organic-matter content and difficult to maintain in good tilth. In cultivated areas the surface layer is dark grayish brown, and in most places reddish-brown material from the subsoil has been mixed into the plow layer.

Included with this soil in mapping are small areas of Urne-Elkmound loams and small areas of Amery loam. Also included are small areas where the slope is less than 6 percent or more than 12 percent.

This Arland soil is suited to corn, small grain, alfalfa, and clover. It is well suited to pasture, woodland, and wildlife plantings. Erosion and drought are moderate hazards. Capability unit IVe–4; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 2.

Arland sandy loam, 12 to 20 percent slopes, eroded (AuD2).—This soil has the profile described as representative of the series. The surface layer is generally grayish brown, and in most places reddish-brown material from the subsoil has been mixed into the surface layer. In places 2 to 6 inches of the original surface layer has been lost through erosion; in these areas the surface layer is low in organic-matter content and fertility and difficult to maintain in good tilth.

Included with this soil in mapping are small areas where the slope is less than 12 percent or more than 20 percent. Also included are areas that are slightly and severely eroded. In addition, small areas of Hixton loam and Amery loam are included.

This Arland soil is suited to pasture and trees, to

recreation, and to wildlife habitat. Capability unit VIe–2; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 2.

Billett Series

The Billett series consists of deep, well-drained, loamy soils on stream terraces and outwash plains. These soils are underlain by medium sand.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The subsurface layer is dark-brown fine sandy loam about 3 inches thick. The subsoil is about 17 inches thick. The upper 14 inches is dark yellowish-brown light loam, and the lower part is dark yellowish-brown fine sandy loam. The underlying material is yellowish-brown medium sand that contains a few bands of loamy material ¼ inch to 1½ inches thick.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. The root zone for most crops extends to the underlying material. Drought is a moderate hazard.

Representative profile of Billett sandy loam, 0 to 2 percent slopes, in a cultivated field, 100 feet west of center of north-south road and 700 feet north of south line of NE¼SW¼ sec. 2, T. 26 N., R. 13 W.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam, pale brown (10YR 6/3) dry; weak, fine, granular structure and moderate, medium, subangular blocky structure; very friable; neutral; abrupt, smooth boundary.

A2—8 to 11 inches, dark-brown (10YR 4/3) fine sandy loam; moderate, medium, platy structure; very friable; slightly acid; clear, smooth boundary.

B2t—11 to 25 inches, dark yellowish-brown (10YR 4/4) light loam; moderate, medium, subangular blocky structure; firm; slightly hard when dry; thin patchy clay films; moderately vesicular; dark-brown (10YR 3/3) coatings on surface of aggregates; medium acid; gradual, smooth boundary.

B3—25 to 28 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; moderate, coarse, subangular blocky structure; very friable; medium acid; clear, smooth boundary.

C—28 to 60 inches, yellowish-brown (10YR 5/6) medium sand; single grain; loose; medium acid; common loamy bands ¼ inch to 1½ inches thick.

The B2t horizon ranges from dark yellowish brown (10YR 4/4) to dark brown (10YR 4/3) in color and from light loam to sandy loam in texture.

The Billett soils in this county have a lower soil temperature and a thinner solum than is defined in the range for the series, but this does not alter the use or behavior of these soils.

Billett soils resemble Meridian soils but are coarser textured. They are underlain by loose sandy sediments, unlike the Eleva soils, which are underlain by sandstone. All these soils have a subsoil of loam to sandy loam.

Billett sandy loam, 0 to 2 percent slopes (BlA).—This soil is on stream terraces and outwash plains. It has the profile described as representative of the series. In cultivated areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is more than 2 percent and small areas of Meridian and Plainfield soils.

Most of the acreage of this Billett soil is used for corn, oats, soybeans, alfalfa, and clover, but a small acreage is used for pasture and trees. Moderate droughtiness is the chief management problem. Some areas are irrigated. Capability unit IIIs–4; woodland group 3o1; tree and shrub group 1; wildlife group 1; recreation group 2.

Billett sandy loam, 2 to 6 percent slopes (BlB).—This soil is on stream terraces and gently undulating plains. The profile is similar to the one described as representative of the series, but the surface layer is about 6 inches thick.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are small areas of Meridian loam and Gotham loamy fine sand.

This Billett soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, trees, and other less intensive uses. Drought and erosion are moderate hazards. Capability unit IIIs–4; woodland group 3o1; tree and shrub group 1; wildlife group 1; recreation group 2.

Billett sandy loam, 6 to 12 percent slopes, eroded (BlC2).—This soil is on stream terraces and in valleys. It has a profile similar to that described as representative of the series, but 6 to 8 inches has been lost through erosion. The present surface layer is less friable, lower in organic-matter content and fertility, and more difficult to keep in good tilth than the original surface layer.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are small areas of Meridian loam and Plainfield loamy sand.

This Billett soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture and woodland. Maintenance of tilth is a minor problem. Drought and erosion are moderate hazards. Capability unit IVe–4; woodland group 3o1; tree and shrub group 1; wildlife group 1; recreation group 2.

Billett Series, Mottled Subsoil Variant

The mottled subsoil variant of the Billett series consists of deep, moderately well drained, loamy soils on outwash plains and stream terraces.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark-brown light sandy loam, the next part is dark-brown sandy loam, and the lower part is dark yellowish-brown sandy loam mottled with light brownish gray and yellowish brown. The underlying material is dark yellowish-brown loamy sand mottled with light brownish gray; this layer extends to a depth of about 42 inches. Below this is grayish-brown sand that contains a few loamy bands, ½ to 1½ inches wide, and dark-brown mottles.

The available water capacity is medium, and permeability is moderately rapid. Natural fertility is medium. Surface runoff is slow, and a seasonal water table is at a depth of 3 to 5 feet at times. Drought is a moderate hazard.

Representative profile of Billett sandy loam, mottled subsoil variant, in a cultivated field, 100 feet east of town road and 100 feet south of north line of SW¼ SW¼ sec. 14, T. 28 N., R. 11 W.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam, pale brown (10YR 6/3) dry; weak, medium, subangular blocky structure; very friable; very strongly acid; abrupt, smooth boundary.

B1—8 to 20 inches, dark-brown (10YR 4/3) light sandy loam; weak, medium, platy structure; friable; strongly acid; gradual, smooth boundary.

B2t—20 to 26 inches, dark-brown (7.5YR 4/4) sandy loam; moderate, medium, subangular blocky structure; thin patchy clay films and bridging; friable; strongly acid; clear, smooth boundary.

B3t—26 to 28 inches, dark yellowish-brown (10YR 4/4) sandy loam; moderate, medium, subangular blocky structure; thin patchy clay films on ped surfaces; friable; common, coarse, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/6) mottles; strongly acid; clear, smooth boundary.

C1—28 to 42 inches, dark yellowish-brown (10YR 4/4) loamy sand; weak, coarse, subangular blocky structure; many, coarse, distinct, light brownish-gray (10YR 6/2) mottles; very friable; strongly acid; clear, smooth boundary.

C2—42 to 60 inches, grayish-brown (10YR 5/2) sand that contains a few loamy bands, ¼ inch to 1½ inches wide; common, medium, prominent, dark-brown (7.5YR 4/4) mottles; loose; single grain; strongly acid.

The A horizon ranges from loam to sandy loam in texture. The solum ranges from 26 to 36 inches in thickness.

The mottled subsoil variant of the Billett series occurs as slight depressions within areas of the associated well-drained Billett soils. These soils are underlain by loamy sand, unlike the Brems soils, which are underlain by medium sand. Soils of both these series are moderately well drained.

Billett sandy loam, mottled subsoil variant (0 to 2 percent slopes) (Bm).—This soil is in benches. In cultivated areas the surface layer is very dark grayish brown; in a few places small areas are darker colored. Included in the areas mapped are a few small areas of Billett sandy loam and Shiffer loam.

This mottled subsoil variant of the Billett soils is well suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, trees, and wildlife plantings. Drought is a moderate hazard. Capability unit IIIs–4; woodland group 3w5; tree and shrub group 3; wildlife group 1; recreation group 2.

Boaz Series

The Boaz series consists of deep, poorly drained to somewhat poorly drained, loamy soils on high stream bottoms and along perennial streams.

In a representative profile the surface layer is very dark gray silt loam about 5 inches thick. The subsoil is about 30 inches thick and is mottled throughout with yellowish red and strong brown. The upper part is dark grayish-brown silt loam, the next part is grayish-brown silty clay loam, and the lower part is grayish-brown silt loam. The underlying material is light brownish-gray silt loam mottled with yellowish red and strong brown.

The available water capacity is high, and permeability is moderate. Natural fertility is high. Surface runoff is slow, and the soils are flooded in spring and after heavy rains. These soils have a high water table.

Representative profile of Boaz silt loam, in a pasture, 75 feet south of center of town road and 600 feet east of west line of NE¼NW¼ sec. 22, T. 27 N., R. 14 W.

A1—0 to 5 inches, very dark gray (10YR 3/1) silt loam; moderate, very fine, subangular blocky structure; friable; neutral; clear, smooth boundary.

B1g—5 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; many, medium, prominent, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; friable; neutral; clear, smooth boundary.

B21g—9 to 23 inches, grayish-brown (10YR 5/2) light silty clay loam; many, medium, prominent, yellowish-red (5YR 4/8) and strong-brown (7.5YR 5/6) mottles; mottles make up 50 percent, by volume, of the horizon; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; firm; neutral; gradual, smooth boundary.

B22g—23 to 35 inches, grayish-brown (2.5Y 5/2) heavy silt loam; many, medium, prominent, yellowish-red (5YR 4/8) and strong-brown (7.5YR 5/6) mottles; mottles make up 50 percent, by volume, of the horizon; weak, coarse, subangular blocky structure; firm; slightly acid; gradual, smooth boundary.

Cg—35 to 60 inches, light brownish-gray (2.5Y 6/2) silt loam; many, medium, prominent, yellowish-red (5YR 4/8) and strong-brown (7.5YR 5/6) mottles; massive; friable; slightly acid.

The A1 horizon ranges from 4 to 8 inches in thickness. It is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). The B2 horizon ranges from grayish brown (2.5Y 5/2) to dark grayish brown (2.5Y 4/2) to gray (10YR 5/1). Distinct or prominent high-chroma mottles make up more than 40 percent of the volume throughout the B horizon.

In most areas the Boaz soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Boaz soils have a darker colored surface layer than the associated Arenzville soils and they are somewhat poorly drained to poorly drained, whereas the Arenzville soils are moderately well drained to well drained. Boaz soils lack a buried substratum of mucky peat, which is present in the associated Wallkill soils.

Boaz silt loam (0 to 2 percent slopes) (Bo).—This soil occupies elongated tracts 5 to 40 acres in size. Included with this soil in mapping are small areas of Stronghurst silt loam, Boaz silt loam, dark variant, and a soil that has a dark-colored horizon between depths of 20 and 40 inches.

If this Boaz soil is adequately drained and protected from flooding, it can be used for corn, small grain, and hay. It is also suited to pasture, water-tolerant trees, and wildlife plantings. The principal limitation for crops is poor drainage, flooding, and the hazard of frost damage in fall. Capability unit IIw–13; woodland group 3w5; tree and shrub group 3; wildlife group 5b; recreation group 7.

Boaz Series, Dark Variant

The dark variant of the Boaz series consists of deep, poorly drained, loamy soils in slight depressions on high bottom lands. These soils have a high water table.

In a representative profile the surface layer is black silt loam about 11 inches thick. The subsoil is very dark gray silty clay loam about 4 inches thick. The underlying material is silt loam and is gray to dark grayish brown mottled with dark reddish brown. The soil is mildly alkaline throughout the profile.

The available water capacity is high, and permeability is moderately slow. Surface runoff is slow.

Representative profile of Boaz silt loam, dark variant, in a cultivated field that has been drained; 150 feet west

of center of town road and 50 feet north of south line of SE¼SW¼ sec 15, T. 26 N., R. 14 W.

Ap—0 to 7 inches, black (N 2/0) silt loam; weak, fine, subangular blocky structure; friable; mildly alkaline; abrupt, smooth boundary.

A3—7 to 11 inches, black (10YR 2/1) to very dark gray (10YR 3/1) silt loam; moderate, fine, subangular blocky structure; firm to friable; mildly alkaline; clear, smooth boundary.

Btg—11 to 15 inches, very dark gray (10YR 3/1) silty clay loam; 60 percent or more of the horizon is soil that has low-chroma colors; few, fine, prominent, dark reddish-brown (5YR 3/4) mottles; moderate, coarse, prismatic structure parting to moderate, fine and medium, angular blocky; firm; thin patchy clay films; mildly alkaline; clear, smooth boundary.

C1g—15 to 26 inches, gray (5Y 5/1) silt loam; 60 percent or more of the horizon is soil that has low-chroma colors; many, medium, prominent, dark reddish-brown (5YR 3/4) mottles; weak, medium, platy structure; few strong vertical cleavage planes; friable; mildly alkaline; gradual, smooth boundary.

C2g—26 to 48 inches, grayish-brown (2.5Y 5/2) silt loam; common, fine, prominent, dark reddish-brown (5YR 3/4) mottles; weak, medium, platy structure; friable; mildly alkaline.

In some places the surface is covered by a few inches of mucky plant remains. The A horizon ranges from about 8 to 14 inches in thickness. The Btg horizon ranges from 4 to 7 inches in thickness.

The dark variant soils of the Boaz series have a darker colored and thicker surface layer than the associated Stronghurst soils. They differ from the associated normal soils of the Boaz series in having a dark-colored Btg horizon.

Boaz silt loam, dark variant (0 to 2 percent slopes) (Br).—This soil occupies irregularly shaped tracts in level areas or in depressions. The areas are 5 to 15 acres in size. The surface layer is black and mucky, and the soil dries out much later in spring than the surface layer of well-drained soils. In a few places thin layers of recently deposited light-colored soil cover the surface.

The main limitation in the use of this soil is wetness and a high water table. Surface runoff is slow.

A small acreage of this soil has been drained and is used for small grain and hay, pasture, and trees. The soil has a high content of organic matter, but fertilization is generally desirable for favorable crop yields. Capability unit IIw–13; woodland group 3w5; tree and shrub group 3; wildlife group 5b; recreation group 7.

Brems Series

The Brems series consists of deep, moderately well drained, sandy soils on stream terraces and outwash plains. The water table fluctuates between depths of 3 and 5 feet.

In a representative profile the surface layer is very dark grayish-brown loamy sand about 7 inches thick. Below this, to a depth of 20 inches, is loose, dark-brown medium sand. The underlying material, to a depth of 60 inches, is dark-brown medium sand. Yellowish-brown mottling begins at a depth of 30 inches.

The available water capacity is low, and permeability is rapid. Natural fertility is low. Drought is a moderate hazard.

Representative profile of Brems loamy sand, in an abandoned cultivated field, 30 feet south of center of east-west road and 400 feet west of east line of NW¼ NW¼ sec. 31, T. 29 N., R. 11 W.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak, subangular blocky structure; very friable; strongly acid; abrupt, smooth boundary.

AC—7 to 20 inches, dark-brown (7.5YR 4/3) medium sand; very weak, medium, subangular blocky structure; loose; strongly acid; clear, irregular boundary.

C1—20 to 30 inches, dark-brown (7.5YR 4/4) medium sand; single grain; loose; strongly acid; gradual, smooth boundary.

C2—30 to 36 inches, dark-brown (7.5YR 4/4) medium sand; common, coarse, faint, dark yellowish-brown (10YR 4/4) mottles; single grain; loose; strongly acid; clear, smooth boundary.

C3—36 to 60 inches, dark yellowish-brown (10YR 4/6) medium sand; single grain; few, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; loose; medium acid.

The A horizon is loamy fine sand or loamy sand in texture. It ranges from very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3) in color. The C2 horizon lacks low-chroma mottles, which is outside the range defined for the series. This difference, however, does not alter the use and behavior of the soils. Mottles in the C2 and C3 horizons range from few to common in abundance and from faint to distinct in contrast.

Brems soils are coarser textured than the associated mottled subsoil variant of the Billett series. They are the moderately well drained associate of the excessively drained Plainfield soils and the somewhat poorly drained Morocco soils.

In most areas the Brems soils in this county have a lower soil temperature than is defined as the range for the series, but this does not alter the use or behavior of the soils.

Brems loamy sand (0 to 2 percent slopes) (Bs).—This soil is on stream terraces. The surface layer is very dark grayish brown.

Included with this soil in mapping are a few small areas of gently sloping soil. Also included are small areas of Morocco loamy sand and areas of Plainfield loamy sand.

This Brems soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, recreation, and wildlife habitat. Much of the acreage that was formerly cropped has been planted to conifers. The chief limitations are moderate droughtiness and low fertility. A good fertilization program and a cropping system that maintains the organic-matter content are desirable. A seasonal water table at a depth of 3 to 5 feet supplies moisture, and crop yields on this soil are slightly higher than on similar soils that have a lower water table. Capability unit IVs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Burkhardt Series

The Burkhardt series consists of shallow, somewhat excessively drained, loamy soils on stream terraces. These soils are underlain by gravelly sand.

In a representative profile (fig. 3), the surface layer is very dark brown sandy loam about 10 inches thick. The subsoil is dark-brown sandy loam about 10 inches thick. The underlying material is sand and gravel.

The available water capacity is low, and permeability is moderately rapid. Natural fertility is medium. Drought is a moderate to severe hazard.

Representative profile of Burkhardt sandy loam, 0 to 6 percent slopes, in a cultivated field, 200 feet west of

Figure 3.—**Profile of Burkhardt sandy loam.**

center of State Highway 25 and 100 feet north of the south line of SW¼NW¼ sec. 12, T. 30 N., R. 13 W.

Ap—0 to 7 inches, very dark brown (10YR 2/2) sandy loam; weak, medium, subangular blocky structure parting to weak, medium, granular; very friable; abundant fine fibrous roots; neutral; abrupt, smooth boundary.

A12—7 to 10 inches, very dark brown (10YR 2/2) sandy loam; weak, fine and very fine, subangular blocky structure; very friable; plentiful fine fibrous roots; slightly acid; clear, smooth boundary.

B2t—10 to 16 inches, dark-brown (7.5YR 3/2, broken; 7.5YR 4/4-3/4, crushed) sandy loam; weak to moderate, fine, subangular blocky structure; friable; few thin clay films on ped faces and clay bridging between sand grains; few fibrous roots; slightly acid; clear, smooth boundary.

B3—16 to 20 inches, dark-brown (7.5YR 4/4, broken and crushed) light sandy loam; weak, medium, subangular blocky structure; dark-colored stains from organic matter on faces of some peds; very friable; slightly acid; clear, smooth boundary.

IIC—20 to 60 inches, strong-brown (7.5YR 5/6) and dark-brown (7.5YR 4/4), stratified sand and gravel; single grain; loose; slightly acid.

The Ap horizon ranges from loam to gravelly sandy loam in texture. Most areas of gravelly sandy loam are associated with rolling kame-esker topography. The Ap horizon ranges from black (10YR 2/1) to very dark brown (10YR 2/2) in color. The solum ranges from 10 to 20 inches in thickness, but is about 18 inches thick in most places. The amount of gravel varies somewhat throughout the profile.

In most areas the Burkhardt soils in this county have a lower soil temperature than is defined as the range for the series, but this does not alter the use or behavior of the soils.

Burkhardt soils are shallower than the associated Dakota soils. Their surface layer is darker colored than that of the Chetek soils.

Burkhardt sandy loam, 0 to 6 percent slopes (BuB).—This soil occupies irregularly shaped tracts. It has the profile described as representative of the series. In cultivated areas the surface layer is very dark brown.

Included with this soil in mapping are small areas where the slope is more than 6 percent, small areas of Hubbard loamy sand, and a few areas of Dakota loam. Also included are areas where the surface layer is gravelly.

This Burkhardt soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, trees, and other less intensive uses. Some areas have been planted to trees. This soil is a source of gravel for commercial purposes. The main hazards are drought and erosion. Capability unit IIIe–3; woodland group 3d1; tree and shrub group 2; wildlife group 3; recreation group 3.

Burkhardt sandy loam, 6 to 12 percent slopes, eroded (BuC2).—This soil occupies elongated tracts, 5 to 30 acres in size, at the base of slopes. It has a profile similar to that described as representative of the series, but 4 to 8 inches of the original surface layer has been lost through erosion. Also, the surface layer is lower in organic-matter content and fertility than that of the representative profile. In cultivated areas the surface layer is very dark brown, and in most places it contains brown material from the subsoil. Nearly all the acreage is in the southeastern part of the town of Spring Brook.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12

percent. Also included are small areas of Hubbard loamy sand and Dakota loam.

This Burkhardt soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is droughty, however, and the erosion hazard is moderate. A few areas can be used for excavation of gravel for commercial purposes. Capability unit IVe–4; woodland group 3d1; tree and shrub group 2; wildlife group 3; recreation group 3.

Campia Series

The Campia series consists of deep, well-drained, loamy soils on glacial outwash plains.

In a representative profile the surface layer is very dark grayish-brown loam about 9 inches thick. The subsurface layer is brown loam 4 inches thick. The subsoil is about 20 inches thick. The upper 3 inches is dark yellowish-brown loam, the next 10 inches is dark-brown heavy loam, and the lower 7 inches is dark-brown silty clay loam. The underlying material is brown light silty clay loam, mottled with yellowish brown and grayish brown.

The available water capacity is high, and permeability is moderate. Natural fertility is high. Surface runoff is slow.

Representative profile of Campia loam, 0 to 2 percent slopes, in a cultivated field, 100 feet south of center of road and 250 feet east of west 40 line of NE¼NW¼ sec. 9, T. 28 N., R. 13 W.

Ap—0 to 9 inches, very dark grayish-brown (10YR 32) loam, light brownish gray (10YR 6/2) dry; moderate, fine, granular structure; very friable; neutral; abrupt, smooth boundary.

A2—9 to 13 inches, brown (10YR 5/3) loam; moderate, thin, platy structure; friable; neutral; clear, smooth boundary.

B&A—13 to 16 inches, dark yellowish-brown (10YR 4/4) loam; grayish-brown (10YR 5/2) tongues of silty material extending from the A2 horizon into this horizon; moderate, thick, platy structure; friable; medium acid; clear, smooth boundary.

B2t—16 to 26 inches, dark-brown (7.5YR 4/4) heavy loam; strong, medium, subangular blocky structure; thin patchy clay films on ped faces; surface of peds coated with bleached sand grains; firm; very strongly acid; clear, smooth boundary.

B3—26 to 33 inches, dark-brown (7.5YR 4/4) silty clay loam; strong, coarse, subangular blocky structure; very firm; very strongly acid; clear, smooth boundary.

C—33 to 60 inches, brown (7.5YR 5/4) light silty clay loam mottled with grayish brown (10YR 5/2) and yellowish brown (10YR 5/6); massive; very firm; strongly acid.

The A horizon ranges from light loam to silt loam in texture and from 8 to 13 inches in thickness. It ranges from very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3) in color. The depth to the silty clay loam substratum ranges from 30 to 40 inches.

More than 15 percent of the B&A horizon consists of fine sand and coarser sand, which is outside the range defined for the series. This difference, however, does not alter the use and behavior of these soils.

Campia soils have a coarser textured solum than Seaton soils. They formed in lacustrine silt and clay, unlike the Seaton soils, which formed in wind-deposited silt. Soils of both these series have a silty subsoil.

Campia loam, 0 to 2 percent slopes (CaA).—This soil occupies elongated tracts 20 to 80 acres in size. Most areas are near areas of Lows loam. The surface layer is grayish brown.

Included with this soil in mapping are small areas of Lows loam and Stronghurst silt loam.

This Campia soil is well suited to corn, small grain, soybeans, alfalfa, and clover. It can also be used for pasture, woodland, wildlife habitat, and recreation. Capability unit I–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Caryville Series

The Caryville series consists of deep, well drained to moderately well drained, loamy alluvial soils on bottom lands and narrow stream terraces. These soils are underlain by sand and gravel. They are subject to flooding.

In a representative profile the surface layer is dark-brown loam about 15 inches thick. Below this is 3 inches of dark reddish-brown sandy loam. The underlying material is dark reddish-brown loamy sand that is slightly acid. This is underlain by stratified brown sand, sandy loam, and loam.

The available water capacity is low. Permeability is moderate in the upper part of the profile and rapid in the lower part. Natural fertility is medium. Drought is a moderately severe hazard.

Representative profile of Caryville loam, in a cultivated field, 50 feet north and 100 feet west of the intersection of County Highway H and a county road; SW¼ SE¼ sec. 35, T. 27 N., R. 11 W.

Ap—0 to 6 inches, dark-brown (7.5YR 3/2) loam, brown (7.5YR 4/2) dry; weak, fine, subangular blocky structure; friable; plentiful fine fibrous roots; many medium, fine, and very fine dendritic pores; few coarse, continuous, mostly exped, dendritic pores; neutral; abrupt, smooth boundary.

A12—6 to 15 inches, dark-brown (7.5YR 3/2) loam, brown (7.5YR 4/2) dry; weak, medium and fine, subangular blocky structure; friable; plentiful fine fibrous roots; many medium, fine, and very fine dendritic pores; few coarse, continuous, mostly exped, dendritic pores; medium acid; clear, wavy boundary.

AC—15 to 18 inches, dark reddish-brown (5YR 3/4) light sandy loam; weak, medium, subangular blocky structure; friable; few fine fibrous roots; common fine and very fine dendritic pores; few medium and coarse, continuous, inped and exped, dendritic pores; slightly acid; clear, smooth boundary.

IIC1—18 to 23 inches, dark reddish-brown (5YR 3/4), medium and fine loamy sand; very weak, medium, subangular blocky structure to single grain; very friable to loose; few fine fibrous roots; common fine and very fine pores; few coarse, obliquely oriented, continuous, mostly inped pores; slightly acid; clear, smooth boundary.

IIC2—23 to 60 inches, brown (7.5YR 5/4) fine and medium sand, stratified with layers, 1 to 5 inches thick, of sandy loam and loam sediments; single grain and massive; loose and friable; few fine fibrous roots and few coarse tap roots; neutral.

The A horizon ranges from 12 to 20 inches in thickness. The color of this horizon is in hues of 10YR or 7.5YR and in values and chroma of 2 or 3.

Caryville soils differ from associated Terril soils in having formed in thin deposits of loamy sediments rather than in thick deposits. They are deeper than the associated moderately deep Dunnville soils.

Caryville loam (0 to 2 percent slopes) (Ce).—This soil occupies irregularly shaped tracts, 5 to 50 acres in size,

on bottom lands and narrow stream terraces. In cultivated fields the surface layer is dark brown.

Included with this soil in mapping are small areas of Dunnville loam and Burkhardt sandy loam. Also included are areas of gently sloping soil.

This Caryville soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, trees, recreation, and wildlife habitat. Capability unit IIIw–12; woodland group 3o1; tree and shrub group 1; wildlife group 7; recreation group 8.

Cathro Series

The Cathro series consists of deep, very poorly drained muck in old lakebeds and along streams. These soils are underlain by loamy material.

In a representative profile the surface layer is black muck about 20 inches thick. Below this is very dark brown muck about 12 inches thick. The underlying material is dark-gray, mildly alkaline silt loam.

The available water capacity is very high. Permeability is moderately rapid in the upper organic part of the soil but moderate in the lower part. Natural fertility is medium. Surface runoff is slow, and the soils are frequently ponded during wet periods.

Representative profile of Cathro muck, in a swampy pasture, 400 feet west of the east line and 500 feet north of the south line of SW¼SE¼ sec. 20, T. 26 N., R. 14 W.

Oa1—0 to 10 inches, black (10YR 2/1) sapric material derived from sedges and reeds; weak, medium to coarse, subangular blocky structure parting to weak, medium, platy; friable; slightly alkaline; clear, smooth boundary.

Oa2—10 to 20 inches, black (10YR 2/1) sapric material that consists mostly of disintegrated sedges and reeds but that also contains a few fragments of woody material; weak, medium, platy structure; friable; neutral; clear, smooth boundary.

Oa3—20 to 32 inches, very dark brown (10YR 2/2) sapric material derived from disintegrated sedges and reeds; very weak, medium, subangular blocky structure parting to weak, medium, platy; friable; pressure faces of structural blocks and plates show very thin colloidal coats of well-decomposed organic material; neutral; clear, smooth boundary.

IICg—32 to 60 inches, dark-gray (N 4/0) silt loam; massive; mildly alkaline.

The organic layer ranges from 16 to 42 inches in thickness. The IICg horizon ranges from fine sandy loam to silt loam in texture. The water table is at or near the surface except during dry periods.

Cathro soils differ from the associated Markey soils in being underlain by silt loam rather than sand. They formed in 16 to 40 inches of organic material, whereas the Houghton soils formed in organic deposits more than 51 inches thick.

Cathro muck (0 to 2 percent slopes) (Ch).—This is a very poorly drained muck soil in small depressions.

Included with this soil in mapping are small areas of Houghton peaty muck and Markey muck.

Most of the acreage of this Cathro soil is in swamp grasses, sedges, willows, and tag alders. Water-tolerant trees grow in a few places. In some areas this soil is drained by ditches and is used for crops, but soil blowing and frost late in spring and early in fall are hazards. Lime and fertilizer are generally needed. Capability unit IVwc–9; woodland group 5w6; tree and shrub group 4; wildlife group 6; recreation group 9.

Chetek Series

The Chetek series consists of somewhat excessively drained, loamy soils that are shallow to sand and gravel. These soils are on stream terraces and outwash plains. They are underlain by acid sand and gravel derived from granite.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The subsoil is dark-brown sandy loam about 11 inches thick. The underlying material is yellowish-brown acid sand and gravel.

The available water capacity is low. Permeability is moderately rapid in the subsoil and rapid in the underlying material. Natural fertility is medium. Drought is a severe hazard.

Representative profile of Chetek sandy loam, 0 to 2 percent slopes, in a cultivated field, 700 feet south of center of Highway 72 and 25 feet west of town road; SW¼NW¼ sec. 3, T. 27 N., R. 14 W.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam, gray (10YR 6/1) dry; weak, medium, subangular blocky structure; friable; slightly acid; abrupt, smooth boundary.

B1—8 to 11 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, thick, platy structure parting to weak, medium, subangular blocky; friable; strongly acid; clear, wavy boundary.

B2t—11 to 18 inches, dark-brown (7.5YR 4/3) heavy sandy loam; moderate, medium, subangular blocky structure; friable; strongly acid; clear, wavy boundary.

B3—18 to 19 inches, dark-brown (7.5YR 4/3) gravelly sandy loam; weak, medium, subangular blocky structure; neutral; friable; abrupt, smooth boundary.

C—19 to 60 inches, yellowish-brown (10YR 5/4) coarse, stratified, granitic sand and gravel; single grain; loose; strongly acid.

The A horizon ranges from dark brown (7.5YR 3/2) to very dark grayish brown (10YR 3/2) in color and from loam to sandy loam in texture. The B horizon ranges from dark brown (10YR 4/3) to brown (7.5YR 5/4) in color. The B2 horizon ranges from heavy sandy loam to loam in texture. The solum ranges from 12 to 20 inches in thickness. The ratio of coarse sand to gravel in the C horizon is variable, but fine gravel predominates. Stoniness is common in moderately steep to steep, convex areas on outwash plains.

Chetek soils have a lighter colored surface layer than the associated Burkhardt soils.

Chetek sandy loam, 0 to 2 percent slopes (CkA).—This soil has the profile described as representative of the series. In cultivated areas the surface layer is very dark grayish-brown sandy loam. In some places small amounts of gravel are on the surface.

Included with this soil in mapping are a few small areas of Plainfield loamy sand. Also included are areas where the surface layer is loam.

Most of the acreage of this Chetek soil is used for corn, small grain, soybeans, alfalfa, and clover. This soil is also suited to less intensive uses, such as woodland, wildlife habitat, and recreation. Natural fertility is medium. Drought is a severe hazard, but the hazard can be reduced by irrigation. In some places gravel can be excavated for commercial purposes. Capability unit IIIs–8; woodland group 3d1; tree and shrub group 2; wildlife group 3; recreation group 3.

Chetek sandy loam, 2 to 6 percent slopes (CkB).—This soil is on stream terraces and outwash plains. It has a profile similar to the one described as representative of

the series, but the surface layer is about 6 inches thick. In cultivated areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where 2 to 4 inches of the original surface layer has been lost through erosion. Also included are some small areas where the slope is less than 2 percent or more than 6 percent. In addition, small areas of Billett sandy loam are included in some places.

This Chetek soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, trees, and wildlife plantings. Natural fertility is medium. Drought is a severe hazard, and erosion is a moderate hazard. The drought hazard can be reduced by irrigation. Capability unit IIIe–3; woodland group 3d1; tree and shrub group 2; wildlife group 3; recreation group 3.

Chetek sandy loam, 12 to 20 percent slopes, eroded (CkD2).—This soil occurs as areas about 25 to 75 acres in size. It has a profile similar to that described as representative of the series, but as much as three-fourths of the surface layer has been lost through erosion. The present surface layer is very dark grayish brown.

Included with this soil in mapping are areas where the surface layer is very dark brown gravelly sandy loam. Also included are areas where the surface layer and the subsoil are loam. In addition, some severely eroded areas are included.

This soil is suited to pasture, trees, or wildlife plantings. Permeability is moderately rapid to rapid. Drought and erosion are severe hazards. Capability unit VIe–3; woodland group 3d2; tree and shrub group 2; wildlife group 3; recreation group 3.

Chetek sandy loam, 20 to 30 percent slopes, eroded (CkE2).—This soil has a profile similar to that described as representative of the series, but in most places as much as three-fourths of the surface layer has been removed through erosion.

Included with this soil in mapping are areas where the surface layer is very dark brown gravely sandy loam and areas where the surface layer is loam. Also included are small areas that are slightly or severely eroded.

This soil is suited to pasture, trees, and wildlife plantings. Permeability is moderately rapid to rapid. Drought and erosion are severe hazards. Capability unit VIIe–4; woodland group 3d2; tree and shrub group 2; wildlife group 3; recreation group 3.

Dakota Series

The Dakota series consists of moderately deep, well-drained, loamy soils (fig. 4) on stream terraces and outwash plains. These soils overlie sand and gravel.

In a representative profile the surface layer is very dark brown loam about 10 inches thick. The subsoil is about 22 inches thick. The upper part is dark-brown loam, and the lower part is dark-brown sandy loam. The underlying material is dark yellowish-brown sand and gravel.

Figure 4.—**An area of Dakota loam on an outwash plain.**

The available water capacity is medium, and permeability is moderate. Natural fertility is high. Drought is a moderate hazard.

Representative profile of Dakota loam, 0 to 2 percent slopes, in a cultivated field, 50 feet east of center of town road and 500 feet south of north 40 line of NW¼ SW¼ sec. 20, T. 27 N., R. 11 W.

Ap—0 to 10 inches, very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) dry; weak, medium, subangular blocky structure; very friable; neutral; abrupt, smooth boundary.
B1—10 to 14 inches, dark-brown (7.5YR 4/3) loam; weak, medium, subangular blocky structure; friable; slightly acid; clear, smooth boundary.
B2t—14 to 28 inches, dark-brown (7.5YR 4/3) heavy loam; moderate, medium, subangular blocky structure; thin patchy clay films on peds; friable; medium acid; clear, smooth boundary.
B3—28 to 32 inches, dark-brown (7.5YR 4/3) sandy loam; moderate, medium, subangular blocky structure; friable; medium acid; clear, smooth boundary.
IIC—32 to 60 inches, dark yellowish-brown (10YR 4/4) sand and gravel; single grain; loose; medium acid.

The A horizon ranges from black (10YR 2/1) to very dark brown (10YR 2/2) in uneroded areas. It ranges from sandy loam to loam in texture. The C horizon begins at depths ranging from 24 to 40 inches. It ranges from fine sand to coarse sand and gravel in texture. The solum ranges from 30 to 40 inches in thickness.

In most areas the Dakota soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Dakota soils have a thicker and finer textured solum than the associated Burkhardt soils. They have a dark-brown subsoil, whereas the associated Dunnville soils have a reddish-brown subsoil.

Dakota sandy loam, 0 to 2 percent slopes (DaA).—This soil has a profile similar to the one described as representative of the series, but its surface layer is sandy loam and slightly lighter colored and the solum is slightly thinner. In this soil the surface layer is very dark grayish brown. In a few small depressions the soil is darker colored.

Included with this soil in mapping are a few small areas of Burkhardt sandy loam and Hubbard loamy sand.

This Dakota soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is suitable for irrigation. Drought is the principal hazard. Capability unit IIIs–4; woodland group 4o1; tree and shrub group 1; wildlife group 4; recreation group 1.

Dakota sandy loam, 2 to 6 percent slopes (DaB).—This soil has a profile similar to the one described as representative of the series, but its surface layer is sandy loam and slightly lighter colored and the subsoil is slightly thinner. In this soil the surface layer is very dark grayish brown. In a few depressions the soil is darker colored.

Included with this soil in mapping are small areas where as much as two-thirds of the surface layer has been removed through erosion. Also included are a few small areas of Dakota loam and Burkhardt sandy loam.

Nearly all the acreage of this Dakota soil is used for crops. It is well suited to corn, small grain, soybeans, alfalfa, and clover. Drought and erosion are moderate hazards. Capability unit IIIs–4; woodland group 4o1; tree and shrub group 1; wildlife group 4; recreation group 1.

Dakota loam, 0 to 2 percent slopes (DbA).—This soil occupies irregularly shaped tracts. It has the profile described as representative of the series. In cultivated areas the surface layer is very dark brown. In a few slight depressions, the surface layer is slightly darker colored.

Included with this soil in mapping are a few small areas of Burkhardt sandy loam and Pillot silt loam. Also included are some small areas where the lower part of the subsoil contains a layer of silty clay loam.

This Dakota soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, wildlife habitat, and recreational areas. Drought is a moderate hazard, and prolonged drought may damage crops. Irrigation can be used to reduce the hazard of drought. Capability unit IIs–1; woodland group 4o1; tree and shrub group 1; wildlife group 4; recreation group 1.

Dakota loam, 2 to 6 percent slopes (DbB).—This soil occupies irregularly shaped tracts 5 to 30 acres in size. It has a profile similar to the one described as representative of the series, but the surface layer is about 8 inches thick. In cultivated areas the surface layer is very dark brown.

Included with this soil in mapping are areas where the slope is less than 2 percent or more than 6 percent. Also included are small areas of Dakota sandy loam and Burkhardt sandy loam.

This Dakota soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture and wildlife and recreational areas. Erosion and drought are moderate hazards. Capability unit IIe–2; woodland group 4o1; tree and shrub group 1; wildlife group 4; recreation group 1.

Dickinson Series

The Dickinson series consists of deep, somewhat excessively drained, loamy soils on broad outwash plains and stream terraces.

In a representative profile the surface layer is very dark brown sandy loam about 16 inches thick. The subsoil is 15 inches thick. The upper 8 inches is dark-brown light sandy loam, and the lower 7 inches is dark-brown loamy sand. Below the subsoil is loose, yellowish-brown and dark-brown medium and coarse sand.

The available water capacity is low, and permeability is moderately rapid. Natural fertility is medium. Drought is a moderate to severe hazard.

Representative profile of Dickinson sandy loam, 0 to 2 percent slopes, in a cultivated field, 15 feet east of the west line and 450 feet south of the north line of SE¼ SE¼ sec. 29, T. 27 N., R. 11 W.

Ap—0 to 8 inches, very dark brown (10YR 2/2) sandy loam; weak, coarse, subangular blocky structure parting to fine, granular; very friable; medium acid; abrupt, smooth boundary.
A12—8 to 16 inches, very dark brown (10YR 2/2) sandy loam; weak, medium, subangular blocky structure; very friable; medium acid; clear, wavy boundary.
B2—16 to 24 inches, dark-brown (7.5YR 3/2) light sandy loam; weak to moderate, medium, subangular blocky structure; very friable; strongly acid; clear, wavy boundary.

B3—24 to 31 inches, dark-brown (7.5YR 3/2) loamy sand; weak, medium, subangular blocky structure; very friable; strongly acid; gradual, wavy boundary.
C1—31 to 36 inches, dark-brown (7.5YR 4/4) medium and coarse sand; single grain; loose; medium acid; clear, smooth boundary.
C2—36 to 60 inches, yellowish-brown (10YR 5/4) medium and coarse sand; single grain; loose; medium acid.

The Ap horizon is black (10YR 2/1) to very dark brown (10YR 2/2) or very dark gray (10YR 3/1). It ranges from 10 to 20 inches in thickness. The B horizon ranges from very dark brown (10YR 2/2) to dark brown (7.5YR 3/2) in color. The C horizon contains small amounts of gravel in some places. The depth to loamy sand ranges from 24 to 38 inches.

In most areas the Dickinson soils in this county have a lower soil temperature and contain more gravel than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Dickinson soils are finer textured than Hubbard soils. They are darker colored than Gotham soils. All these soils have a sandy subsoil.

Dickinson sandy loam, 0 to 2 percent slopes (DdA).—This soil is somewhat excessively drained. It has the profile described as representative of the series. The surface layer is very dark brown in most places, but it is lighter colored in a few spots.

Included with this soil in mapping are small areas of Burkhardt sandy loam and Hubbard loamy sand. Also included are a few areas where the slope is more than 2 percent.

This Dickinson soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is important to maintain the content of organic matter and the level of fertility. Drought is a moderate to severe hazard, but the hazard can be reduced by irrigation. Capability unit IIIs–4; woodland group 3o1; tree and shrub group 1; wildlife group 4; recreation group 2.

Dickinson sandy loam, 2 to 6 percent slopes (DdB).—This soil is on outwash plains and stream terraces. It has a profile similar to the one described as representative of the series, but the surface layer is about 12 inches thick. In cultivated areas the surface layer is very dark brown.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent and small areas where as much as three-fourths of the surface layer has been lost through erosion. Also included are small areas of Gotham soils.

Most of the acreage of this Dickinson soil is used for crops. The soil is also suited to pasture and woodland. Drought and erosion are the main hazards. Capability unit IIIs–4; woodland group 3o1; tree and shrub group 1; wildlife group 4; recreation group 2.

Dubuque Series

The Dubuque series consists of moderately deep, well-drained, loamy soils on broad upland ridges. These soils are underlain by limestone.

In a representative profile the surface layer is dark grayish-brown, friable silt loam about 7 inches thick. The subsurface layer is dark grayish-brown silt loam about 3 inches thick. The subsoil is 20 inches thick. The upper 4 inches is dark-brown silt loam, the next 10 inches is dark-brown or strong-brown silty clay loam, and the lower 6 inches is reddish-brown clay. Thick beds of limestone bedrock underlie the subsoil.

The available water capacity is medium. Permeability is moderate in the layers of silt loam but moderately slow in the clay. Natural fertility is medium. Drought is a moderate hazard.

Representative profile of Dubuque silt loam, 6 to 12 percent slopes, eroded, in a cultivated field, 250 feet north of center of town road and 300 feet east of west line of NW¼SE¼ sec. 17, T. 26 N., R. 14 W.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, subangular blocky structure; friable; medium acid; abrupt, smooth boundary.
A2—7 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, platy structure; friable; medium acid; clear, smooth boundary.
B11—10 to 12 inches, dark-brown (10YR 4/3 silt loam; weak, thick, platy structure parting to moderate, medium, subangular blocky; friable; medium acid; abrupt, smooth boundary.
B11—10 to 12 inches, dark-brown (10YR 4/3) silt loam; moderate, medium, subangular blocky structure; friable; medium acid; abrupt, smooth boundary.
B21t—14 to 17 inches, dark-brown (10YR 4/3) light silty clay loam; strong, medium, subangular blocky structure; dark-brown (7.5YR 3/2) clay skins on ped surfaces; friable; medium acid; clear, smooth boundary.
B22t—17 to 24 inches, strong-brown (7.5YR 5/6) heavy silty clay loam; strong, coarse, prismatic structure parting to strong, medium angular blocky; prominent dark-brown (7.5YR 3/2) clay skins; very firm; medium acid; clear, smooth boundary.
IIB23t—24 to 30 inches, reddish-brown (5YR 4/3) clay; strong, coarse, angular blocky structure; dark reddish-brown (5YR 3/4) clay skins; very firm; numerous small fragments of limestone; neutral; clear, smooth boundary.
IIIR—30 to 100 inches, massive limestone.

In cultivated fields the A horizon ranges from very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2) in color. The silty soil above the clayey limestone residuum ranges from 15 to 28 inches in thickness. The residuum ranges from 3 to 6 inches in thickness. In some places a few chert fragments are on the surface and throughout the profile.

In most areas the Dubuque soils in this county have a lower soil temperature than is defined in the range for the series. Also, some have residuum from limestone that is slightly thicker. Neither factor, however, alters the use or behavior of the soils.

Dubuque soils differ from the deep Palsgrove soils in having formed in a thinner silt cap overlying limestone. They formed in a thicker silt cap over limestone than that of Dunbarton soils. All these soils are underlain by limestone at a depth of less than 5 feet.

Dubuque silt loam, 2 to 6 percent slopes (DfB).—This soil occupies irregularly shaped tracts. It has a profile similar to the one described as representative of the series, but the surface layer is thicker and darker colored. In this soil the surface layer is dark grayish brown.

Included with this soil in mapping are a few small areas of Dunbarton silt loam and Palsgrove silt loam. Also included are areas where the slope is less than 2 percent or more than 6 percent and small areas where sandy layers are above the limestone and the clay layer contains rounded granitic cobblestones. In addition, a few spots are included where as much as three-fourths of the surface layer has been lost through erosion.

This Dubuque soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, and wildlife habitat. Control of erosion and

maintenance of fertility are needed. Capability unit IIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Dubuque silt loam, 6 to 12 percent slopes, eroded (DfC2).—This soil occupies narrow upland ridges. It has the profile described as representative of the series. In most places the surface layer is dark grayish brown and contains dark yellowish-brown material from the subsoil. Water erosion has removed about 6 to 8 inches of the original surface layer, and the present surface layer is less friable, is lower in organic-matter content and fertility, and is more difficult to keep in good tilth than the uneroded surface layer.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent and areas where the soil is slightly or severely eroded. Also included are small areas of Palsgrove and Dunbarton soils.

This Dubuque soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture and woodland. Erosion is the main hazard. Management that includes erosion control and maintenance of organic-matter content and fertility help to maintain favorable crop yields. Capability unit IIIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Dubuque silt loam, 12 to 20 percent slopes, eroded (DfD2).—This soil occupies ridges. In most places the surface layer is dark grayish brown and contains dark yellowish-brown material from the subsoil. The silty soil extends about 20 to 30 inches to reddish-brown clay. Erosion has removed one-fourth to three-fourths of the surface layer, and the present plow layer is less friable, is lower in organic-matter content and fertility, and is more difficult to keep in good tilth than the uneroded surface layer.

Included with this soil in mapping are small areas of a deep Dubuque soil and small areas where the slope is less than 12 percent or more than 20 percent.

This soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture plants and trees. Runoff is rapid, and the erosion hazard is severe. Management practices are needed to control erosion in areas used for crops. Capability unit IVe–2; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Dubuque silt loam, 20 to 30 percent slopes, eroded (DfE2).—This soil occurs as irregularly shaped tracts. It has a profile similar to the one described as representative of the series, but the soil layers are thinner and the layer of clay weathered from limestone is thinner. In this soil the surface layer is dark grayish brown, but spots of dark-brown soil occur in most of the acreage. In a few places limestone bedrock is exposed.

Included with this soil in mapping are small areas of Steep stony rock land. Also included are small areas that are slightly or severely eroded.

This soil is suited to pasture, trees, and wildlife plantings. It is not suited to cultivated crops, because the erosion hazard is severe. Capability unit VIe–2; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Dunbarton Series

The Dunbarton series consists of shallow, well-drained, loamy soils on upland ridges. These soils are underlain by limestone.

In a representative profile the surface layer is dark grayish-brown silt loam about 6 inches thick. The subsoil is about 12 inches thick. The upper 4 inches is dark-brown silty clay loam, and the lower 8 inches is reddish-brown clay. The underlying material consists of pale-brown limestone.

The available water capacity is low. Permeability is moderate in the upper 10 inches of the profile and moderately slow in the lower part. Natural fertility is medium. Drought is a moderately severe hazard.

Representative profile of Dunbarton silt loam, 2 to 6 percent slopes, eroded, in a cultivated field, 50 feet east of center of town road and 350 feet south of north line of SW¼NW¼ sec. 28, T. 26 N., R. 14 W.

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.

IIB21t—6 to 10 inches, dark-brown (7.5YR 4/2) silty clay loam; strong, fine, subangular blocky structure; firm; thin patchy clay films; medium acid; clear, smooth boundary.

IIB22t—10 to 14 inches, reddish-brown (5YR 4/4) clay; strong, fine, angular blocky structure; very firm; thick patchy clay films; neutral; few limestone chips; clear, smooth boundary.

IIB3t—14 to 18 inches, reddish-brown (5YR 4/4) clay that contains many small fragments of chert; strong, medium, angular blocky structure; very firm; thick patchy clay films; neutral; clear, irregular boundary.

R—18 to 100 inches, pale-brown (10YR 6/3) limestone.

The A and IIB21t horizons together range from 6 to 12 inches in thickness. The underlying residuum ranges from 4 to 14 inches in thickness, but in most places it is 4 to 12 inches thick. The residuum is strong brown in places. The fragments range from one-half inch to two feet in diameter.

In most areas the Dunbarton soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Dunbarton soils differ from Dubuque soils in having formed in a thinner silt cap overlying limestone. Their B horizon is clay, unlike the B horizon of the Northfield soils, which is silt loam. Dunbarton soils are underlain by limestone, whereas Northfield soils formed over sandstone. All these soils are underlain by bedrock at depths of less than 40 inches.

Dunbarton silt loam, 2 to 6 percent slopes, eroded (DnB2).—This soil occupies irregularly shaped tracts. It has the profile described as representative of the series. In cultivated areas the surface layer is dark grayish brown and in most places it contains reddish-brown material from the subsoil.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent and areas that are severely eroded. Also included are small areas of Dubuque silt loam.

This Dunbarton soil is suited to corn, small grain, alfalfa, and clover. It is also suited to pasture, wildlife habitat, and selected recreational uses. Erosion is a moderate hazard, and drought is a moderately severe hazard. Capability unit IIIe–3; woodland group 3d1; tree and shrub group 2; wildlife group 3; recreation group 3.

Dunbarton silt loam, 6 to 12 percent slopes, eroded (DnC2).—This soil is on upland ridges. The surface layer is about 4 inches thick. It is dark grayish brown, and in most places it contains reddish-brown material from the subsoil.

Included with this soil in mapping are areas where the slope is less than 6 percent or more than 12 percent. Also included are small areas of an eroded Dubuque silt loam.

This Dunbarton soil is suited to corn, small grain, alfalfa, and clover. It is also suited to pasture, woodland, and wildlife habitat. Drought is a moderately severe hazard, and erosion is a moderate hazard. Capability unit IVe–3; woodland group 3d1; tree and shrub group 2; wildlife group 3; recreation group 3.

Dunbarton silt loam, 12 to 20 percent slopes, eroded (DnD2).—This soil is on ridges. It has a profile similar to the one described as representative of the series, but the surface layer is thinner and limestone is nearer the surface. In this soil the surface layer is very dark grayish brown, and in most places it contains reddish-brown material from the subsoil.

Included with this soil in mapping are small areas where the slope is less than 12 percent or more than 20 percent. Also included are small areas of a Dubuque soil.

This Dunbarton soil is suited to pasture or woodland. The erosion hazard is severe. Capability unit VIe–3; woodland group 3d2; tree and shrub group 2; wildlife group 3; recreation group 3.

Dunbarton silt loam, 20 to 30 percent slopes (DnE).—This soil is on upland ridges. It has a profile similar to the one described as representative of the series, but the surface layer is thinner and limestone is nearer the surface.

Included with this soil in mapping are areas where the slope is less than 20 percent or more than 30 percent and areas that are moderately or severely eroded. Also included are small areas of a Dubuque silt loam.

This Dunbarton soil is suited to permanent vegetation, such as pasture, woodland, and wildlife plantings. Runoff is rapid, and erosion is a severe hazard. South- and west-facing slopes are more droughty than east- and north-facing slopes. Capability unit VIIe–2; woodland group 3d2; tree and shrub group 2; wildlife group 3; recreation group 3.

Dunnville Series

The Dunnville series consists of well-drained, moderately deep, loamy soils on stream terraces and outwash plains. These soils overlie sand.

In a representative profile the surface layer is very dark brown loam about 10 inches thick. The subsoil is 22 inches thick. The upper 6 inches is dark reddish-brown loam, the next 8 inches is reddish-brown loam, and the lower 8 inches is reddish-brown sandy loam. The underlying material is dark-brown medium and coarse sand that is medium acid.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. Drought is a moderate hazard.

Representative profile of Dunnville loam, in a cultivated area, 250 feet west and 200 feet north of road intersection, SE¼SW¼ sec. 35, T. 27 N., R. 12 W.

Ap—0 to 10 inches, very dark brown (7.5YR 2/2) loam; moderate, medium and fine, subangular blocky structure; friable; abundant fine fibrous roots; slightly acid; abrupt, smooth boundary.

B21—10 to 16 inches, dark reddish-brown (5YR 3/3) loam; weak and moderate, fine, subangular blocky structure; friable; plentiful fine fibrous roots; medium acid; clear, wavy boundary.

B22—16 to 24 inches, reddish-brown (5YR 4/3) loam; weak and moderate, fine, subangular blocky structure; friable; few thin fibrous roots; medium acid; clear, wavy boundary.

B3—24 to 32 inches, reddish-brown (5YR 4/3) sandy loam; weak, fine, subangular blocky structure; friable; medium acid; gradual, wavy boundary.

IIC—32 to 60 inches, dark-brown (7.5YR 4/4) medium and coarse sand; single grain; medium acid; a few thin, colored bands at a depth below 50 inches.

The A horizon ranges from 10YR 2/2 to 7.5YR 3/2 in color. The color of the B2 and C horizons is in hue of 5YR or 7.5YR. The solum ranges from 28 to 40 inches in thickness. The substratum ranges from reds to yellows in hue. In most places the depth to outwash sands ranges from 30 to 40 inches. In some profiles varying amounts of small concretions of iron occur throughout the solum and substratum.

Dunnville soils have a redder subsoil than that of the associated Dakota soils. They are moderately deep, whereas the associated Caryville soils are deep.

Dunnville loam (0 to 2 percent slopes) (Du).—This soil occurs as irregularly shaped tracts 10 to 25 acres in size. The surface layer is very dark brown.

Included with this soil in mapping are a few small areas of a well-drained Hubbard loamy sand.

This Dunnville soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to recreation and wildlife habitat. Drought is a moderate hazard, but crop damage can be reduced by irrigation. Capability unit IIs–1; woodland group 3o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Dunnville Series, Silty Subsoil Variant

The silty subsoil variant of the Dunnville series consists of deep, well-drained, loamy soils that are underlain by loamy fine sand. Most areas of these soils are on stream terraces along the Chippewa River.

In a representative profile the surface layer is silt loam about 15 inches thick. The upper 12 inches is very dark brown, and the lower 3 inches is very dark grayish brown. The subsoil is about 25 inches thick. The upper 17 inches is dark-brown silt loam, and the lower 8 inches is dark-brown very fine sandy loam. The underlying material is dark-brown very fine sandy loam. Below this is dark reddish-brown loamy fine sand.

The available water capacity is high, and permeability is moderate. Natural fertility is high.

Representative profile of Dunnville silt loam, silty subsoil variant, in a cultivated field, 50 feet north of center of road and 200 feet east of west line of SE¼ SE¼ sec. 3, T. 26 N., R. 11 W.

Ap—0 to 7 inches, very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; moderate, medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A1—7 to 12 inches, very dark brown (10YR 2/2) silt loam; moderate, fine, granular structure; very friable; strongly acid; clear, smooth boundary.
A3—12 to 15 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, subangular blocky structure; very friable; strongly acid; clear, smooth boundary.
B1—15 to 22 inches, dark-brown (7.5YR 3/4) silt loam; weak, thick, platy structure; friable; medium acid; gradual, smooth boundary.
B2—22 to 32 inches, dark-brown (7.5YR 3/4) silt loam; weak, medium, subangular blocky structure; medium acid; gradual, smooth boundary.
B3—32 to 40 inches, dark-brown (7.5YR 3/4) very fine sandy loam; weak, coarse, subangular blocky structure; friable; medium acid; gradual, smooth boundary.
C1—40 to 45 inches, dark-brown (7.5YR 3/4) very fine sandy loam that contains bands of fine sandy loam and loamy fine sand; massive; slightly acid; clear, smooth boundary.
IIC2—45 to 60 inches, dark reddish-brown (5YR 3/4) loamy fine sand; single grain; loose; slightly acid.

The A horizon ranges from 14 to 20 inches in thickness. The depth to the IIC horizon ranges from 36 to 45 inches.

The silty subsoil variant of the Dunnville series resembles soils of the Terril series, but it is finer textured and has a substratum of loamy fine sand.

Dunnville silt loam, silty subsoil variant (0 to 2 percent slopes) (Dv).—This soil has a surface layer of very dark brown silt loam. A few dark-colored concave spots occur throughout the acreage.

Included with this soil in mapping are small areas of Terril loam.

This silty subsoil variant of the Dunnville soils is suited to corn, small grain, soybeans, alfalfa, and clover. Nearly all the acreage is cultivated. A few areas are in woodland. Natural fertility is high, and this soil has few limitations if used for crops. Capability unit I–1; woodland group 3o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Eleva Series

The Eleva series consists of moderately deep, well-drained, loamy soils on uplands. These soils are underlain by sandstone.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 7 inches thick. The subsoil is about 25 inches thick. It is brown to dark-brown sandy loam in the upper part and dark-brown sandy loam in the lower part. The underlying material is brown, strongly acid, medium sand about 6 inches thick. This layer overlies sandstone bedrock.

The available water capacity is low, and permeability is moderate. Natural fertility is medium. Drought is a moderate hazard.

Representative profile of Eleva sandy loam, 2 to 6 percent slopes, in a cultivated field, 100 feet west of center of north-south road and 600 feet south of center of east-west road; SW¼SE¼ sec. 9, T. 27 N., R. 12 W.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) sandy loam, pale brown (10YR 6/3) dry; crumb structure; very friable; medium acid; abrupt, smooth boundary.
B1—7 to 18 inches, brown (10YR 5/3) sandy loam; weak, medium, platy structure; very friable; strongly acid; clear, smooth boundary.
B21t—18 to 22 inches, dark-brown (10YR 4/3) heavy sandy loam; weak, medium, subangular blocky structure; friable; thin clay films on ped surfaces; strongly acid; clear, smooth boundary.
B22t—22 to 30 inches, dark-brown (7.5YR 4/4) loam; moderate, medium, subangular blocky structure; friable; thin clay films on ped surfaces; strongly acid; clear, smooth boundary.
B3—30 to 32 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; friable; strongly acid; clear, wavy boundary.
IIC—32 to 38 inches, yellowish-brown (10YR 5/4) medium sand; single grain; loose; strongly acid; abrupt, smooth boundary.
R—38 to 100 inches, yellowish-brown (10YR 5/4) poorly cemented sandstone that contains thin bands of dark reddish-brown (5YR 3/4) sandy loam.

When dry, the A horizon is very light brownish gray (10YR 6/2) to gray (10YR 6/1) or pale brown (10YR 6/3). An A2 horizon, 1 to 2 inches thick, occurs in some profiles. The depth to sandstone ranges from 36 to 40 inches. The solum ranges from 26 to 36 inches in thickness.

In most areas the Eleva soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Eleva soils have a finer textured solum than Plainbo soils. They are underlain by sandstone, whereas Billett soils are underlain by sand.

Eleva sandy loam, 2 to 6 percent slopes (ElB).—This soil occupies irregularly shaped tracts on low uplands. It has the profile described as representative of the series. The surface layer is uniformly very dark grayish brown. A few sandstone chips are on the surface.

Included with this soil in mapping are small areas of well-drained Norden silt loam and Northfield silt loam. Also included are small areas where the slope is less than 2 percent or more than 6 percent.

Most of the acreage of this Eleva soil is used for corn, small grain, soybeans, alfalfa, and clover. The soil is also suited to pasture, woodland, wildlife habitat, and recreation. Erosion and drought are the main hazards. Capability unit IIIs–4; woodland group 3o1; tree and shrub group 1; wildlife group 1; recreation group 2.

Eleva sandy loam, 6 to 12 percent slopes, eroded (ElC2).—This soil has a profile similar to the one described as representative of the series, but about two-thirds of the original surface layer has been removed through erosion. The present surface layer is lighter colored and contains less organic matter than the uneroded surface layer.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are some small spots of severely eroded soil.

Most of the acreage of this Eleva soil is used for corn, small grain, soybeans, alfalfa, and clover. Some of it is used for pasture, woodland, and wildlife habitat. Practices that include protection from fire and grazing are needed in woodland areas and areas used for wildlife. Erosion and drought are the main hazards. Capability unit IVe–4; woodland group 3o1; tree and shrub group 1; wildlife group 1; recreation group 2.

Elkmound Series

The Elkmound series consists of shallow, well-drained, loamy soils on uplands. These soils are underlain by hard, platy sandstone.

In a representative profile the surface layer is very dark grayish-brown loam 7 inches thick. The subsoil is

dark yellowish-brown loam about 7 inches thick. The underlying material is pale-brown, thinly bedded, firmly cemented, fine-grained sandstone.

The available water capacity is low, and permeability is moderate. Natural fertility is medium. Drought is a severe hazard.

Representative profile of Elkmound loam, 2 to 6 percent slopes, in a cultivated field, 400 feet west of center of town road and 400 feet south of north line of NE¼ NE¼ sec. 13, T. 26 N., R. 14 W.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; commonly contains sandstone fragments; weak, medium, subangular blocky structure; friable; slightly acid; abrupt, smooth boundary.

B—7 to 14 inches, dark yellowish-brown (10YR 4/4) loam; commonly contains sandstone fragments; weak, thick, platy structure parting to weak, medium, subangular blocky; friable; medium acid; clear, smooth boundary.

R—14 to 100 inches, pale-brown (10YR 6/3), thinly bedded, firmly cemented, fine-grained sandstone.

When dry, the A horizon ranges from light brownish gray (10YR 6/2) to gray (10YR 6/1). The B horizon ranges from medium acid to strongly acid in reaction. The depth to sandstone ranges from 12 to 20 inches.

In most areas the Elkmound soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Elkmound soils are coarser textured than the associated Northfield soils. They are shallow, unlike the Urne soils, which are moderately deep. All these soils are underlain by sandstone at a depth of less than 40 inches.

Elkmound loam, 0 to 2 percent slopes (EmA).—This soil occupies irregularly shaped areas on ridgetops. It has a profile similar to the one described as representative of the series, but the solum is about 16 inches thick. In cultivated areas the surface layer is very dark grayish brown when moist.

Included with this soil in mapping are areas where the slope is more than 2 percent. Also included are small areas of Northfield silt loam and Norden silt loam.

This Elkmound soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Droughtiness is the main hazard. Capability unit IIIs–8; woodland group 3d1; tree and shrub group 2; wildlife group 3; recreation group 3.

Elkmound loam, 2 to 6 percent slopes (EmB).—This soil occurs on ridgetops. It has the profile described as representative of the series. In cultivated fields the surface layer is very dark grayish brown when moist. Many sandstone fragments are on the surface.

Included with this soil in mapping are a few small areas of Norden silt loam and Northfield silt loam. Also included are some small areas that are moderately or severely eroded.

This Elkmound soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, and certain uses for wildlife and recreation. Drought is a severe hazard, and erosion is a moderate hazard. Capability unit IIIe–3; woodland group 3d1; tree and shrub group 2; wildlife group 3; recreation group 3.

Elkmound loam, 6 to 12 percent slopes, eroded (EmC2).—This soil is on ridges. It has a profile similar to the one described as representative of the series, but in most places 4 to 6 inches of the original surface layer has been lost through erosion. Also, in this soil the surface layer is less friable, lower in organic-matter content and fertility, and more difficult to keep in good tilth than that of the representative profile. In cultivated areas the surface layer is very dark grayish brown and contains spots of dark yellowish-brown material from the subsoil.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent and areas that are slightly to severely eroded. Also included are some small areas of an eroded Norden silt loam and of Northfield silt loam, 6 to 12 percent slopes, eroded.

This Elkmound soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, and certain uses for wildlife and recreation. Capability unit IVe–3; woodland group 3d1; tree and shrub group 2; wildlife group 3; recreation group 3.

Gotham Series

The Gotham series consists of deep, well-drained to somewhat excessively drained, sandy soils on stream terraces and outwash plains.

In a representative profile the surface layer is very dark grayish-brown loamy fine sand about 8 inches thick. The subsoil is about 24 inches thick. It is dark-brown loamy fine sand in the upper part and dark-brown fine sand in the lower part. The underlying material is brown fine sand.

The available water capacity is low, and permeability is rapid. Natural fertility is low. Drought is a severe hazard; water erosion and soil blowing are moderate hazards.

Representative profile of Gotham loamy fine sand, 2 to 6 percent slopes, in a cultivated field, 150 feet east of road and 200 feet north of south line of NW¼SW¼ sec. 29, T. 26 N., R. 11 W.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy fine sand; weak, fine, crumb structure; very friable; medium acid; abrupt, smooth boundary.

B2t—8 to 16 inches, dark-brown (7.5YR 4/4) loamy fine sand; slightly higher content of clay than in Ap horizon; weak, medium, subangular blocky structure; friable; clay bridging of sand grains; medium acid; gradual, wavy boundary.

B3—16 to 32 inches, dark-brown (7.5YR 4/4) coherent fine sand; weak, coarse, subangular blocky structure; very friable; strongly acid; gradual, smooth boundary.

C1—32 to 48 inches, brown (7.5YR 5/4) fine sand; single grain; loose; strongly acid; gradual, smooth boundary.

C2—48 to 60 inches, brown (7.5YR 5/4) fine sand; single grain; loose; few thin layers of dark-brown (7.5YR 4/4) light sandy loam ⅛ to ¼ inch thick; few, distinct, yellowish-brown (10YR 5/6) mottles at a depth of 60 inches.

The B2t horizon ranges from loamy fine sand to light fine sandy loam in texture. The solum extends to depths ranging from 28 to 40 inches. Finer textured layers ranging from 1 to 3 inches in thickness are common at depths of 4 to 6 feet.

In most areas the Gotham soils in this county have a lower soil temperature than is defined as the range for the series, but this does not alter the use or behavior of the soils.

Gotham soils formed in finer textured sand than the parent material of the associated Plainfield soils. Their solum is lighter colored than that of the Dickinson soils.

Gotham loamy fine sand, 0 to 2 percent slopes (GoA).—This soil has a profile similar to the one described as representative of the series, but the solum is slightly thicker. In cultivated fields the surface layer is very dark grayish brown; concave spots throughout the acreage are darker colored.

Included with this soil in mapping are small areas of Gotham loamy fine sand, loamy substratum, and small areas of Plainfield loamy sand. Also included are small areas where sandstone bedrock begins at a depth of about 3 feet.

Most of the acreage of this Gotham soil is used for corn, small grain, soybeans, alfalfa, and clover. Some of the acreage is in native hardwoods or recently planted pines. Large areas formerly used for cultivated crops have been planted to conifers. This soil is also suited to wildlife habitat and recreation. Drought is a severe hazard, and soil blowing is a moderate hazard. Capability unit IVs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Gotham loamy fine sand, 2 to 6 percent slopes (GoB).—This soil has the profile described as representative of the series. In cultivated areas the surface layer is very dark grayish brown. Small areas are included where the slope is less than 2 percent or more than 6 percent.

Most areas are used for corn, small grain, soybeans, alfalfa, and clover. Large areas formerly used for cultivated crops have been planted to conifers. This soil is also suited to pasture, woodland, and certain uses for wildlife and recreation. Drought and soil blowing are hazards. Capability unit IVs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Gotham loamy fine sand, 6 to 12 percent slopes, eroded (GoC2).—This soil is on stream terraces and outwash plains. The profile is similar to that described as representative of the series, but in most places 4 to 10 inches of the original surface layer has been lost through erosion. Also, the surface layer is lower in organic-matter content and fertility than that of the profile described as representative. The surface layer of this eroded soil is very dark grayish brown, and in most places it contains dark-brown material from the subsoil.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are small areas of Plainfield loamy sand and Hubbard loamy sand. In addition, small areas are included where the soil has been slightly eroded or severely eroded.

This Gotham soil is suited to Norway pine and white pine. It is also suited to wildlife habitat. Much of the acreage formerly used for cultivated crops has been planted to conifers. Drought, soil blowing, and water erosion are severe hazards. Capability unit IVs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Gotham loamy fine sand, loamy substratum, 0 to 2 percent slopes (GsA).—The surface layer of this soil is very dark grayish brown. In a few scattered, concave areas the surface layer is darker colored. The profile of this soil is like that described as representative of the series, but a loamy layer, 6 to 12 inches thick, begins at a depth of about 40 to 60 inches.

Included with this soil in mapping are small areas where the slope is 3 to 5 percent. Also included are a few small areas of another Gotham loamy fine sand.

This Gotham soil is suited to corn, small grain, soybeans, and alfalfa. It is also suited to pine trees, wildlife habitat, and recreation. Drought is a moderately severe hazard. Water erosion and soil blowing are moderate hazards. Capability unit IVs–3; woodland group 3o1; tree and shrub group 1; wildlife group 3; recreation group 4.

Gotham loamy fine sand, loamy substratum, 2 to 6 percent slopes (GsB).—This soil occupies irregularly shaped tracts 5 to 35 acres in size. In cultivated areas the surface layer is very dark grayish brown; in most areas along streams, the surface layer is darker colored. The profile of this soil is like that described as representative of the series, but a loamy layer, 6 to 12 inches thick, begins at a depth of about 40 to 60 inches.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are a few small areas of Hubbard loamy sand and Plainfield loamy sand, as well as some moderately eroded areas.

This Gotham soil is suited to corn, small grain, soybeans, and alfalfa. The main hazards are soil blowing and droughtiness. Low natural fertility is a limitation. Windbreaks, stripcropping, and shelterbelts help to control soil blowing in cultivated areas. Capability unit IVs–3; woodland group 3o1; tree and shrub group 1; wildlife group 3; recreation group 4.

Gotham loamy fine sand, loamy substratum, 6 to 12 percent slopes, eroded (GsC2).—This soil occupies elongated areas on benches and valley sides. The profile is like that described as representative of the series, but about half of the original surface layer has been lost through erosion and a layer of silt, 6 to 12 inches thick, begins at a depth of about 40 to 60 inches. In addition, the surface layer of this soil is lower in organic-matter content and fertility than that of the profile described as representative.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are small areas where the soil has been slightly eroded or severely eroded. In addition, small areas of Plainfield loamy sand, eroded, and Hubbard loamy sand, eroded, are included.

This Gotham soil is suited mainly to pine trees and to plantings for wildlife. Drought is a moderate hazard, and natural fertility is low. Soil blowing and water erosion are moderate hazards. Capability unit IVs–3; woodland group 3o1; tree and shrub group 1; wildlife group 3; recreation group 4.

Hixton Series

The Hixton series consists of moderately deep, well-drained, loamy soils. These soils overlie sandstone bedrock.

In a representative profile the surface layer is very dark grayish-brown, friable loam about 6 inches thick.

The subsurface layer is dark grayish-brown loam 4 inches thick. The subsoil is about 21 inches thick. It is dark-brown loam in the upper 12 inches and dark-brown sandy loam in the lower 9 inches. The underlying material is yellowish-brown, strongly acid, medium sand. Below this is sandstone bedrock.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. Drought is a moderate hazard.

Representative profile of Hixton loam, 2 to 6 percent slopes, in a cultivated field, 75 feet east of center of north-south road and 600 feet north of east-west road, SW¼SE¼ sec. 17, T. 28 N., R. 11 W.

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) loam; moderate, medium, granular structure; friable; medium acid; abrupt, smooth boundary.

A2—6 to 10 inches, dark grayish-brown (10YR 4/2) loam; weak, medium, platy structure; friable; medium acid; clear, smooth boundary.

B1—10 to 12 inches, dark-brown (10YR 4/3) loam; weak, medium, subangular blocky structure; friable; medium acid; clear, smooth boundary.

B2t—12 to 22 inches, dark-brown (10YR 4/3) heavy loam; moderate, medium, subangular blocky structure; firm; thin patchy clay films on ped faces; strongly acid; gradual, smooth boundary.

B3t—22 to 31 inches, dark-brown (10YR 4/3) heavy sandy loam; moderate, coarse, subangular blocky structure; firm; few thin patchy clay films on ped faces; very strongly acid; clear, irregular boundary.

IIC—31 to 37 inches, yellowish-brown (10YR 5/4) medium sand; single grain; loose; strongly acid; clear, smooth boundary.

IIIR—37 to 100 inches, yellowish-brown (10YR 5/6) partly weathered sandstone in upper part; indurated sandstone in lower part.

The solum ranges from 28 to 34 inches in thickness. The depth to the underlying sandstone ranges from 30 to 40 inches. The A horizon ranges from very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2).

In most areas the Hixton soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Hixton soils have a finer textured solum than the associated Arland soils.

Hixton loam, 2 to 6 percent slopes (HfB).—This soil occurs as irregularly shaped tracts 3 to 60 acres in size. It has the profile described as representative of the series. The surface layer is very dark grayish brown. In places a few sandstone fragments are on the surface.

Included with this soil in mapping are small areas of Northfield and Norden soils. Also included are areas that are moderately eroded.

This Hixton soil is suited to corn, small grain, alfalfa, and clover. It is also suited to trees, pasture, and certain uses for wildlife and recreation. Drought and erosion are moderate hazards. Capability unit IIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Hixton loam, 6 to 12 percent slopes, eroded (HfC2).—This soil occurs as irregularly shaped tracts in valleys and on ridges. It has a profile similar to the one described as representative of the series, but about 4 to 8 inches of the original surface layer has been lost through erosion. Also, the surface layer is less friable, lower in organic-matter content and fertility, and more difficult to keep in good tilth than the surface layer described in the representative profile. In cultivated areas the surface layer is very dark grayish brown and contains dark-brown material from the subsoil.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are small areas of an eroded Northfield soil and an eroded Norden soil. In addition, small areas are included where the soil is slightly or severely eroded.

This Hixton soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, and other less intensive uses. Drought and erosion are moderate hazards. Capability unit IIIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Hixton loam, 12 to 20 percent slopes, eroded (HfD2).—This soil has a profile similar to the one described as representative of the series, but 6 to 8 inches of the original surface layer has been lost through erosion. Also, the surface layer is less friable and lower in organic-matter content and fertility than the surface layer described in the representative profile. In this soil the surface layer is very dark grayish brown, and in about half the acreage it contains brown material from the subsoil.

Included with this soil in mapping are small areas where the slope is less than 12 percent or more than 20 percent. Also included are small areas that are slightly or severely eroded. In addition, small areas of Northfield and Eleva soils are included in places.

This Hixton soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to trees, pasture, and other less intensive uses. Drought and erosion are moderate hazards. Capability unit IVe–2; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Hixton Series, Mottled Subsoil Variant

The mottled subsoil variant of the Hixton series consists of moderately deep, somewhat poorly drained, loamy soils at the base of upland slopes and on ridgetops. These soils are underlain by medium-grained sandstone and shale.

In a representative profile the surface layer is very dark grayish-brown, friable loam 10 inches thick. The upper 8 inches of the subsoil is dark-brown heavy loam that is mottled with dark brown. The lower 3 inches is brown sandy loam mottled with dark brown and grayish brown. The underlying material is light-gray fine sand. Medium-grained sandstone begins at a depth of less than 40 inches in most places.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. These soils warm up later in spring than the well-drained soils of the Hixton series.

Representative profile of Hixton loam, mottled subsoil variant, 2 to 6 percent slopes, in a cultivated field, 100 feet east of center of town road and 500 feet north of County Highway E; NE¼NW¼ sec. 12, T. 28 N., R. 12 W.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam, gray (10YR 6/1) dry; weak, medium, subangular blocky structure; friable; strongly acid; abrupt, smooth boundary.

A12—8 to 10 inches, very dark grayish-brown (10YR 3/2) loam; moderate, medium, platy structure; friable; strongly acid; abrupt, smooth boundary.

B2t—10 to 18 inches, dark-brown (10YR 4/3) heavy loam; common, medium, faint, dark-brown (7.5YR 4/4) mottles; moderate, medium, subangular blocky structure; friable; thin patchy clay films on ped surfaces; strongly acid; gradual, smooth boundary.

B3—18 to 21 inches, brown (10YR 5/3) sandy loam; common, coarse, faint, dark-brown (7.5YR 4/4) and grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; friable; strongly acid; abrupt, smooth boundary.

IIC—21 to 38 inches, light-gray (10YR 7/1) fine sand; few, coarse, prominent, brownish-yellow (10YR 6/8) mottles; single grain; loose; medium acid; gradual, smooth boundary.

IIIR—38 to 100 inches, medium-grained sandstone and shale.

The A horizon ranges from very dark grayish brown (10YR 3/2) to very dark brown (10YR 2/2) in color. The depth to sandstone ranges from 24 to 40 inches.

The mottled subsoil variant of the Hixton soils differs from Shiffer soils in being underlain by sandstone rather than loose sandy stream sediments. Soils of both these series are somewhat poorly drained and have a subsoil of loam.

Hixton loam, mottled subsoil variant, 2 to 6 percent slopes (HmB).—This soil occurs as concave areas at the base of steep slopes. In cultivated areas the surface layer is very dark grayish brown. In a few scattered areas the soil is darker colored, and in these places internal drainage is slow.

Included with this soil in mapping are a few small areas of poorly drained Rib silt loam, moderately shallow variant. Also included are small areas where the slope is less than 2 percent or more than 6 percent.

This mottled subsoil variant of the Hixton soils is suited to corn, small grain, and clover. It is also suited to pasture, water-tolerant trees, and wildlife plantings. Capability unit IIw–5; woodland group 3w5; tree and shrub group 3; wildlife group 5a; recreation group 5.

Houghton Series

The Houghton series consists of deep, very poorly drained peaty muck soils. These soils are in marshes and swamps.

In a representative profile the surface layer is black peaty muck about 11 inches thick. The next layer is very dark brown peaty muck about 17 inches thick. Below this is dark-brown, partly decomposed mucky peat.

The available water capacity is very high, and permeability is moderately rapid. Natural fertility is medium. Frost is a hazard late in spring and early in fall. Soil blowing is a severe hazard.

Representative profile of Houghton peaty muck, in a swamp, 250 feet east of center of town road and 400 feet south of north line of NE¼NE¼ sec. 1, T. 27 N., R. 12 W.

Oa1—0 to 11 inches, black (10YR 2/1) sapric material that consists of decomposed fibrous plant remains; weak, coarse, subangular blocky structure parting to weak, medium, platy; friable; medium acid; abrupt, smooth boundary.

Oa2—11 to 17 inches, black and very dark brown (10YR 2/1-2/2) sapric material; weak, medium, subangular blocky structure parting to weak, medium, platy; friable; thin continuous iron oxide films of dark reddish brown (5YR 3/3) along cleavage planes; medium acid; clear, smooth boundary.

Oa3—17 to 23 inches, black and very dark brown (10YR 2/1-2/2) sapric material; weak, medium, platy structure that shows few vertical cleavage planes; friable; few patchy films of reddish-brown (5YR 3/3) iron oxide form thin coats along vertical cleavages; medium acid; gradual, smooth boundary.

Oa4—23 to 28 inches, very dark brown (10YR 2/2) sapric material and partly decomposed peat that shows moderate, thick, platy structure parting with pressure to weak, thin to medium, platy; friable; thin patchy films of iron oxide on faces of plates; medium acid; gradual, smooth boundary.

Oe1—28 to 38 inches, dark-brown (7.5YR 3/2-4/4) hemic material; moderate, thick, platy structure parting with pressure to weak, thin to medium, platy; friable; when exposed to air, color changes within 5 minutes to black or very dark brown (10YR 2/1-2/2); slightly acid; gradual, smooth boundary.

Oe2—38 to 60 inches, dark-brown (7.5YR 3/4) hemic material; generally weak, thin to medium, platy structure; friable; when exposed to air, color changes rapidly to lower value and chroma; neutral.

In some places an alluvial mineral soil, 2 to 6 inches thick, covers the surface. The solum ranges from 51 inches to about 5 feet in thickness.

In most areas the Houghton soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter their use or behavior.

Houghton soils formed in deep accumulations of organic material, in contrast with Markey soils, which formed in 16 to 42 inches of organic material overlying sand. They formed in more than 51 inches of organic material, whereas Cathro soils formed in 16 to 40 inches of organic material overlying loamy material.

Houghton peaty muck (0 to 2 percent slopes) (Ho).—This soil occurs as rounded or elongated tracts 3 to about 1,000 acres in size. The surface layer is black.

Included with this soil in mapping are small areas of very poorly drained Newton loamy sand and, in some places, areas of Markey muck.

This Houghton soil is rarely used for crops. If it is properly drained and fertilized, however, it can produce high yields. It is better suited to wildlife plantings. Most areas are in marsh grass, sedges, alders, and a few elm and ash trees. The water table is high. Frost is a hazard, and soil blowing is a severe hazard. Capability unit IVwc–9; woodland group 5w6; tree and shrub group 4; wildlife group 6; recreation group 9.

Hubbard Series

The Hubbard series consists of deep, well-drained to somewhat excessively drained, sandy soils on stream terraces and outwash plains.

In a representative profile (fig. 5) the surface layer is black loamy sand about 13 inches thick. The upper 10 inches is black, and the lower 3 inches is very dark brown. The subsoil is dark-brown loamy sand about 11 inches thick. The underlying material is medium acid, yellowish-brown medium sand.

The available water capacity is low, and permeability is rapid. Natural fertility is low. Drought and soil blowing are severe hazards.

Representative profile of Hubbard loamy sand, 0 to 2 percent slopes, in a cultivated field, 300 feet south of center of County Highway C, and 50 feet west of east line of NW¼NE¼ sec. 21, T. 27 N., R. 11 W.

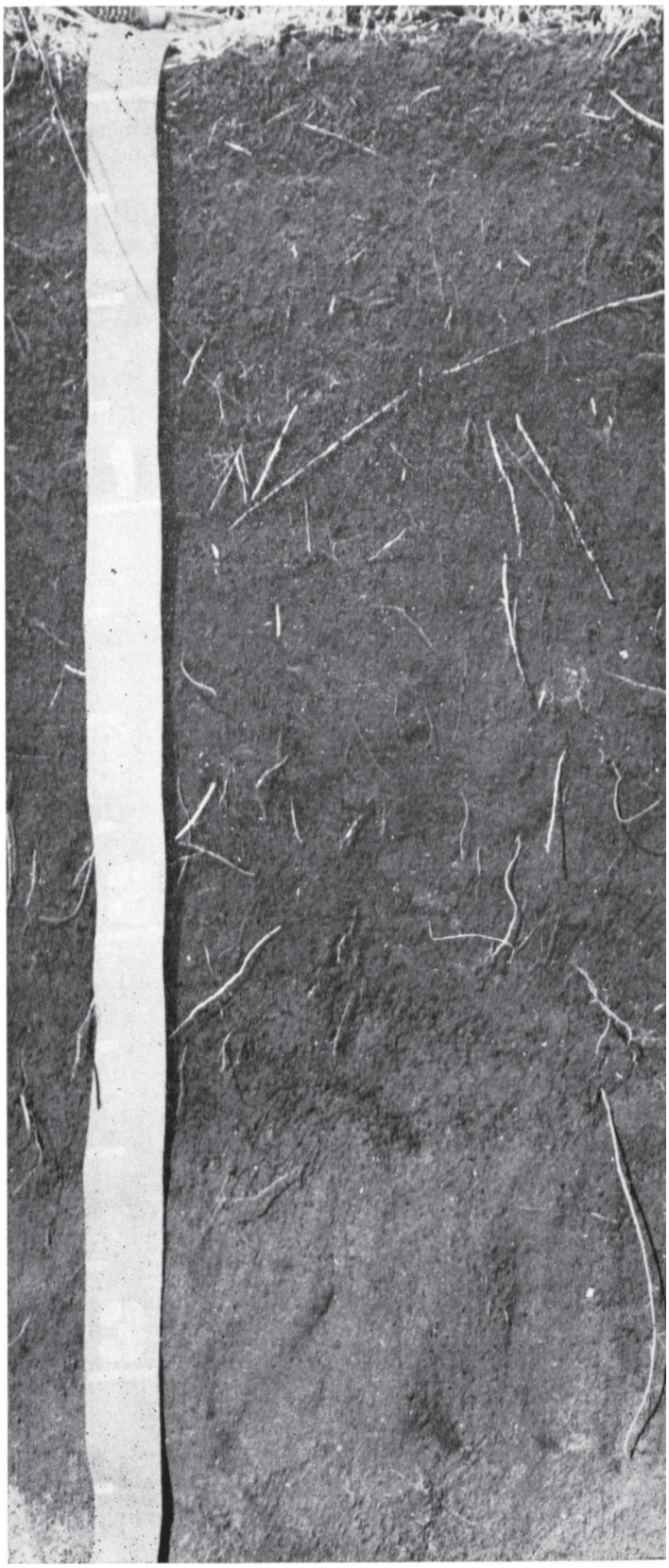

Figure 5.—Profile of a Hubbard loamy sand.

Ap—0 to 6 inches, black (10YR 2/1) loamy sand; weak, fine, crumb structure; friable; medium acid; abrupt, smooth boundary.
A12—6 to 10 inches, black (10YR 2/1) loamy sand; weak, coarse, subangular blocky structure; friable; medium acid; clear, smooth boundary.
A3—10 to 13 inches, very dark brown (10YR 2/2) loamy sand; weak, coarse, subangular blocky structure; friable; strongly acid; clear, smooth boundary.
B2—13 to 18 inches, dark-brown (10YR 3/3) heavy loamy sand; weak, coarse, subangular blocky structure; friable; strongly acid; gradual, smooth boundary.
B3—18 to 24 inches, dark-brown (10YR 4/3) loamy sand; weak, coarse, subangular blocky structure; friable; medium acid; clear, smooth boundary.
C—24 to 60 inches, yellowish-brown (10YR 5/6) medium sand; single grain; loose; medium acid.

The A horizon ranges from loamy sand to light sandy loam in texture and from 10 to 20 inches in thickness. The B horizon ranges from dark brown (10YR 3/3) to reddish brown (5YR 4/3) in color. A small amount of fine granitic gravel occurs within the solum and the C horizon. The C horizon contains high to medium amounts of dark, weatherable minerals.

Hubbard soils have a coarser textured solum than that of Dickinson soils. Their solum is darker colored than that of Plainfied soils. All these soils have a sandy subsoil.

Hubbard loamy sand, 0 to 2 percent slopes (HuA).—This soil has the profile described as representative of the series. Its surface layer is black. In some cultivated areas where the soil is slightly undulating, lighter colored spots are scattered throughout the acreage.

Included with this soil in mapping are small areas of Burkhardt sandy loam.

This Hubbard soil is suited to corn, small grain, soybeans, and alfalfa. It is also suited to pine trees, wildlife habitat, and recreation. Much of the acreage of this soil that was formerly cultivated has now been planted to conifers. Drought and soil blowing are severe hazards. Capability unit IVs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Hubbard loamy sand, 2 to 6 percent slopes (HuB).—This soil occurs on outwash plains and stream terraces. It has a profile similar to the one described as representative of the series, but it is slightly thinner. The surface layer is black.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are a few areas where the soil is moderately eroded. In addition, a few areas of Plainfield loamy sand and Gotham loamy fine sand are included.

This Hubbard soil is suited to corn, small grain, soybeans, and alfalfa. It is also suited to pasture, pine trees, and certain uses for wildlife and recreation. Much of the acreage of this soil that was formerly cultivated has now been planted to conifers. Natural fertility is low. Drought and soil blowing are hazards. Capability unit IVs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Hubbard loamy sand, 6 to 12 percent slopes, eroded (HuC2).—This soil is on outwash plains and stream terraces. It has a profile similar to the one described as representative of the series, but about half of the original surface layer has been lost through erosion. In cultivated areas the surface layer is very dark brown.

Included with this soil in mapping are small areas of Dakota sandy loam and Burkhardt sandy loam.

This Hubbard soil is suited to pine trees and wildlife plantings. Much of the acreage that was formerly cultivated has now been planted to conifers. Drought is a severe hazard. Water erosion and soil blowing are moderate hazards. Natural fertility is low. Capability unit IVs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Hubbard loamy sand, loamy substratum (0 to 2 percent slopes) (Hv).—This soil has a profile similar to the one described as representative of the series, but a loamy layer, 6 to 12 inches thick, begins at a depth of 40 to 60 inches. The plow layer is black; in slight depressions throughout the acreage a few spots are lighter colored.

Included with this soil in mapping are small areas of Hubbard loamy sand.

This Hubbard soil is suited to corn, small grain, soybeans, and alfalfa. It is also suited to pasture, pine trees, wildlife plantings, and recreation. Much of the acreage that was formerly cultivated has now been planted to conifers. Low organic-matter content and low fertility are limitations to use of this soil, and maintenance of the organic-matter content and fertility level is important. Drought and soil blowing are hazards. Capability unit IVs–3; woodland group 3o1; tree and shrub group 1; wildlife group 3; recreation group 4.

Hubbard sand, hummocky (0 to 12 percent slopes) (HwC).—This soil consists of windblown mounds of dark-colored sand. Most of the areas have been stabilized, but a few small areas are actively drifting.

This soil is associated with Hubbard loamy sand and in some places with Plainfield soils. It is near areas of Terrace escarpments, sandy.

This Hubbard soil is suited to pine trees and wildlife plantings. The vegetation is mainly scrub oak and jack pine. Natural fertility is low. Drought and soil blowing are severe hazards. Capability unit VIIs–3; woodland group 4s1; tree and shrub group 2; wildlife group 8; recreation group 4.

Kickapoo Series

The Kickapoo series consists of deep, well drained to moderately well drained, loamy soils in narrow upland drainageways.

In a representative profile the surface layer is dark-brown fine sandy loam about 7 inches thick. The next layer is dark-brown fine sandy loam, 19 inches thick, that overlies a layer of very dark grayish-brown loam 26 inches thick. This layer is underlain by dark-brown, strongly acid to medium acid fine sand.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. Surface runoff is slow.

Representative profile of Kickapoo fine sandy loam, in a cultivated field in a drainageway, 75 feet east of center of north-south road and 400 feet south of east-west road; NW¼NW¼ sec. 4, T. 27 N., R. 12 W.

Ap—0 to 7 inches, dark-brown (10YR 4/3) fine sandy loam; weak, medium, subangular blocky structure; friable; medium acid; abrupt, smooth boundary.

C1—7 to 16 inches, dark-brown (10YR 4/3) fine sandy loam, weak, fine, subangular blocky structure; very friable; medium acid; abrupt, smooth boundary.

C2—16 to 26 inches, dark-brown (10YR 4/3) fine sandy loam; weak, thick, platy structure; very friable; medium acid; abrupt, smooth boundary.

Ab—26 to 52 inches, very dark grayish-brown (10YR 3/2) loam; few, medium, prominent, reddish-brown (2.5YR 4/4) mottles; massive; friable; medium acid; gradual, smooth boundary.

Cb—52 to 60 inches, dark-brown (7.5YR 3/4) fine sand; single grain; loose; medium acid.

The A horizon ranges from dark brown (10YR 3/3) to dark grayish brown (10YR 4/2) in color.

In most areas the Kickapoo soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Kickapoo soils differ from Arenzville soils in having formed in coarser textured alluvial sediments. Soils of both these series are on flood plains.

Kickapoo fine sandy loam (0 to 2 percent slopes) (Kc).—This soil occurs as long, narrow tracts, about 2 to 10 acres in size, in narrow draws. The surface layer ranges from dark brown to dark grayish brown in color. The color of the soil is closely related to the color of the material washed in from surrounding uplands.

Included with this soil in mapping are small areas of Arenzville silt loam and Boaz silt loam. Also included are small areas where the surface layer is silty and is 12 to 18 inches thick. In addition, areas where the slope is more than 2 percent are included.

This soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, trees, and wildlife plantings. The soil is flooded at times in spring and after heavy rains. Capability unit IIIw–12; woodland group 3o1; tree and shrub group 1; wildlife group 7; recreation group 8.

La Farge Series

The La Farge series consists of moderately deep, well-drained, loamy soils that are underlain by fine-grained sandstone. These soils are nearly level to steep.

In a representative profile the surface layer is dark-brown silt loam 6 inches thick. The subsurface layer is dark grayish-brown silt loam about 3 inches thick. The subsoil is about 27 inches thick. The upper 3 inches is dark-brown silt loam, the next 16 inches is dark yellowish-brown light silty clay loam, and the lower 8 inches is dark-brown loam. The underlying material is fine-grained sandstone that contains varying amounts of glauconite.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. Drought is a moderate hazard.

Representative profile of La Farge silt loam, 6 to 12 percent slopes, eroded, in a cultivated field, 25 feet northeast of center of State Highway 72, and 400 feet south of north line of NW¼SE¼ sec. 33, T. 27 N., R. 13 W.

Ap—0 to 6 inches, dark-brown (10YR 3/3) silt loam, gray (10YR 6/1) dry; weak, fine, granular structure; very friable; mildly alkaline; abrupt, smooth boundary.

A2—6 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, thin, platy structure; vesicular; very friable; medium acid; clear, smooth boundary.

B1—9 to 12 inches, dark-brown (10YR 4/3) silt loam; moderate, very fine, subangular blocky structure; vesicular; friable; silt coatings; strongly acid; clear, smooth boundary.

B2t—12 to 28 inches, dark yellowish-brown (10YR 4/4) light silty clay loam, crushes to yellowish brown (10YR 5/6); moderate, medium, subangular blocky structure; vesicular; firm; many thin patchy clay films on peds; silt coatings; few dark-colored iron and manganese spots on surfaces and interiors of peds; plentiful roots; strongly acid; gradual, smooth boundary.

IIB3—28 to 36 inches, dark-brown (7.5YR 4/4) loam; moderate, medium, subangular blocky structure; friable; few, fine, faint mottles; few very dark gray (5YR 3/1-2/2) iron or manganese spots on surfaces and interiors of peds; plentiful roots; strongly acid; clear, smooth boundary.

R—36 to 60 inches, fine-grained, glauconitic sandstone.

The amount of glauconitic material in the R horizon ranges from none to more than two-thirds of the horizon, by visual observation. The depth to the glauconitic underlying material ranges from 24 to 40 inches. The sandstone has a wide range of color. Reaction ranges from strongly acid to moderately alkaline.

In most areas La Farge soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

La Farge soils formed in thicker deposits of silt than the associated Norden soils. The silt cap in which they formed, however, was not so thick as that in which Seaton soils formed. La Farge soils are underlain by sandstone at a depth of 24 to 40 inches, whereas Palsgrove soils are 46 inches deep over limestone and Seaton soils are more than 60 inches deep over limestone. La Farge and Palsgrove soils have a subsoil of silty clay loam, whereas Seaton soils have a subsoil of heavy silt loam.

La Farge silt loam, 2 to 6 percent slopes (LfB).—This soil occurs as irregularly shaped tracts about 5 to 50 acres in size. Its profile is slightly thicker than that described as representative. The surface layer is dark brown. In a few places shallow draws traverse the areas.

Included with this soil in mapping are small areas of Norden silt loam and Seaton silt loam. Also included are a few small areas where the slope is less than 2 percent or more than 6 percent. In addition, some areas are included where the soil is moderately eroded.

This La Farge soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, trees, wildlife plantings, and recreation. Drought and erosion are moderate hazards. Capability unit IIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

La Farge silt loam, 6 to 12 percent slopes, eroded (LfC2).—This soil occurs as irregularly shaped tracts on upland ridges. It has the profile described as representative of the series. The surface layer is dark brown.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are small acreages of an eroded Norden silt loam and an eroded Seaton silt loam. In addition, small areas are included where the soil is slightly eroded.

This La Farge soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, trees, and other less intensive uses. Runoff is moderately rapid. Drought and erosion are moderate hazards. Capability unit IIIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

La Farge silt loam, 6 to 12 percent slopes, severely eroded (LfC3).—This soil occurs on upland ridges. It has a profile similar to the one described as representative of the series, but more than three-fourths of the surface layer and some of the upper part of the subsoil has been lost through erosion. The present surface layer is lighter colored, higher in clay content, and more difficult to cultivate than the uneroded surface layer.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are areas where the soil is moderately eroded.

This soil is suited to corn, small grain, alfalfa, and clover. It is also suited to pasture, trees, and wildlife plantings. The available water capacity and permeability of the plow layer have been reduced by erosion. Capability unit IVe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

La Farge silt loam, 12 to 20 percent slopes, eroded (LfD2).—This soil occurs as elongated areas. It has a profile similar to the one described as representative of the series, but 6 to 8 inches of the original surface layer has been lost through erosion. The surface layer is less friable, lower in organic-matter content and fertility, and more difficult to keep in good tilth than that of the representative profile. The present surface layer is grayish brown, and in most places it contains yellowish-brown material from the subsoil.

Included with this soil in mapping are small areas where the slope is less than 12 percent or more than 20 percent.

This soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, trees, and wildlife plantings. Drought is a moderate hazard, and erosion is a severe hazard. Capability unit IVe–2; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 1.

La Farge silt loam, 12 to 20 percent slopes, severely eroded (LfD3).—This soil has a profile similar to the one described as representative of the series, but erosion has removed more than three-fourths of the surface layer and, in places, the upper part of the subsoil. The present surface layer is lighter colored, higher in clay content, and more difficult to cultivate than the uneroded surface layer.

Included with this soil in mapping are small areas where the slope is less than 12 percent or more than 20 percent. Also included are small areas where the soil is moderately eroded.

This soil is suited to pasture, hay, and trees. It is also suited to wildlife plantings. Erosion is a severe hazard. Capability unit VIe–2; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 1.

La Farge silt loam, 20 to 30 percent slopes, eroded (LfE2).—This soil has a profile similar to the one described as representative of the series, but 6 to 8 inches of the original surface layer has been lost through erosion. The surface layer is less friable, lower in organic-matter content and fertility, and more difficult to keep in good tilth than that of the representative profile. The present surface layer is grayish brown, and in most places it contains yellowish-brown material from the subsoil.

Included with this soil in mapping are small areas where the slope is less than 20 percent or more than 30 percent. Also included are small acreages of an eroded Norden silt loam and an eroded Seaton silt loam. In addition, small areas are included where the soil is slightly eroded.

This La Farge soil is suited mainly to pasture and woodland. Drought is a moderate hazard, and erosion is a severe hazard. Capability unit VIe–2; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Lows Series

The Lows series consists of moderately deep, poorly drained, loamy soils on low stream terraces. These soils are nearly level or slightly depressional. They are underlain by medium sand.

In a representative profile the surface layer is very dark gray loam about 6 inches thick, and the subsurface layer is gray, mottled loam about 7 inches thick. The subsoil is gray, mottled loam about 15 inches thick. The underlying material is gray medium sand.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. The water table is high.

Representative profile of Lows loam, in a pasture, 400 feet east of center of road and 800 feet north of south line of SW¼SE¼ sec. 32, T. 27 N., R. 12 W.

A1—0 to 6 inches, very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak, fine, subangular blocky structure; friable; abundant fine fibrous roots; many medium, fine and very fine pores and few continuous, mostly exped, dendritic pores; medium acid; abrupt, smooth boundary.

A2g—6 to 13 inches, gray (10YR 5/1) loam, light gray (10YR 7/1) dry; common, fine, faint and distinct, dark-brown (7.5YR 4/2-4/4) mottles; weak, medium, platy structure; friable; plentiful fine fibrous roots; common fine and very fine pores and few, medium and coarse, continuous, inped and exped, dendritic pores; strongly acid; clear, smooth boundary.

B1g—13 to 16 inches, gray (10YR 5/1) loam; many, coarse and medium, prominent, yellowish-red (5YR 4/6) mottles; weak, very fine, subangular blocky structure; firm; few fine fibrous roots; common fine and very fine pores and few, medium and coarse, continuous, inped and exped, dendritic pores; strongly acid; clear, smooth boundary.

B21g—16 to 23 inches, gray (10YR 5/1) heavy loam; many, fine, prominent, yellowish-red (5YR 4/6) mottles; moderate, medium, subangular blocky structure; firm; few fine fibrous roots; common medium, fine and very fine, continuous, obliquely oriented, mostly exped pores; strongly acid; clear, smooth boundary.

B22g—23 to 26 inches, gray (10YR 5/1) silt loam; relatively high percentage of fine sand; many, fine, prominent, yellowish-red (5YR 4/6) mottles; weak, medium and coarse, subangular blocky structure; friable; common fine and very fine pores and few medium, continuous, obliquely oriented, inped and exped pores; slightly acid; clear, smooth boundary.

B3g—26 to 28 inches, gray (10YR 5/1) loam; many, medium, prominent, yellowish-red (5YR 4/6) mottles; weak, medium, subangular blocky structure; friable; common fine and very fine, continuous, vertically oriented, inped and exped pores; slightly acid; abrupt, smooth boundary.

IICg—28 to 60 inches, gray (10YR 6/1) medium sand; few thin bands, ½ inch to 2 inches wide, of finer textured sediments; bands are 12 to 14 inches apart; single grain; loose; slightly acid.

The A1 horizon ranges from 6 to 8 inches in thickness and from black (10YR 2/1) to very dark grayish brown (10YR 3/2) in color. The depth to underlying sand ranges from 24 to 40 inches.

Lows soils differ from the associated Shiffer soils in being poorly drained rather than somewhat poorly drained and in having a darker colored surface layer. They also differ in drainage characteristics from the associated Meridian soils, which are well drained. They have a coarser textured solum than the associated Marshan soils, and their surface layer is thinner than that of those soils.

Lows loam (0 to 2 percent slopes) (Lo).—This soil occupies irregularly shaped tracts on low outwash plains and stream terraces. The areas are 3 to 30 acres in size. In cultivated areas the surface layer is very dark gray. Some of the areas are underlain by thick beds of dark reddish-brown silt loam.

Included with this soil in mapping are small areas of Marshan silt loam and Shiffer loam. Also included are small areas where the surface layer is sandy loam and areas where the slope is 2 to 5 percent.

This Lows soil has a high water table, and surface runoff is slow. Drained areas are suited to corn, small grain, and clover. Wetness is a limitation, and frost damage is a hazard if this soil is used for crops. Corn can be harvested early in fall to avoid frost damage. Capability unit IIw–5; woodland group 3w5; tree and shrub group 3; wildlife group 5b; recreation group 6.

Markey Series

The Markey series consists of very poorly drained muck soils in depressions on outwash plains. These soils formed in organic material derived from decayed sedges and grasses. They are underlain by sandy material at a depth of less than 42 inches.

In a representative profile the surface layer is black muck 14 inches thick. This layer is neutral in reaction. It is underlain by 11 inches of black muck that overlies gray sand. The sand extends to a depth of 5 feet or more.

The available water capacity is high. Permeability is moderately rapid in the organic layer and rapid in the underlying sand. The water table is high. Runoff is slow to ponded. Natural fertility is medium.

Representative profile of Markey muck, in a swampy pasture, 600 feet south of center of highway and 100 feet west of the east 40 line of SW¼NW¼ sec. 32, T. 31 N., R. 13 W.

Oa1—0 to 14 inches, black (N 2/0) sapric material derived from well-decomposed fibrous plant remains; weak, thick, platy structure; very friable; neutral; abrupt, smooth boundary.

Oa2—14 to 18 inches, black (N 2/0) sapric material; weak, coarse, subangular blocky structure parting to weak, thick, platy; friable; neutral; abrupt, smooth boundary

Oa3—18 to 25 inches, black (N 2/0) sapric material; weak, medium, subangular blocky structure that shows weak, medium plates; neutral; abrupt, smooth boundary.

IIC—25 to 60 inches, olive-gray (5Y 5/2) sand; single grain; loose; mildly alkaline.

The Oa1 horizon ranges from 10 to 16 inches in thickness and from muck to peaty muck in texture. Colors range from black (N 2/0) to very dark brown (10YR 2/2). Ground water is usually at depths between 12 and 42 inches. The depth to the underlying sand ranges from 16 to 42 inches.

Markey soils differ from Cathro soils in being underlain by sandy material rather than loamy material. They formed in organic material, 16 to 42 inches thick, overlying sand, whereas Houghton soils formed in organic material more than 51 inches thick.

Markey muck (0 to 2 percent slopes) (Ma).—This soil occupies flats and depressions. Included in the areas mapped are small areas of Houghton peaty muck.

The use of this Markey soil for crops is severely limited. If drained, the soil is subject to drought, shrinkage, and soil blowing. It is suited to wildlife habitat. Natural fertility is low. Capability unit Vw–7; woodland group 5w6; tree and shrub group 4; wildlife group 6; recreation group 9.

Marshan Series

The Marshan series consists of deep, poorly drained, loamy soils in depressions on outwash plains.

In a representative profile the surface layer is 16 inches thick. The upper part is very dark grayish-brown silt loam, and the lower part is very dark gray silt loam. The subsoil is about 23 inches thick. The upper part is gray or grayish-brown silt loam, and the lower part is grayish-brown and yellowish-red silty clay loam. The underlying material is grayish-brown sand.

The available water capacity is medium, and permeability is moderate except in the underlying material, where it is rapid. Natural fertility is medium. Runoff is slow, and the water table is high.

Representative profile of Marshan silt loam, in a cultivated field, 125 feet north of center of County Highway E and 150 feet west of east line of SW¼SW¼ sec. 13, T. 27 N., R. 11 W.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark gray (10YR 3/1) dry; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A12—7 to 16 inches, very dark gray (10YR 3/1) silt loam; few, fine, prominent, strong-brown (7.5YR 5/6) mottles; weak, thin, platy structure; friable; slightly acid; gradual, smooth boundary.

B11—16 to 20 inches, grayish-brown (10YR 5/2) silt loam; few, fine, prominent, strong-brown (7.5YR 5/6) mottles; 60 percent or more low-chroma color; weak, very fine, subangular blocky structure; friable; medium acid; clear, smooth boundary.

B12—20 to 28 inches, gray (10YR 5/1) silt loam; common, fine, prominent, dark reddish-brown (5YR 3/4) mottles; 60 percent or more low-chroma color; weak, thin, platy structure; friable; medium acid; gradual, smooth boundary.

B21g—28 to 34 inches, grayish-brown (2.5Y 5/2) silt loam; few, fine, prominent, dark reddish-brown (5YR 3/4) mottles; 60 percent or more low-chroma color; weak, thin, platy structure; friable; medium acid; clear, smooth boundary.

B22g—34 to 39 inches, grayish-brown (2.5Y 5/2) and yellowish-red (5YR 5/8) silty clay loam, colors are approximately equal; weak, fine, subangular blocky structure; firm; medium acid; abrupt, smooth boundary.

IICg—39 to 60 inches, grayish-brown (2.5Y 5/2) sand; single grain; loose; medium acid.

The A horizon ranges from loam to silt loam in texture. The depth to the underlying sand ranges from 24 to 40 inches.

In most areas the Marshan soils in this county have a lower soil temperature than is defined in the range for the series, and they lack gravel in the underlying material, but this does not alter the use or behavior of the soils.

525-315—75——3

Marshan soils differ from the associated Pillot soils in being poorly drained and in having a mottled subsoil. They have a finer textured solum and a thicker surface layer than the associated Lows soils.

Marshan silt loam (0 to 2 percent slopes) (Mc).—This soil occupies irregularly shaped tracts on outwash plains and stream terraces. The areas are 3 to 30 acres in size. The surface layer is very dark grayish brown.

Included with this soil in mapping are some small areas of Shiffer loam and Lows loam. Also included are small areas where the surface layer is sandy loam or loam.

In its natural state this Marshan soil is usually too wet to be used for crops. If adequately drained, the soil is suited to corn, small grain, and clover. Crops are sometimes damaged by frost early in fall or late in spring. The soil is also suited to wildlife plantings and water-tolerant trees. Capability unit IIw–5; woodland group 4w5; tree and shrub group 3; wildlife group 5b: recreation group 6.

Meridian Series

The Meridian series consists of moderately deep, well-drained, loamy soils on stream terraces and outwash, plains. These soils are underlain by sand.

In a representative profile the surface layer is very dark grayish-brown loam about 8 inches thick. The subsurface layer is dark grayish-brown fine sandy loam about 3 inches thick. The subsoil is about 25 inches thick. The upper 7 inches is dark-brown loam, the next 8 inches is dark-brown heavy loam, and the lower 10 inches is friable, dark-brown fine sandy loam. The underlying material is yellowish-brown stratified sand.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. Drought is a moderate hazard.

Representative profile of Meridian loam, 2 to 6 percent slopes, in a cultivated field, 400 feet south of center of U.S. Highway 12 and 500 feet from center of side road; NW¼NW¼ sec. 25, T. 28 N., R. 12 W.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam, pale brown (10YR 6/3) dry; weak, medium, subangular blocky structure; friable; slightly acid; abrupt, smooth boundary.

A2—8 to 11 inches, dark grayish-brown (10YR 4/2) fine sandy loam; weak, medium, platy structure; friable; medium acid; clear, smooth boundary.

B1—11 to 18 inches, dark-brown (10YR 4/3) loam; weak, medium, subangular blocky structure; friable; strongly acid; gradual, smooth boundary.

B2t—18 to 26 inches, dark-brown (10YR 4/3) heavy loam; moderate, medium, subangular blocky structure; friable; clay films on peds; strongly acid; gradual, smooth boundary.

B3—26 to 36 inches, dark-brown (7.5YR 4/3) fine sandy loam; moderate, coarse, subangular blocky structure; friable; strongly acid; gradual, smooth boundary.

C—36 to 100 inches, yellowish-brown (10YR 5/4) stratified sand; single grain; loose.

The A horizon is dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2). The thickness of the A2 and Ap horizons combined is 12 to 14 inches in some places where the soil is in slight depressions. The A2 horizon is lacking in some cultivated areas. The solum ranges from 26 to 38 inches. The C horizon commonly contains loamy bands ¼ inch to 1½ inches thick; these bands are medium acid.

In many areas the Meridian soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

In the southern and eastern parts of the county, Meridian soils are associated with Tell soils. They have a coarser textured solum than those soils. In the north-central and northwestern parts of the county, Meridian soils are associated with Dakota soils; the Dakota soils have a loamy solum overlying sand and gravel. Meridian soils formed in parent material similar to that of Dakota soils, but their surface layer is thinner or lighter colored.

Meridian soils have a finer textured solum than that of the associated Billett soils. They are well drained, in contrast with the associated Lows soils, which are poorly drained.

Meridian loam, 0 to 2 percent slopes (MeA).—This soil is on stream terraces. Its profile is slightly thicker than the one described as representative of the series. In some places the surface layer is darker colored and the substratum contains more gravel than is normal.

Included with this soil in mapping are small areas where the slope is more than 2 percent. Also included are small areas of Billett sandy loam, Tell silt loam, and Billett sandy loam, mottled subsoil variant.

Nearly all the acreage of this Meridian soil is used for crops, but some areas are used for pasture and woodland. Crops are sometimes damaged by drought during hot, dry spells. Capability unit IIs–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Meridian loam, 2 to 6 percent slopes (MeB).—This soil is on stream terraces. It has the profile described as representative of the series. In cultivated areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are small areas of Tell silt loam and Billett sandy loam. In addition, areas are included where the soil is moderately eroded.

This Meridian soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Drought is a moderate hazard, and erosion is a slight hazard. Capability unit IIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Meridian loam, 6 to 12 percent slopes, eroded (MeC2).—This soil occupies stream terraces. It has a profile similar to the one described as representative of the series, but in cultivated areas the surface layer is lighter colored. Also, the surface layer is less friable, is lower in organic-matter content and fertility, and is more difficult to keep in good tilth than the uneroded surface layer.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are small areas of Tell silt loam and Billett sandy loam. In addition, small areas are included where the soil is slightly or severely eroded.

This Meridian soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Drought and erosion are moderate hazards. Capability unit IIIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Morocco Series

The Morocco series consists of deep, somewhat poorly drained, sandy soils on stream terraces and outwash plains.

In a representative profile the surface layer is loamy sand about 10 inches thick. The upper part is very dark brown, and the lower part is brown. Below this is 16 inches of brown and grayish-brown sand that is mottled with dark yellowish brown, light brownish gray, and strong brown.

The available water capacity is low, and permeability is rapid. The water table is moderately high, and surface runoff is slow. Natural fertility is low.

Representative profile of Morocco loamy sand, in a cultivated field 100 feet north of center of road and 300 feet east of west line of SW¼SE¼ sec. 32, T. 26 N., R. 11 W.

Ap—0 to 6 inches, very dark brown (10YR 2/2) loamy sand; very weak, coarse, subangular blocky structure; very friable; strongly acid; abrupt, smooth boundary.

AC—6 to 10 inches, brown (10YR 5/3) loamy sand; very weak, thick, platy structure; very friable; common, medium, faint, dark yellowish-brown (10YR 4/4) mottles and light brownish-gray (10YR 6/2) mottles; strongly acid; clear, wavy boundary.

C1—10 to 18 inches, brown (10YR 5/3) coherent sand; very weak, coarse, subangular blocky structure; very friable; common, medium, faint, dark yellowish-brown (10YR 4/4) mottles and light brownish-gray (2.5Y 6/2) mottles; strongly acid; clear, smooth boundary.

C2—18 to 26 inches, brown (7.5YR 5/4) medium sand; single grain; loose; common, medium, distinct, brown (7.5YR 5/2) mottles and strong-brown (7.5YR 5/8) mottles; medium acid; gradual, smooth boundary.

C3—26 to 60 inches, grayish-brown (10YR 5/2) medium sand; single grain; loose; medium acid.

The A horizon is loamy sand or sand in texture and is very dark brown (10YR 2/2), dark gray (10YR 4/1), or dark grayish brown (10YR 4/2) in color. Color values and chromas darker than 4/1 or 4/2 occur in horizons 6 inches or less in thickness or that have values and chromas of 6/1 or 6/2 when the soil is dry. Where present, the B horizon is brownish or yellowish, medium or strongly acid, loose sand that contains faint or distinct, low-chroma mottles. The solum ranges from 24 to 40 inches in thickness.

In most areas the Morocco soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Morocco soils differ from Newton soils in being somewhat poorly drained and in having a thinner and lighter colored surface layer. They are the somewhat poorly drained associate of the moderately well drained Brems soils. All these soils have a sandy subsoil.

Morocco loamy sand (0 to 2 percent slopes) (Mo).—This soil occurs on benches and outwash plains. The surface layer is very dark brown.

Included with this soil in mapping are small areas of gently sloping soil. Also included are small areas of Brems and Newton soils. In addition, small areas of a soil that has a loamy substratum at a depth of 3 to 5 feet were included with the areas mapped northeast of Downsville.

About half the acreage of this Morocco soil is used for small grain and hay. The rest is in pasture, woodland, and wildlife cover. Crops grow fairly well during dry seasons because the soil has a high water table. In wet years, however, crops are sometimes drowned out.

Water-tolerant trees and shrubs are suitable plants. Runoff is slow. Capability unit IVw–5; woodland group 3w4; tree and shrub group 3; wildlife group 5a; recreation group 5.

Morocco Series, Loamy Subsoil Variant

The loamy subsoil variant of the Morocco series consists of deep, nearly level, somewhat poorly drained, sandy soils on outwash plains and stream terraces. These soils are in small depressions.

In a representative profile the surface layer is very dark brown light sandy loam about 9 inches thick. Below this is dark grayish-brown light sandy loam about 14 inches thick. At a depth below 23 inches, the underlying material consists of consecutive layers of dark-brown loamy sand, brown mottled heavy clay loam, light brownish-gray mottled medium sand, and dark yellowish-brown medium sand.

The available water capacity is low. Permeability is rapid in the upper layer of loamy sand and moderate in the lower loamy layer. Natural fertility is low. The water table is moderately high, and surface runoff is slow.

Representative profile of Morocco sandy loam, loamy subsoil variant, in a cultivated field, 550 feet east of center of town road and 300 feet north of the south side of NW¼ sec. 24, T. 27 N., R. 11 W.

Ap—0 to 9 inches, very dark brown (10YR 2/2) light sandy loam, very dark grayish brown (10YR 3/2) dry; weak, medium, granular structure; very friable; strongly acid; abrupt, smooth boundary.

AC—9 to 23 inches, dark grayish-brown (10YR 4/2) light sandy loam; weak, medium, subangular blocky structure; very friable; medium acid; clear, smooth boundary.

C1—23 to 28 inches, dark-brown (7.5YR 4/2) loamy sand; weak, medium, subangular blocky structure; friable; medium acid; clear, smooth boundary.

C2—28 to 36 inches, dark-brown (7.5YR 4/4) loamy sand; few, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; very friable; medium acid; gradual, smooth boundary.

C3—36 to 50 inches, brown (7.5YR 5/4) heavy clay loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; very friable; medium acid; gradual, smooth boundary.

C4—50 to 53 inches, light brownish-gray (10YR 6/2) medium sand; common, coarse, prominent, strong-brown (7.5 YR 5/6) mottles; single grain; loose; medium acid; clear, smooth boundary.

C5—53 to 60 inches, dark yellowish-brown (10YR 4/4) medium sand; single grain; loose; high iron content; slightly acid.

The A horizon ranges from loamy sand to sandy loam in texture. The color range in the solum caused by gleying is dark grayish brown (10YR 4/2) to gray (10YR 6/1). The number of mottles ranges from common to none. The layer of heavy clay loam ranges from 8 to 18 inches in thickness.

The loamy subsoil variant of the Morocco soils differs from Shiffer soils in being coarser textured throughout the profile and in having a layer of heavy clay loam in the substratum. Soils of both these series are somewhat poorly drained.

Morocco sandy loam, loamy subsoil variant (0 to 2 percent slopes) (Mr).—This soil has a very dark brown surface layer.

Included with this soil in mapping are small areas of moderately well drained Brems loamy sand. Also included are some areas of poorly drained to very poorly drained Newton loamy sand.

Most of the acreage of this loamy subsoil variant of the Morocco soils is used for grain and hay. Crops grow fairly well during dry seasons because the soil has a high water table. In wet years, however, crops are sometimes drowned out. This soil can be used also for pasture, wildlife habitat, and water-tolerant trees. The water table is moderately high, and surface runoff is slow. Capability unit IVw–5; woodland group 3w4; tree and shrub group 3; wildlife group 5a; recreation group 5.

Newton Series

The Newton series consists of deep, poorly drained, sandy soils on stream terraces.

In a representative profile the surface layer is loamy sand about 11 inches thick. The upper part is black, and the lower part is dark grayish brown. The subsoil is gray fine sand about 10 inches thick. The upper part of the underlying material is grayish-brown sand, and the lower part is yellowish-brown loose sand.

The available water capacity is low, and permeability is very rapid. Natural fertility is low. Newton soils have a high water table, and surface runoff is very slow to ponded.

Representative profile of Newton loamy sand, in a cultivated field, 150 feet west of center of County Highway H and 600 feet north of south line of NE¼SE¼ sec. 34, T. 26 N., R. 11 W.

Ap—0 to 8 inches, black (10YR 2/1) loamy sand; moderate, fine, crumb structure; friable; medium acid; abrupt, wavy boundary.

A12g—8 to 11 inches, dark grayish-brown (10YR 4/2) loamy sand; few, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; very friable; medium acid; clear, smooth boundary.

Bg—11 to 21 inches, gray (10YR 5/1) fine sand; few, prominent, yellowish-brown (10YR 5/6) mottles; single grain; loose; medium acid; gradual, smooth boundary.

C1—21 to 26 inches, grayish-brown (10YR 5/2) sand; few, coarse, prominent, yellowish-brown (10YR 5/6) mottles; single grain; loose; very strongly acid; clear, smooth boundary.

C2—26 to 60 inches, yellowish-brown (10YR 5/6) sand; single grain; loose; strongly acid.

The A horizon ranges from 8 to 14 inches in thickness and from loamy sand to sand in texture. In places bands of fine sand or very fine sandy loam occur at a depth of 3 to 5 feet.

In most areas the Newton soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Newton soils have a thicker darker colored surface layer than that of the somewhat poorly drained Morocco soils. Soils of both these series have a sandy subsoil.

Newton loamy sand (0 to 2 percent slopes) (Ne).—This soil occupies stream terraces. The surface layer is black. Included with this soil in mapping are small areas of Morocco, Brems, and Markey soils.

This Newton soil is suited mainly to water-tolerant grasses, shrubs for wildlife cover, and water-tolerant trees. It has a high water table, and surface runoff is very slow to ponded. If the soil is drained, drought is a severe hazard. Capability unit IVw–5; woodland group 4w4; tree and shrub group 3; wildlife group 5b; recreation group 6.

Norden Series

The Norden series consists of moderately deep, well-drained, loamy soils on upland ridges and valley sides. These soils are underlain by glauconitic sandstone.

In a representative profile the surface layer is dark grayish-brown, friable silt loam about 8 inches thick. The subsurface layer is brown very fine sandy loam about 3 inches thick. The subsoil is about 18 inches thick. The upper 4 inches is dark yellowish-brown loam, the next 8 inches is dark-brown heavy loam, and the lower 6 inches is olive-colored loam. The underlying material is olive-colored glauconitic sandstone.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. Drought is a moderate hazard.

Representative profile of Norden silt loam, 12 to 20 percent slopes, eroded, in a cultivated field, 100 feet west of town road and 200 feet south of the north section line of NE¼NE¼ sec. 6, T. 27 N., R. 13 W.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, granular structure; friable; plentiful roots; medium acid; abrupt, smooth boundary.

A2—8 to 11 inches, brown (10YR 5/3) very fine sandy loam; weak, medium, platy structure; friable; plentiful roots; medium acid; gradual, wavy boundary.

B1—11 to 15 inches, dark yellowish-brown (10YR 4/4) loam; weak, thick, platy structure parting to weak, medium, subangular blocky; friable; plentiful roots; few grayish-brown (10YR 5/2) silt coatings on larger vertical structure faces; strongly acid; clear, wavy boundary.

B2t—15 to 23 inches, dark-brown (10YR 4/3) heavy loam; moderate, fine, subangular blocky structure; firm; thin patchy clay films; few grayish-brown (10YR 5/2) silt coatings on larger vertical structure faces; plentiful roots; strongly acid; gradual, wavy boundary.

B3—23 to 29 inches, olive (5YR 4/4 and 5/3)) loam that has a high content of glauconite; weak to moderate, medium, subangular blocky structure; friable; few fragments of partly weathered glauconitic sandstone; plentiful roots; medium acid; clear, wavy boundary.

R—29 to 60 inches, thin layers of olive and pale-olive (5Y 4/3, 4/4, 5/3, and 6/3) glauconitic sandstone; weakly cemented; firm in place; thin layers of siltstone within the sandstone.

The Ap horizon ranges from very dark grayish brown (10YR 3/2) to brown (10YR 5/3) in color. Rectangular fragments of flinty sandstone, about 1 inch thick and 3 to 6 inches in diameter, occur in some places between the A2 and B1 horizons. Bands of silty clay, 3 to 6 inches wide, occur in the C horizon in some profiles. The C and R horizons range from olive (5Y 5/3) to dark yellowish brown (10YR 4/4) in color.

In most areas the Norden soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Norden soils formed in a thinner mantle of silt over glauconitic sandstone than that in which the La Forge soils formed. They are similar to Urne soils, but have a finer textured solum. In contrast with the Norden soils, the sandstone underlying the Arland and Hixton soils lacks glauconite. Soils of the Norden, La Farge, Urne, Arland, and Hixton series are underlain by sandstone at a depth of less than 40 inches.

Norden silt loam, 2 to 6 percent slopes (NrB).—This soil occurs on ridgetops. It has a profile similar to the one described as representative of the series, but the surface layer is thicker and darker colored. In this soil the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are small areas of La Farge silt loam. Northfield silt loam, and Urne-Norden loams. In addition, small acreages are included where the soil is moderately or severely eroded.

This Norden soil is suited to corn. small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Erosion is a moderate hazard. Crops are sometimes damaged by drought during prolonged dry spells. Capability unit IIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Norden silt loam, 6 to 12 percent slopes, eroded (NrC2).—This soil is on narrow upland ridges. It has a profile similar to the one described as representative of the series, but about half of the original surface layer has been lost through erosion. The present surface layer is lighter colored, less friable, lower in organic-matter content and fertility, and more difficult to keep in good tilth than the uneroded surface layer.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent and small acreages where the soil is only slightly eroded. Also included are small areas of eroded Northfield and La Farge soils and eroded areas of an Urne-Norden complex.

This Norden soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, trees, and wildlife habitat. Surface runoff is medium, and erosion is a moderate hazard. Capability unit IIIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Norden silt loam, 12 to 20 percent slopes, eroded (NrD2).—This soil is on upland ridges. It has the profile described as representative of the series. About one-fourth to three-fourths of the original surface layer has been lost through erosion. The present surface layer is lighter colored. less friable, and lower in organic-matter content and fertility than the uneroded surface layer. Also, it is more difficult to keep in good tilth.

Included with this soil in mapping are small areas where the slope is less than 12 percent or more than 20 percent and areas where the soil is slightly eroded. Also included are small areas of eroded La Farge silt loam and eroded areas of an Urne-Norden complex.

This Norden soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, and wildlife habitat. Surface runoff is rapid, and erosion is a severe hazard. Capability unit IVe–2; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Norden silt loam, 20 to 30 percent slopes, eroded (NrE2).—This soil occurs as elongated areas on upland ridges. It has a profile similar to the one described as representative of the series, but the surface layer and the subsoil are slightly thinner. About half of the original surface layer has been removed through erosion. The present surface layer is very dark grayish brown, and in places spots of yellowish-brown material from the subsoil are at the surface.

Included with this soil in mapping are small areas where the slope is less than 20 percent or more than 30 percent and minor acreages where the soil is slightly

eroded. Also included are small areas of eroded La Farge silt loam and eroded areas of an Urne-Norden complex.

This Norden soil is suited to pasture, woodland, and wildlife habitat. Surface runoff is rapid, and erosion is a severe hazard. Capability unit VIe–2; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Northfield Series

The Northfield series consists of shallow, well-drained, loamy soils on upland ridges. These soils overlie fine-grained, platy sandstone.

In a representative profile (fig. 6) the surface layer is dark grayish-brown silt loam about 8 inches thick. The subsoil is dark-brown and brown silt loam about 8 inches thick. This is underlain by thick beds of hard, platy sandstone.

The available water capacity is low, and permeability is moderate. Natural fertility is medium. Drought is a moderate hazard.

Representative profile of Northfield silt loam, 2 to 6 percent slopes, in a cultivated field, 75 feet north of center of town road and 125 feet west of east line of SW¼NE¼ sec. 4, T. 27 N., R. 11 W.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, thin, platy structure; friable; strongly acid; abrupt, smooth boundary.

B1—8 to 10 inches, brown (10YR 4/3) silt loam; weak, medium, subangular blocky structure; friable; strongly acid; clear, smooth boundary.

B2t—10 to 16 inches, dark-brown (10YR 4/3) heavy silt loam; moderate, medium, subangular blocky structure; firm; thin patchy clay skins; medium acid; abrupt, smooth boundary.

IIR—16 to 100 inches, fine-grained, platy sandstone; weakly cemented.

The A horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2) in color. In cultivated fields the A1 horizon and part or all of the A2 horizon, where present, are generally incorporated into the plow layer. The depth to platy sandstone ranges from 12 to 20 inches.

In most areas the Northfield soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Northfield soils have a finer textured solum than that of the Elkmound soils. They are underlain by sandstone, whereas Dunbarton soils are shallow over limestone. Bedrock is at a depth of less than 20 inches in all these soils.

Northfield silt loam, 0 to 2 percent slopes (NtA).—This is a shallow soil on broad ridgetops. It has a profile similar to the one described as representative of the series, but the solum is slightly thicker. In cultivated areas the surface layer is dark grayish brown.

Included with this soil in mapping are small areas where the slope is more than 2 percent. Also included are small areas of Norden silt loam and Elkmound silt loam.

This Northfield soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Drought is a moderate hazard. Capability unit IIIs–8; woodland group 3d1; tree and shrub group 2; wildlife group 3; recreation group 3.

Northfield silt loam, 2 to 6 percent slopes (NtB).—This is a shallow soil on ridgetops. It has the profile described as representative of the series. In cultivated areas the surface layer is dark grayish brown.

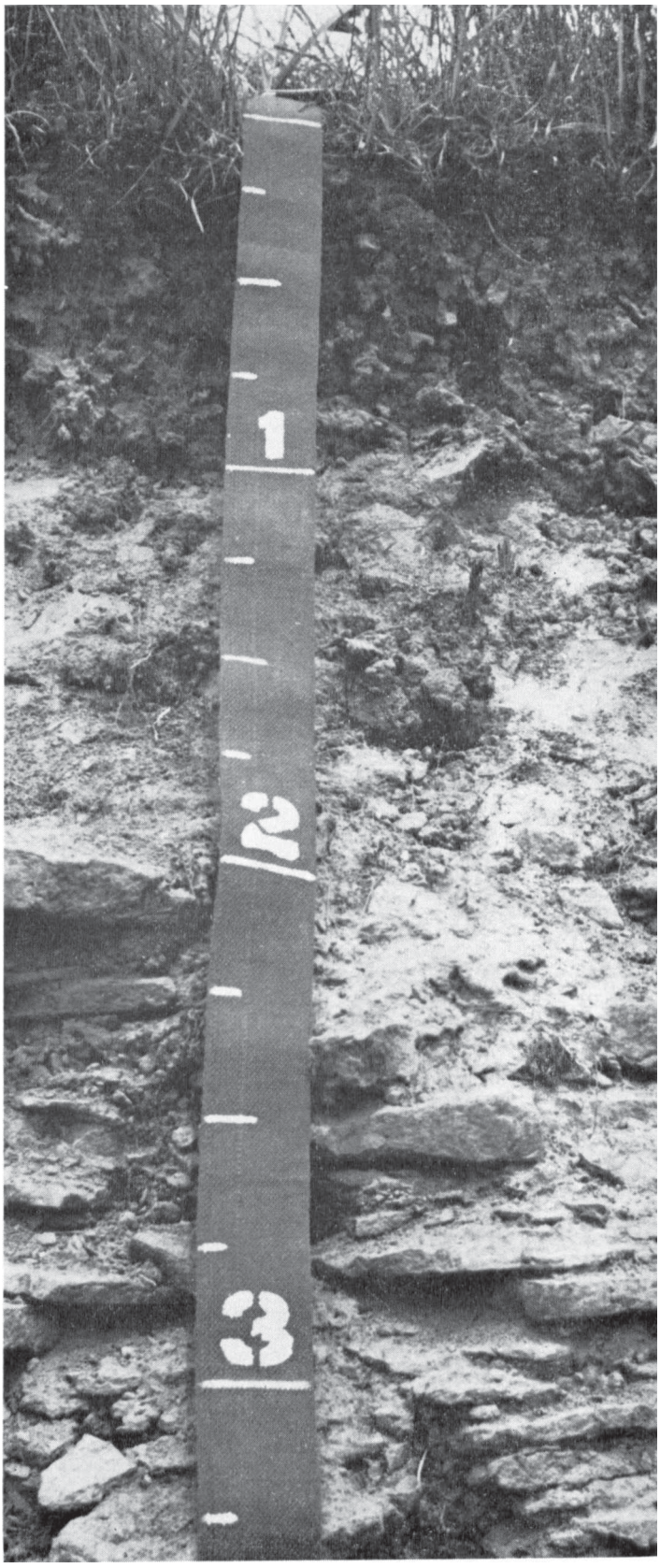

Figure 6.—**Profile of a Northfield silt loam.**

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are small areas of Norden silt loam and Elkmound loam. In addition, small areas are included where the soil is moderately or severely eroded.

This Northfield soil is suited to corn, grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and limited recreational uses. Erosion is a hazard, and drought is a moderate hazard. Capability unit IIIe–3; woodland group 3d1; tree and shrub group 2; wildlife group 3; recereation group 3.

Northfield silt loam, 6 to 12 percent slopes, eroded (NtC2).—This is a shallow soil on ridgetops. It has a profile similar to the one described as representative of the series, but the surface layer is lighter colored, less friable, and lower in organic-matter content and fertility than that of the representative profile. Also, the surface layer is more difficult to keep in good tilth than the uneroded surface layer.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are areas where the soil is severely or slightly eroded. In addition, small areas of eroded Norden and Elkmound soils are included.

This Northfield soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to woodland, pasture, and wildlife habitat. Erosion is a moderate hazard. Capability unit IVe–3; woodland group 3d1; tree and shrub group 2; wildlife group 3; recreation group 3.

Otterholt Series

The Otterholt series consists of deep, well-drained, loamy soils on glacial uplands.

In a representative profile (fig. 7) the surface layer is very dark grayish-brown silt loam about 7 inches thick. The subsurface layer is dark grayish-brown silt loam about 6 inches thick. The subsoil is dark-brown silt loam about 23 inches thick. The underlying material is dark-brown massive silt loam. Dark-brown loam or sandy clay loam of glacial origin begins at a depth of about 42 inches.

The available water capacity is high, and permeability is moderate. Natural fertility is high.

Representative profile of Otterholt silt loam, 2 to 6 percent slopes, in a cultivated field, 50 feet west of center of road and 125 feet south of north line of NE¼SE¼ sec. 33, T. 28 N., R. 14 W.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, subangular blocky structure; friable; abundant fine fibrous roots; neutral; abrupt, smooth boundary.

A2—7 to 13 inches, dark grayish-brown (10YR 4/2) silt loam; weak, thin, platy structure; thin, continuous, pale-brown 10YR 6/3), bleached silt coatings on surfaces of individual plates and along weakly developed vertical cleavage planes; vesicular; friable; plentiful fine fibrous roots; medium acid; clear, smooth boundary.

B&A—13 to 19 inches, dark-brown (10YR 4/3) silt loam; weak, medium, platy structure parting under pressure to weak, fine, subangular blocky; thin, continuous, bleached silt coatings on ped faces; few (between 15 and 50 percent of horizon), very thin (1 to 2 millimeters), pale-brown (10YR 6/3) tongues or veins of bleached silt along vertical cleavage planes;

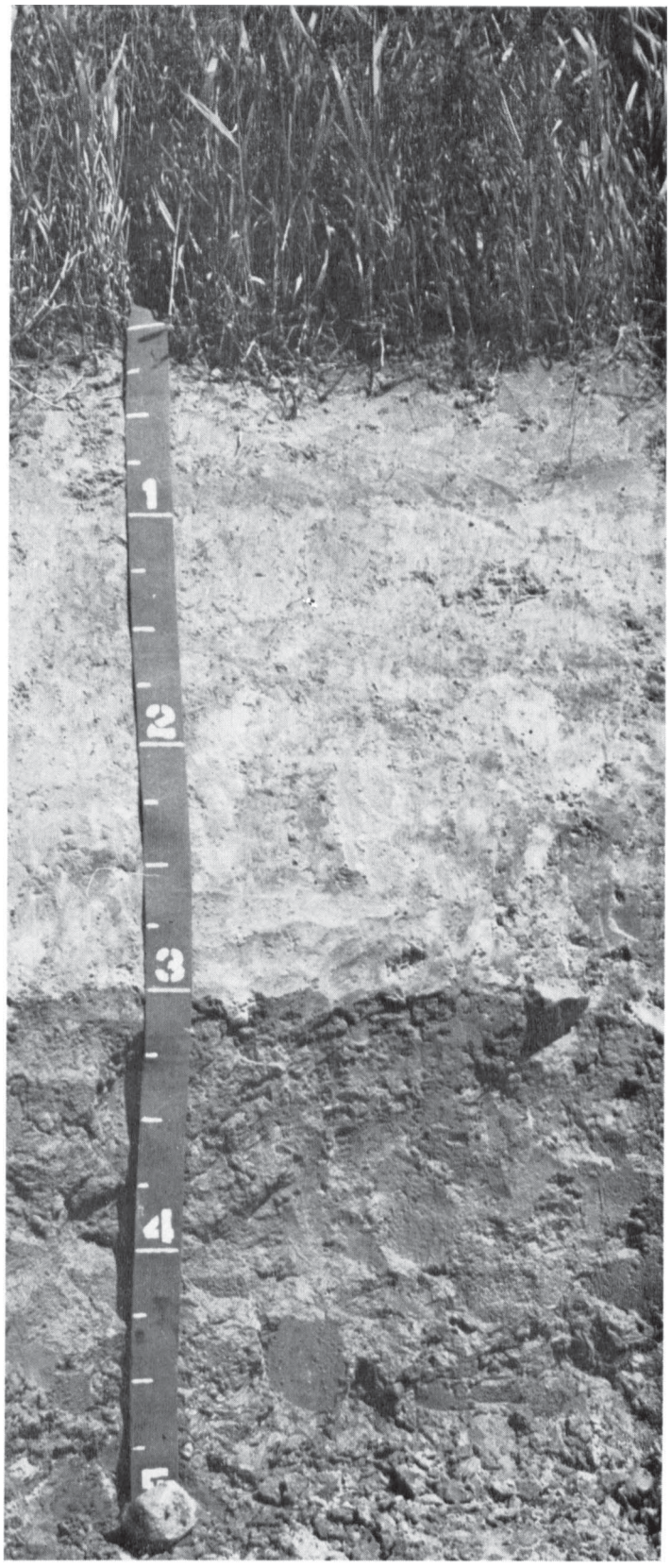

Figure 7.—**Profile of an Otterholt silt loam.**

friable; vesicular; few fibrous roots and some coarse roots; strongly acid; clear, smooth boundary.

B2t—19 to 27 inches; dark-brown (10YR 4/3) heavy silt loam; moderate, medium, subangular blocky structure; few, thin (1 millimeter) veins of bleached silt along major vertical cleavage planes; thin patchy low-contrast clay films on ped faces; firm; few coarse roots; very strongly acid; clear, smooth boundary.

B3—27 to 36 inches, dark-brown (10YR 4/3) silt loam; weak, coarse and medium, subangular blocky structure; few thin patchy clay films along vertical cleavage planes; friable; few coarse roots; strongly acid; abrupt, smooth boundary.

C1—36 to 42 inches, dark-brown (10YR 4/3) silt loam; massive, but weak, thick, platy structure in places; strongly acid; clear, smooth boundary.

IIC2—42 to 60 inches, dark-brown (7.5YR 4/4) loam to sandy clay loam glacial till; weak, thick, platy structure; friable to firm; strongly acid.

The Ap horizon ranges from very dark grayish brown (10YR 3/2) to grayish brown (10YR 5/2). In uncultivated areas the profile has a thin A1 horizon that is black (10YR 2/1) to very dark grayish brown (10YR 3/2). The solum ranges from 32 to 44 inches in thickness.

Otterholt soils vary widely in the amount of tonguing into the upper part of the B horizon and in thickness of the layer of loess. In places most of the B1 horizon has been replaced through degradation by bleached silt. This results in an A2 horizon that is as much as 10 inches thick and ranges to grayish brown (10YR 5/2) in color. These soils generally have an irregular boundary between the A2 and B horizons. In many places the A2 horizon extends as tongues into the B horizon. The degree of development of clay films in the B horizon is variable.

The till that underlies Otterholt soils is variable in color and texture. It is generally yellowish brown (10YR 5/4) to dark brown (7.5YR 4/4). In a few places, however, it is dark yellowish brown (10YR 4/4) in color and ranges from loam to sandy clay loam in texture. Except for a few small areas that have been influenced by local limestone, the till is acid in reaction.

Otterholt soils are the well-drained counterpart of the somewhat poorly drained Almena soils. In contrast with the Otterholt soils, the Stronghurst soils have a dark grayish-brown, mottled subsoil. Soils of all these series have a silty subsoil.

Otterholt silt loam, 2 to 6 percent slopes (OsB).—This soil occurs on upland ridges. It has the profile described as representative of the series. The surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are small areas of Santiago silt loam. In addition, small areas are included where the soil is moderately eroded.

Most of the acreage of this Otterholt soil is used for crops, but a few small areas are used for trees or pasture. The soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Surface runoff is medium, and the hazard of erosion is moderate. Capability unit IIe–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Otterholt silt loam, 6 to 12 percent slopes, eroded (OsC2).—This soil is on upland ridges. It has a profile similar to the one described as representative of the series, but the surface layer is lighter colored, less friable, and lower in organic-matter content and fertility than the uneroded surface layer. Also, the present surface layer is more difficult to keep in good tilth. It is dark grayish brown, and in most places it contains dark-brown material from the subsoil.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are small areas of an eroded Santiago silt loam. In addition, small areas are included where the soil is slightly or severely eroded.

This Otterholt soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Surface runoff is medium, and erosion is a moderate hazard. The maintenance of organic-matter content and fertility is desirable. Capability unit IIIe–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Palsgrove Series

The Palsgrove series consists of deep, well-drained, loamy soils on broad upland ridges.

In a representative profile the surface layer is very dark grayish-brown silt loam about 9 inches thick. The subsurface layer is dark grayish-brown silt loam about 3 inches thick. The subsoil, about 34 inches thick, is dark-brown silt loam in the upper 5 inches, dark-brown silty clay loam in the next 13 inches, and dark reddish-brown clay in the lower 16 inches. The underlying material is hard, massive limestone to a depth of 100 inches or more.

The available water capacity is high, and permeability is moderate. Natural fertility is high.

Representative profile of Palsgrove silt loam, deep, 2 to 6 percent slopes, in a cultivated field, 100 feet east of center of road and 60 feet north of the south line of SW¼NW¼ sec. 28, T. 26 N., R. 14 W.

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam, light gray (10YR 6/1) dry; weak, fine, subangular blocky structure; very friable; medium acid; abrupt, smooth boundary.

A2—9 to 12 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium. subangular blocky structure; silica coatings on ped faces; very friable; medium acid; clear, smooth boundary.

B1—12 to 17 inches, dark-brown (10YR 4/3) silt loam; weak, thick, platy structure parting to moderate, medium, subangular blocky; very friable; medium acid; clear, smooth boundary.

B22t—17 to 28 inches, dark-brown (10YR 4/3) light silty clay loam; moderate, medium, subangular blocky structure; dark-brown (10YR 3/3) clay films; firm; strongly acid; clear, smooth boundary.

B23—28 to 30 inches, dark-brown (10YR 4/3) silty clay loam; moderate, medium, subangular blocky structure; dark-brown (10YR 3/3) clay films; firm; strongly acid; clear, smooth boundary.

IIB3—30 to 46 inches, dark reddish-brown (5YR 3/4) clay; strong, coarse, angular blocky structure; dark-brown (7.5YR 3/3) clay films; very firm; medium acid; clear, smooth boundary.

IIIR—46 to 100 inches, hard, massive limestone.

The silty soil material overlying reddish-brown clay ranges from 29 to 42 inches in thickness in uncultivated areas. Clay residuum is nearer the surface and is thicker than is typical of the series.

The silt mantle in which the Palsgrove soils in this county formed is thicker than that in which the Dubuque soils formed. Palsgrove soils are underlain by limestone, unlike the La Farge soils, which are underlain by sandstone. Soils of all these series are underlain by bedrock at depths of less than 5 feet.

Palsgrove silt loam, deep, 2 to 6 percent slopes (PaB).—This soil is on uplands. It has the profile described as representative of the series. In cultivated areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are a few areas where the soil is moderately eroded.

This soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Surface runoff is medium, and the erosion hazard is moderate. Capability unit IIe–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Palsgrove silt loam, deep, 6 to 12 percent slopes, eroded (PaC2).—This soil is on broad upland ridges and on valley sides. It has a profile similar to the one described as representative of the series, but about half of the original surface layer has been lost through erosion. The present surface layer is less friable, lower in organic-matter content and fertility, and more difficult to keep in good tilth than the uneroded surface layer. In cultivated areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are small areas of Dubuque and Seaton soils.

This Palsgrove soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, and wildlife plantings. Capability unit IIIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Palsgrove silt loam, deep, 12 to 20 percent slopes, eroded (PaD2).—This soil has a profile similar to the one described as representative of the series, but about half of the original surface layer has been lost through erosion. The present surface layer is less friable, lower in organic-matter content and fertility, and more difficult to keep in good tilth than the uneroded surface layer.

Included with this soil in mapping are small areas where the slope is less than 12 percent. Also included are small areas where the soil is slightly or severely eroded. In addition, small areas of Dubuque silt loam and Seaton silt loam are included.

This Palsgrove soil is suited to corn, small grain, alfalfa, and clover. It is also suited to pasture, trees, and wildlife plantings. Erosion is a severe hazard. Capability unit IVe–1; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Pillot Series

The Pillott series consists of moderately deep, well-drained, loamy soils on stream terraces and outwash plains. These soils are underlain by sand.

In a representative profile the surface layer is very dark brown to very dark grayish-brown, friable silt loam about 17 inches thick. The subsoil is about 15 inches thick. It is dark-brown silt loam in the upper part and dark-brown loam in the lower part. The substratum is brown medium sand.

The available water capacity is medium, and permeability is moderate. Natural fertility is moderately high. Surface runoff is slow to medium. Drought is a moderate hazard.

Representative profile of Pillot silt loam, in a cultivated field, 175 feet east of center of road and 50 feet north of south 40 line of NE¼NW¼ sec. 4, T. 31 N., R. 13 W.

Ap—0 to 7 inches, very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A12—7 to 15 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, medium, subangular blocky structure; friable; slightly acid; abrupt, smooth boundary.

A3—15 to 17 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, platy structure; very friable; slightly acid; clear, smooth boundary.

B1—17 to 20 inches, dark-brown (7.5YR 4/4) silt loam; moderate, medium, subangular blocky structure; friable; strongly acid; clear, smooth boundary.

B2t—20 to 28 inches, dark-brown (7.5YR 4/4) heavy silt loam; thin patchy clay films on ped faces; moderate, medium, subangular blocky structure; friable; strongly acid; gradual, smooth boundary.

IIB3—28 to 32 inches, dark-brown (7.5YR 4/4) loam; weak, medium, subangular blocky structure; friable; strongly acid; abrupt, smooth boundary.

IIC—32 to 60 inches, brown (7.5YR 5/4) medium sand; single grain; loose; acid.

The A horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). The depth to the sand substratum ranges from 24 to 40 inches.

In most areas the Pillot soils in this county have a lower soil temperature than is defined in the range for the series, and they lack silty clay loam in the B2t horizon, but this does not alter the use or behavior of the soils.

Pillot soils differ from the associated Marshan soils in being well drained rather than poorly drained, and in lacking mottles in their subsoil. Their surface layer is darker colored than that of the associated Tell soils.

Pillot silt loam (0 to 2 percent slopes) (Pc).—This soil has a very dark brown surface layer. Included in the areas mapped are a few small areas of well-drained Meridian loam and areas that are underlain by sand and gravel. Also included are small areas where the slope is 3 to 5 percent and a few areas where the soil is moderately eroded. East of Menomonie are areas of this Pillot soil where the substratum is a thick layer of dark reddish-brown silt loam.

Most of the acreage of this Pillot soil is used for crops. It is suited to corn, small grain, soybeans (fig. 8), alfalfa, and clover. Crops are sometimes damaged by drought during prolonged dry spells. Management that maintains the organic-matter content and fertility level is desirable. Capability unit IIs–1; woodland group 4o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Plainbo Series

The Plainbo series consists of moderately deep, excessively drained, sandy soils overlying sandstone.

In a representative profile (fig. 9) the surface layer is very dark grayish-brown loamy sand about 8 inches thick. The upper part of the subsoil is dark-brown medium sand about 4 inches thick, and the lower part is about 7 inches of dark yellowish-brown medium sand. The underlying material is yellowish-brown sand. Fine-grained sandstone begins at a depth of about 35 inches.

The available water capacity is very low, and perme-

Figure 8.—An area of Pillot silt loam. The crop in the foreground is soybeans.

ability is rapid. Natural fertility is low. Drought is a severe hazard.

Representative profile of Plainbo loamy sand, 6 to 12 percent slopes, eroded, in a cultivated field, 150 feet west of east line and 200 feet north of center of County Highway V; SW¼SE¼ sec. 15, T. 31 N., R. 11 W.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak, medium, subangular blocky structure; very friable; neutral; abrupt, smooth boundary.

B2—8 to 12 inches, dark-brown (10YR 4/3) medium sand; very weak, medium, subangular blocky structure; very friable; slightly acid; clear, smooth boundary.

B3—12 to 19 inches. dark yellowish-brown (10YR 4/4) medium sand; single grain; loose; slightly acid; gradual, smooth boundary.

C—19 to 35 inches, yellowish-brown (10YR 5/4) medium sand; single grain; loose; slightly acid; abrupt, smooth boundary.

R—35 to 100 inches, light yellowish-brown (10YR 6/4), fine-grained, platy sandstone; slightly acid.

The A horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). The depth to bedrock ranges from 20 to 40 inches. In most places the sandstone is medium grained and poorly cemented. Its color ranges from 10YR to 7.5YR in hue.

Plainbo soils have a coarser textured solum than Eleva soils. Soils of both these series are underlain by sandstone at depths of less than 40 inches. In contrast with Plainbo soils, the Plainfield soils are underlain by loose, stratified fine sand. Soils of the Plainbo and Plainfield series have a sandy subsoil.

Plainbo loamy sand, 2 to 6 percent slopes (PdB).—This soil occurs at the base of steep slopes. It has a profile similar to the one described as representative of the series, but the solum is slightly thicker. The surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are small areas of Plainfield loamy sand and Elkmound loam. In addition, small areas are included where the soil is moderately or severely eroded.

This Plainbo soil is suited to corn, grain, soybeans, and alfalfa. It is also suited to woodland, wildlife habitat, and recreation. In recent years many of the areas have been planted to Norway pine and white pine. The available water capacity is very low, and fertility is low. Drought and soil blowing are severe hazards. Capability unit IVs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Plainbo loamy sand, 6 to 12 percent slopes, eroded (PdC2).—This soil occupies tracts at the base of steep slopes. As much as three-fourths of the original surface layer has been lost through soil blowing and water erosion. The present surface layer is very dark grayish brown, and in most places it contains dark yellowish-brown material from the subsoil.

Included in mapping is the soil that has the profile described as representative of the series. Also included

525-315—75——4

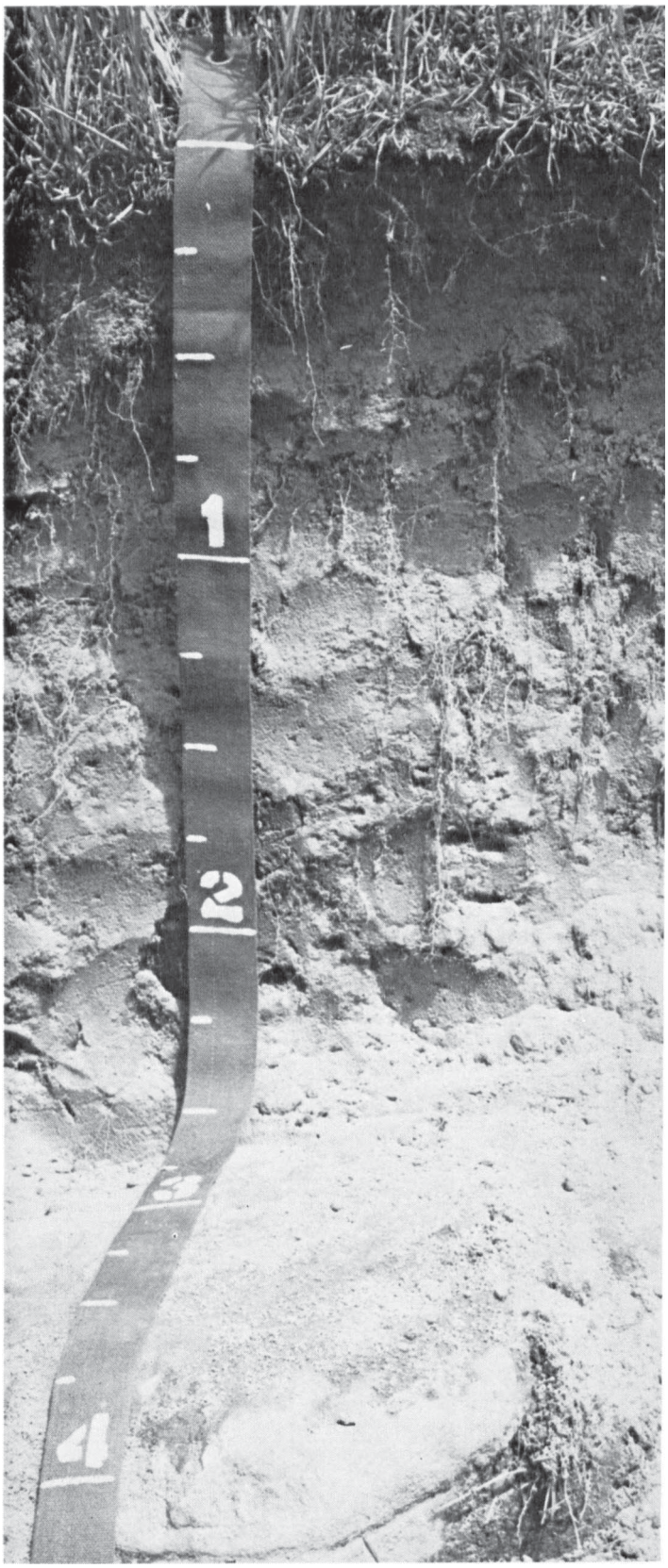

Figure 9.—Profile of Plainbo loamy sand.

are small, slightly eroded areas and small areas where the slope is less than 6 percent or more than 12 percent. In addition, small areas of an eroded Plainfield loamy sand are included.

This Plainbo soil can be used for hay or pasture, but it is better suited to trees. It is also suited to wildlife plantings. A large acreage is in scrub oak and jack pine. In addition, a large acreage that was formerly used for crops has been planted to Norway pine and white pine. Droughtiness, susceptibility to soil blowing and water erosion, and low fertility are severe limitations. Capability unit VIs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Plainbo loamy sand, 12 to 40 percent slopes (PdF).—This soil consists of loose loamy sand, fragments of sandstone, and sandstone outcrops. Weathered sandstone is near the surface in most places and is exposed in some areas. The profile is similar to the one described as representative of the series, but the mantle of loamy sand over the sandstone is thinner.

Included with this soil in mapping are small areas of Urne-Elkmound loams and small tracts where the soil is moderately or severely eroded.

Most of the acreage of this Plainbo soil is in woodland. Most of the native trees are poor-quality scrub oak or jack pine, but some of the north- and east-facing slopes support fair-quality timber. This soil is also suited to wildlife plantings. Drought and erosion are severe hazards. Natural fertility is low. Capability unit VIIs–3; woodland group 3s2; tree and shrub group 2; wildlife group 3; recreation group 4.

Plainfield Series

The Plainfield series consists of deep, excessively drained, sandy soils on outwash plains and stream terraces. These soils formed in sand that contains more than 5 percent weatherable minerals.

In a representative profile the surface layer is very dark grayish-brown loamy sand about 7 inches thick. The subsoil is about 7 inches thick. It is dark-brown loamy sand in the upper part and dark yellowish-brown sand in the lower part. The underlying material is dark yellowish-brown sand and yellowish-brown fine sand that extends to a depth of 60 inches or more.

The available water capacity is low, and permeability is rapid. Natural fertility is low. Drought is a severe hazard.

Representative profile of Plainfield loamy sand, 0 to 2 percent slopes, in a cultivated field, 50 feet west of the east line and 50 feet south of center of County Highway V; NE¼SE¼ sec. 16, T. 31 N., R. 11 W.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) to dark-brown (10YR 3/3) loamy sand, light brownish gray (10YR 6/2) dry; weak, fine, crumb structure; very friable; abundant roots; neutral; abrupt, smooth boundary.

B2—7 to 10 inches, dark-brown (10YR 4/3) loamy sand; weak, coarse, subangular blocky structure; very friable; few roots; slightly acid; clear, wavy boundary.

B3—10 to 14 inches, dark yellowish-brown (10YR 3/4) sand; single grain; loose; few roots; slightly acid; clear, wavy boundary.

C1—14 to 36 inches, dark yellowish-brown (10YR 4/4) sand; single grain; loose; few roots; medium acid; gradual, smooth boundary.
C2—36 to 60 inches, yellowish-brown (10YR 5/4) stratified fine sand; single grain; loose; strongly acid.

The A horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or dark brown (10YR 3/3). It ranges from medium sand to loamy fine sand in texture. The content of gravel in the profile varies widely from one place to another.

Plainfield soils formed in coarser textured sand than the parent material of the associated Gotham soils. They are the excessively drained associate of the moderately well drained Brems soils. Their solum is lighter colored than that of the associated Hubbard soils. Plainfield soils lack the underlying sandstone of Plainbo soils.

Plainfield loamy sand, 0 to 2 percent slopes (PfA).—This soil is on stream terraces. It has the profile described as representative of the series. In cultivated areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is more than 2 percent.

This soil is suited to corn, small grain, soybeans, and alfalfa. It is also suited to pasture, woodland, wildlife habitat, and recreation. In recent years many areas have been planted to white pine and Norway pine. Drought and soil blowing are the main hazards. Natural fertility is low. Capability unit IVs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Plainfield loamy sand, 2 to 6 percent slopes (PfB).—This soil is on stream terraces. It has a profile similar to the one described as representative, but it is slightly thinner. In cultivated areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent.

This soil is suited to corn, small grain, soybeans, and alfalfa. It is also suited to pasture, woodland, wildlife habitat, and recreation. Much of the acreage that was formerly used for crops has been planted to conifers. If this soil is irrigated, the kind and extent of the irrigation system is limited by the slope. Soil blowing and drought are the main hazards. Natural fertility is low. Capability unit IVs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Plainfield loamy sand, 6 to 12 percent slopes, eroded (PfC2).—This soil is at the base of steep slopes. It has a lighter colored surface layer than that of the representative profile.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are small areas of Plainbo loamy sand and Gotham loamy fine sand. In addition, areas are included where the soil is slightly or severely eroded.

This soil is suited to pasture, woodland, wildlife habitat, and recreation. Many areas formerly used for crops have been planted to Norway pine and white pine. A large acreage is in natural stands of scrub oak and jack pine. Drought, soil blowing, and water erosion are hazards. Natural fertility is low. Capability unit VIs–3; woodland group 3s1; tree and shrub group 2; wildlife group 3; recreation group 4.

Poskin Series

The Poskin series consists of moderately deep, somewhat poorly drained. loamy soils on stream terraces and outwash plains. These soils overlie sand and gravel.

In a representative profile the surface layer is very dark grayish-brown silt loam about 7 inches thick. The subsurface layer is 4 inches of mottled, dark grayish-brown silt loam. The subsoil is about 19 inches thick. The upper part is grayish-brown silt loam mottled with dark brown, and the lower part is dark-brown sandy loam that contains a few distinct, dark grayish-brown mottles. The underlying material is sand and gravel.

The available water capacity is medium, and permeability is moderate. The water table is seasonally high. Surface runoff is slow.

Representative profile of Poskin silt loam, in a cultivated field, 150 feet south of center of east-west road and 600 feet west of center of north-south road; SW¼SE¼ sec. 29, T. 31 N.. R. 14 W.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.
A2—7 to 11 inches, dark grayish-brown (10YR 4/2) silt loam; many, medium, distinct, dark-brown (7.5YR 4/4) mottles and few, fine, prominent, strong-brown (7.5YR 5/5) mottles; moderate, thin, platy structure; very friable; medium acid; clear, smooth boundary.
A&B—11 to 14 inches, grayish-brown (10YR 5/2) silt loam; tongues of dark-brown (7.5YR 4/4) heavy silt loam; compound structure of moderate, coarse, prismatic parting to weak, medium, platy structure, which in turn parts to weak, fine, subangular blocky; friable; strongly acid; clear, smooth boundary.
B2tg—14 to 24 inches, grayish-brown (10YR 5/2) heavy silt loam; less than 60 percent of the horizon has low chroma colors; many, distinct, dark-brown (7.5YR 4/4) mottles; strong, coarse, prismatic structure parting to weak, medium, subangular blocky; friable; thin clay films on ped faces; strongly acid; clear, smooth boundary.
IIB3—24 to 30 inches, dark-brown (7.5YR 4/4) sandy loam; few, medium, distinct, dark grayish-brown (10YR 4/2) mottles; less than 60 percent of the horizon has low-chroma colors; weak, medium, subangular blocky structure; friable; medium acid; gradual, smooth boundary.
IIC—30 to 60 inches, stratified sand and gravel; single grain; loose; medium acid.

The solum ranges from 24 to 36 inches in thickness. The mottles range from reddish brown (5YR 4/4) to strong brown (7.5YR 5/6) in color.

Poskin soils are the somewhat poorly drained associate of the poorly drained Rib soils. They are similar to Shiffer soils, but they have a finer textured solum and their B horizon contains tongues of soil material from the A horizon. Soils of both these series are underlain by sand and gravel.

Poskin silt loam (0 to 2 percent slopes) (Po).—This soil occurs on outwash plains. It is somewhat poorly drained. The surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is more than 2 percent. Also included are small areas of Lows soils and areas where the soil is better drained.

This Poskin soil is suited to grain and hay. Poor drainage, a moderately high water table, and slow surface runoff are the main limitations. Crops are sometimes stunted in wet years, and yields are reduced. Capability unit IIw–5;

woodland group 2w5; tree and shrub group 3; wildlife group 5a; recreation group 5.

Renova Series

The Renova series consists of deep, well-drained, loamy soils on glacial uplands.

In a representative profile the surface layer is very dark grayish-brown silt loam about 7 inches thick. The subsurface layer is about 4 inches of dark grayish-brown silt loam. The subsoil is about 22 inches thick. The upper part is dark-brown silt loam, and the lower part is dark yellowish-brown loam. The underlying material is yellowish-brown loam glacial till.

The available water capacity is high, and permeability is moderately slow. Natural fertility is moderately high.

Representative profile of Renova silt loam, 2 to 6 percent slopes, in a cultivated field, 150 feet south of center of town road and 150 feet west of east line of SE¼NE¼ sec. 33, T. 28 N., R. 14 W.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak, medium, subangular blocky structure; very friable; slightly acid; abrupt, smooth boundary.

A2—7 to 11 inches, dark grayish-brown (10YR 4/2) silt loam; weak, thin, platy structure; very friable; strongly acid; clear, wavy boundary.

B11—11 to 16 inches, dark-brown (10YR 4/3) silt loam; moderate, fine, subangular blocky structure; friable; strongly acid; clear, smooth boundary.

IIB12—16 to 21 inches, dark-brown (10YR 4/3) silt loam that has a high content of sand; moderate, medium, subangular blocky structure; few thin patchy clay films; friable; strongly acid; clear, smooth boundary.

IIB2t—21 to 30 inches, dark yellowish-brown (10YR 4/4) heavy loam; moderate, coarse, prismatic structure; thick coatings of white sand on surface of peds; the prisms part to moderate, medium, subangular blocky structure; thin patchy clay films on blocky ped surfaces; firm; very strongly acid; gradual, smooth boundary.

IIB3—30 to 33 inches, dark yellowish-brown (10YR 4/6) loam; moderate, medium and coarse, subangular blocky structure; strongly acid; clear, smooth boundary.

IIC—33 to 60 inches, yellowish-brown (10YR 5/6) loam glacial till; massive, except for a few vertical seams that have white sand coatings.

The silty upper part of the A and B horizons ranges from 12 to 30 inches in thickness. The A horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). The till ranges from loam to sandy clay loam in texture, but sandy clay loam in predominant. Lenses of sand occur in the till. The till ranges from very strongly acid to medium acid in reaction and from yellowish brown (10YR 5/6) to dark yellowish brown (10YR 4/4) in color. The number of stones and cobblestones in the till ranges from many to a few.

In most areas the Renova soils in this county have a lower soil temperature than is defined in the range for the series, and their solum is thinner, but this does not alter the use or behavior of the soils.

Renova soils differ from the associated Santiago soils in having formed over finer textured glacial till. Their solum is finer textured than that of the associated Amery soils.

Renova silt loam, 2 to 6 percent slopes (RaB).—This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are small areas of Otterholt silt loam and small areas where the soil is moderately eroded.

This Renova soil is suited to corn, soybeans, small grain, alfalfa, and clover. It is also suited to pasture, trees, wildlife plantings, and recreation. Surface runoff is medium, and erosion is a moderate hazard. Capability unit IIe–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Renova silt loam, 6 to 12 percent slopes, eroded (RaC2).—This soil has a profile similar to the one described as representative of the series, but the surface layer is lighter colored, less friable, and lower in organic-matter content and fertility. Also, it is more difficult to keep in good tilth than the uneroded surface layer.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are small areas where the soil is slightly or severely eroded.

This soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Capability unit IIIe–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Renova silt loam, 12 to 20 percent slopes, eroded (RaD2).—This soil is on ridges in the western part of the county. It has a profile similar to the one described as representative of the series, but the surface layer is lighter colored and in most places is lower in organic-matter content and fertility. Also, it is more difficult to keep in good tilth than the uneroded surface layer.

Included with this soil in mapping are small acreages where the soil is slightly or severely eroded.

This soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, and wildlife plantings. Surface runoff is rapid, and erosion is a severe hazard. Capability unit IVe–1; woodland group 2r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Rib Series

The Rib series consists of poorly drained, moderately deep, loamy soils on stream terraces and outwash plains. These soils overlie sand and gravel.

In a representative profile the surface layer is very dark grayish-brown silt loam about 8 inches thick. The subsoil is about 17 inches thick. The upper 6 inches is olive-gray silt loam mottled with yellowish red, the next 9 inches is olive-gray, mottled heavy silt loam, and the lower 2 inches is dark grayish-brown, friable loam mottled with dark brown. The underlying material is dark-brown sand and gravel.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. The water table is high, and surface runoff is very slow.

Representative profile of Rib silt loam, in a cultivated field, 75 feet west of center of road and 125 feet south of north line of SE¼NE¼ sec. 2, T. 28 N., R. 14 W.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, gray (10YR 5/1) dry; weak, fine, subangular blocky structure; friable; slightly acid; abrupt, smooth boundary.

B1g—8 to 14 inches, olive-gray (5Y 5/2) silt loam; 60 percent or more of the horizon has low-chroma colors; many, fine, prominent, yellowish-red (5YR 5/6) mot-

tles; weak, coarse, prismatic structure parting to weak, thick, platy structure, which in turn parts to weak, fine, subangular blocky; friable; strongly acid; clear, smooth boundary.

B2g—14 to 23 inches, olive-gray (5YR 5/2) heavy silt loam; 60 percent or more of the horizon has low-chroma colors; dark-brown (7.5YR 4/4 to 10YR 4/3) mottles in ped interiors; moderate, coarse, prismatic structure parting to moderate, thick, platy structure, which in turn parts to moderate, fine, subangular blocky; thick, bleached silt coatings on prism surfaces; friable; strongly acid; clear, smooth boundary.

IIB3g—23 to 25 inches, dark grayish-brown (10YR 4/2) loam; 60 percent or more of the horizon has low-chroma colors; medium to coarse, distinct, dark-brown (7.5YR 4/4) mottles; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; friable; many ferric hydroxide or manganese dioxide coatings on ped faces; clear, wavy boundary.

IIC—25 to 60 inches, dark-brown (7.5YR 3/2) sand and gravel; single grain; loose; medium acid.

In places thin remnants of A2 material occur at the upper boundary of the B1g horizon. The gleyed horizons range from 10YR to 5Y in hue. The depth to sand and gravel ranges from 24 to 36 inches.

Rib soils differ from the associated wet variant of the Almena soils in being underlain by stratified sand and gravel rather than by gravelly sandy loam glacial till. Rib soils are poorly drained, unlike the associated Poskin soils, which are somewhat poorly drained.

Rib silt loam (0 to 2 percent slopes) (Rb).—This soil is poorly drained. It occupies irregularly shaped, slightly concave tracts on stream terraces and outwash plains. The areas are 5 to 20 acres in size. The surface layer is very dark grayish brown.

Included with this soil in mapping are small areas of Poskin silt loam.

Most of the acreage of this Rib soil is used for crops, but some areas are used for pasture and woodland. Small grain and clover are the commonly grown crops. This soil is also suited to water-tolerant trees and shrubs for wildlife plantings. The water table is high, and surface runoff is very slow. Capability unit IIw–5; woodland group 3w5; tree and shrub group 3; wildlife group 5b; recreation group 6.

Rib Series, Moderately Shallow Variant

The moderately shallow variant of the Rib series consists of moderately deep, poorly drained, loamy soils in seepage areas or depressions. These soils are underlain by sandstone. Their acreage is small.

In a representative profile the surface layer is black silt loam about 3 inches thick. The subsurface layer is 10 inches of silt loam that is very dark gray in the upper part and light grayish brown in the lower part. The upper 6 inches of the subsoil is olive-gray silty clay loam mottled with strong brown. The lower 4 inches is olive-gray sandy clay loam mottled with dark brown. The underlying material is yellowish-brown and light brownish-gray sandstone.

The available water capacity is medium, and permeability is moderate. The water table is high, and surface runoff is very slow.

Representative profile of Rib silt loam, moderately shallow variant, in a cultivated field, 50 feet north of center of road and 200 feet east of west line of SW¼SE¼ sec. 14, T. 27 N., R. 12 W.

A1—0 to 3 inches, black (10YR 2/1) silt loam; weak, very fine, subangular blocky structure; friable; slightly acid; clear, smooth boundary.

A21—3 to 9 inches, very dark gray (10YR 3/1) silt loam; 60 percent or more of the horizon has low-chroma color; many, fine, prominent, yellowish-red (5YR 5/6) mottles; weak, very thin to thin, platy structure; friable; slightly acid; clear, smooth boundary.

A22g—9 to 13 inches, light grayish-brown (2.5YR 6/2) silt loam; 60 percent or more of the horizon has low-chroma color; many, coarse, distinct, yellowish-brown (10YR 5/4) mottles; weak, thin to medium, platy structure; friable; strongly acid; clear, smooth boundary.

B2g—13 to 19 inches, olive-gray (5Y 5/2) silty clay loam; 60 percent or more of the horizon has low-chroma color; many, medium, prominent, strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; very strongly acid; clear, smooth boundary

IIB3—19 to 23 inches, olive-gray (5Y 5/2) sandy clay loam; many, medium, prominent, dark-brown (7.5YR 4/4) mottles; moderate, medium, subangular blocky structure; friable; strongly acid; abrupt, smooth boundary.

IIR—23 to 60 inches, yellowish-brown (10YR 5/8) and light brownish-gray (10YR 6/2) sandstone fragments grading to sandstone.

The A1 horizon ranges from 3 to 10 inches in thickness. The thickness of the silt cap ranges from 1 to 2 feet, and the depth to bedrock ranges from 2 to 4 feet.

The moderately shallow variant of the Rib soils has a finer textured solum than that of the mottled subsoil variant of the Hixton soils, and it is poorly drained rather than somewhat poorly drained. Soils of both these series are underlain by sandstone at a depth of less than 40 inches.

Rib silt loam, moderately shallow variant (0 to 2 percent slopes) (Rc).—This soil occurs at the base of steep slopes. The surface layer is black silt loam, which in places resembles muck.

Included with this soil in mapping are small areas of Hixton loam, mottled subsoil variant.

This moderately shallow variant of the Rib soils is suited to small grain and hay. It is also suited to pasture, wildlife plantings, and water-tolerant trees. The water table is high, and surface runoff is slow. Capability unit IIw–5; woodland group 3w5; tree and shrub group 3; wildlife group 5b; recreation group 6.

Riverwash

Riverwash (0 to 2 percent slopes) (Re) consists of loose sand and gravel freshly deposited by streams. Most of the acreage occurs as sand bars and beaches along the Chippewa and Red Cedar Rivers. The areas are subject to annual flooding.

Areas of Riverwash are very droughty and support little or no vegetation. In some places they support a sparse growth of alders, willows, and yellow birch trees. The areas are suitable mainly for recreational uses; some areas are a source of sand and gravel. Capability unit VIIIs–9; woodland group 6s1; not in a tree and shrub group; wildlife group 8; recreation group 7.

Santiago Series

The Santiago series consists of deep, well-drained, loamy soils on glacial uplands.

In a representative profile the surface layer is very dark grayish-brown silt loam about 8 inches thick. The subsurface layer is dark grayish-brown silt loam 4 inches

thick. The subsoil, about 21 inches thick, is dark-brown silt loam in the upper part and dark-brown sandy loam in the lower part. The substratum is reddish-brown glacial till of sandy loam texture.

The available water capacity is high, and permeability is moderate. Natural fertility is high.

Representative profile of Santiago silt loam, 2 to 6 percent slopes, in a pasture, 300 feet south of center of road and 600 feet west of east line of NW¼SE¼ sec. 17, T. 30 N., R. 14 W.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, subangular blocky structure; very friable; slightly acid; abrupt, smooth boundary.

A2—8 to 12 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, thin, platy structure; very friable; medium acid; clear, irregular boundary.

A&B—12 to 15 inches, dark grayish-brown (10YR 4/2) tongues of silt loam marginal to silt that has weak, medium, platy structure intermixed with dark-brown (10YR 3/4) silt loam that has fine, subangular blocky structure; friable; very strongly acid; clear, wavy boundary.

B21t—15 to 20 inches, dark-brown (10YR 4/3) to grayish-brown (10YR 5/2) heavy silt loam; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; friable; structural peds thickly coated with bleached silt; very strongly acid; clear, wavy boundary.

IIB22t—20 to 26 inches, dark-brown (7.5YR 4/4) heavy sandy loam; moderate, coarse, prismatic structure parting to coarse, angular blocky; friable; thin, continuous clay films, thickest on vertical faces of peds; very strongly acid; clear, smooth boundary.

IIB3—26 to 33 inches, dark-brown (7.5YR 4/4) heavy sandy loam; weak, coarse, angular blocky structure; firm; thin, continuous clay films on primary vertical cleavage planes; strongly acid; clear, smooth boundary.

IIC—33 to 60 inches, reddish-brown (5YR 4/4) sandy loam; glacial till that shows weak, thick, platy structure; medium acid.

The Ap horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). The solum ranges from 26 to 38 inches in thickness. The underlying till ranges from light sandy loam to heavy sandy loam in texture and from dark brown (7.5YR 4/4) to reddish brown (5YR 4/4) in color. The number of glacial cobblestones or stones on the surface and throughout the profile ranges from a few to many.

Santiago soils differ from the associated Renova soils in having coarser textured underlying glacial till. Their solum is finer textured than that of the associated Amery soils.

Santiago silt loam, 2 to 6 percent slopes (ScB).—This soil has the profile described as representative of the series. Granitic stones and boulders are on the surface in a few places.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are small areas where the soil is moderately eroded.

This soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Surface runoff is medium, and erosion is a moderate hazard. Capability unit IIe–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Santiago silt loam, 6 to 12 percent slopes, eroded (ScC2).—This soil has a profile similar to the one described as representative of the series, but about half of the original surface layer has been lost through erosion. The present surface layer is lighter colored, less friable, and lower in organic-matter content and fertility than the uneroded surface layer. Also, it is more difficult to keep in good tilth than the surface layer in the representative profile.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent and areas where the soil is slightly or severely eroded. Also included are small areas of Amery soil.

This Santiago soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Surface runoff is medium, and erosion is a moderate hazard. Capability unit IIIe–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Seaton Series

The Seaton series consists of deep, loamy, well-drained soils on upland ridges and valley slopes.

In a representative profile the surface layer is very dark grayish-brown silt loam about 8 inches thick. The subsurface layer is dark grayish-brown silt loam about 2 inches thick. The subsoil, about 25 inches thick, is dark yellowish-brown silt loam in the upper part and dark-brown in the lower part. The underlying material is yellowish-brown silt loam.

The available water capacity is high, and permeability is moderate. Natural fertility is high.

Representative profile of Seaton silt loam, 6 to 12 percent slopes, eroded, in a cultivated field, 100 feet north of south line and 50 feet east of center of north-south road; NW¼NE¼ sec. 21, T. 28 N., R. 13 W.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak, very thin, platy structure; friable; neutral; abrupt, smooth boundary.

A2—8 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; weak, thin, platy structure; friable; neutral; clear, smooth boundary.

B1—10 to 14 inches, dark yellowish-brown (10YR 4/4) silt loam; compound structure of weak, medium, platy parting to weak, fine, subangular blocky structure; friable; medium acid; clear, smooth boundary.

B21t—14 to 20 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; compound structure of weak, thick, platy parting to moderate, medium, subangular blocky structure; very thin silt films and thin patchy clay films on structural ped faces; friable; medium acid; gradual, smooth boundary.

B22t—20 to 27 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; compound structure of moderate, medium, platy parting to moderate, medium, subangular blocky structure; few thin patchy clay films on structural ped faces; few manganese spots; friable; medium acid; gradual, smooth boundary.

B3—27 to 35 inches, dark-brown (10YR 4/3) silt loam; compound structure of weak, thick, platy parting to weak, medium, subangular blocky; few patchy clay films on structural ped faces; friable; medium acid; diffuse, smooth boundary.

C—35 to 60 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, platy structure; friable; medium acid.

In cultivated areas the Ap horizon ranges from very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2). In uncultivated areas the A horizon ranges from very dark brown (10YR 2/2) to black (10YR 2/1). The solum ranges from 30 to 48 inches in thickness. The clay content of the B horizon ranges from 18 to 24 percent. Where this soil occurs on valley slopes, some of the profiles have a high content of sand. Seaton soils are generally underlain by limestone at depths of more than 5 feet.

Seaton soils have a finer textured solum than that of the associated Campia soils. Also, they formed in wind-deposited silt rather than in lacustrine silt and clay. In contrast with Seaton soils, La Farge soils formed in a moderately thick layer of silt overlying sandstone.

Seaton silt loam, 2 to 6 percent slopes (SeB).—This soil has a profile (fig. 10) similar to the one described as representative of the series, but has a thicker surface layer.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are a few areas where the soil is moderately eroded. In addition, small areas of La Farge silt loam and Dubuque silt loam, deep, are included.

This Seaton soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, trees, wildlife plantings, and recreation. Surface runoff is medium, and erosion is a moderate hazard. Capability unit IIe–1; woodland group 1o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Seaton silt loam, 6 to 12 percent slopes, eroded (SeC2).—This soil is on broad upland ridges and valley slopes. It has the profile described as representative of the series. About half of the original surface layer has been lost through erosion. The present surface layer is less friable, lower in organic-matter content and fertility, and is more difficult to keep in good tilth than the original surface layer. In cultivated areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are small areas where the soil is slightly or severely eroded. In addition, areas of La Farge and Dubuque soils are included.

This Seaton soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Surface runoff is medium, and erosion is a moderate hazard. Capability unit IIIe–1; woodland group 1o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Seaton silt loam, 12 to 20 percent slopes, eroded (SeD2).—This soil has a profile similar to that described as representative of the series, but about half of the original surface layer has been lost through erosion. The present surface layer is less friable, lower in organic-matter content and fertility, and more difficult to keep in good tilth than the original surface layer.

Included with this soil in mapping are small areas where the slope is less than 12 percent or more than 20 percent. Also included are small areas where the soil is slightly or severely eroded. In addition, small areas of La Farge silt loam and Dubuque silt loam are included.

This Seaton soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, and wildlife habitat. Surface runoff is rapid, and erosion is a severe hazard. Capability unit IVe–1; woodland group 1r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Seaton silt loam, 20 to 30 percent slopes, eroded (SeE2).—This soil has a profile similar to the one described as representative of the series, but about half the original surface layer has been lost through erosion. Also, the present surface layer is lower in organic-matter content and fertility than the surface layer of the representative profile.

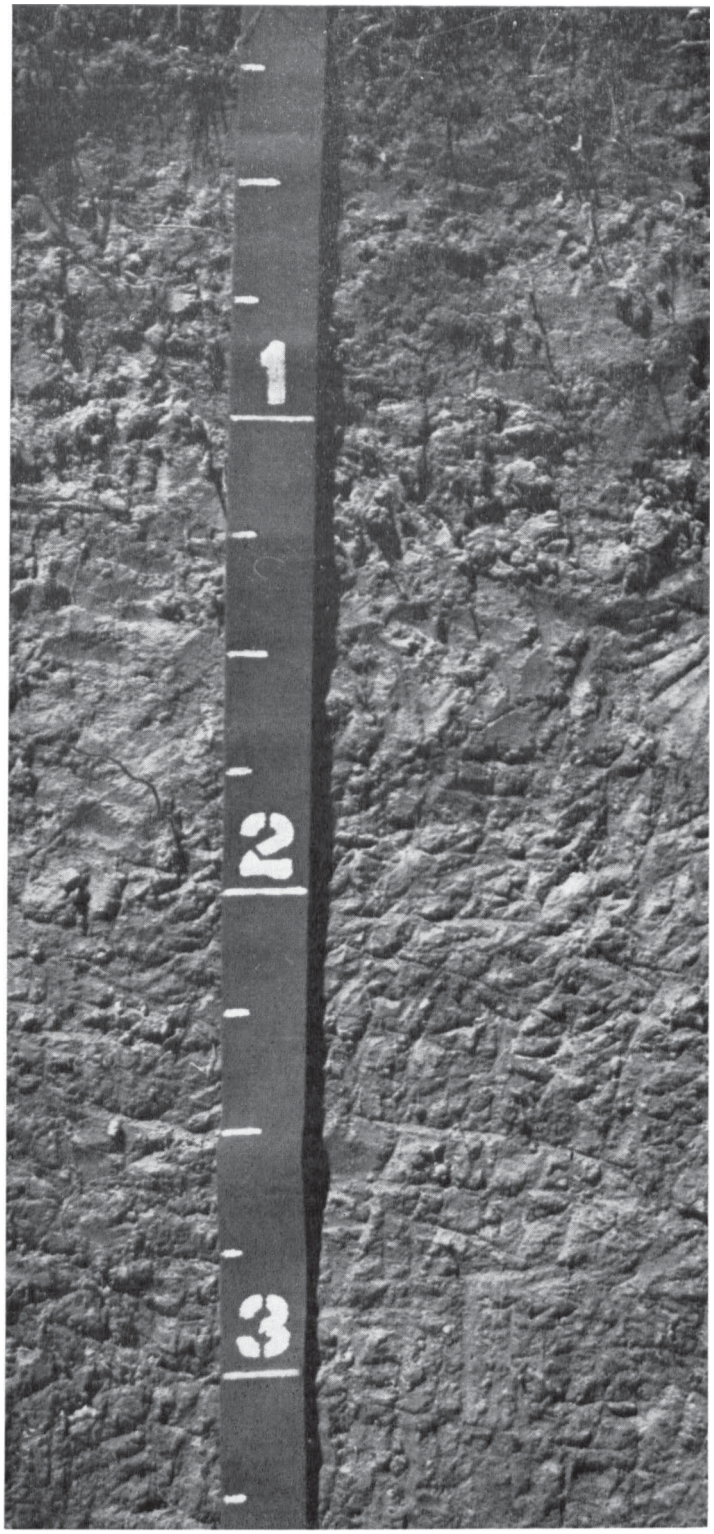

Figure 10.—**Profile of Seaton silt loam, 2 to 6 percent slopes.**

Included with this soil in mapping are small areas where the slope is less than 20 percent or more than 30

percent and small areas where the soil is slightly or severely eroded. Also included are small areas of La Farge silt loam and Dubuque silt loam.

This Seaton soil is suited to pasture, hay crops, trees, and wildlife plantings. Woodland should be protected from fire and grazing to avoid damage to new seedlings and to preserve the leaf mulch. Surface runoff is rapid, and erosion is a severe hazard. Capability unit VIe–1; woodland group 1r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Seaton silt loam, benches, 0 to 2 percent slopes (SfA).—This soil is on benches. It has a profile similar to the one described as representative of the series, but the soil is underlain by old alluvium. The surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is more than 2 percent and small areas of Tell silt loam. Also included are a few areas where alternating bands of sand and silt occur at a depth of 5 to 6 feet and areas where internal drainage is slightly restricted.

This Seaton soil is well suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Capability unit I–1; woodland group 1o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Seaton silt loam, benches, 2 to 6 percent slopes (SfB).—This soil has a profile similar to the one described as representative of the series, but in most places the soil is underlain by old alluvium. Included in mapping are small areas where alternating bands of sand and silt occur at a depth of 5 to 6 feet.

This soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife plantings, and recreation. Surface runoff is medium, and erosion is a moderate hazard. Capability unit IIe–1; woodland group 1o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Shiffer Series

The Shiffer series consists of deep, somewhat poorly drained, loamy soils on outwash plains and stream terraces. These soils are underlain by sand.

In a representative profile the surface layer is very dark grayish-brown loam about 9 inches thick. The subsurface layer is grayish-brown loam about 5 inches thick. The subsoil is about 16 inches thick. The upper 5 inches is brown loam, the next 5 inches is yellowish-brown heavy loam, and the lower 6 inches is dark-brown sandy loam. The underlying material is strong-brown and brown, fine and medium sand that contains thin bands of loamy sand and light sandy loam.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. Surface runoff is slow. The water table is seasonally high.

Representative profile of Shiffer loam, in a cultivated field, 150 feet west of center of road and 400 feet south of north line of NE¼SE¼ sec. 11, T. 27 N., R. 11 W.

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loam, gray (10YR 6/1) dry; weak to moderate, fine, subangular blocky structure; friable; medium acid; abrupt, smooth boundary.

A2—9 to 14 inches, grayish-brown (10YR 5/2) loam; many, fine, distinct, yellowish-brown mottles (10YR 5/4); moderate, medium, platy structure; very friable; medium acid clear, smooth boundary.

B1—14 to 19 inches, brown (10YR 5/3) loam; many, coarse, distinct, grayish-brown (2.5YR 5/2) and strong-brown (7.5YR 5/6) mottles; less than 60 percent low-chroma color; weak, moderately thick, platy structure parting to moderate, fine, subangular blocky; friable; strongly acid; clear, smooth boundary.

B2t—19 to 24 inches, yellowish-brown (10YR 5/4) heavy loam; many, coarse, distinct, light brownish-gray (10YR 6/2) and strong-brown (7.5YR 5/6 mottles; less than 60 percent low-chroma color; weak, thick, platy structure parting to moderately fine, subangular blocky; friable; thin patchy clay films; very strongly acid; clear, smooth boundary.

IIB3—24 to 30 inches, dark-brown (7.5YR 4/4) sandy loam; many, coarse, distinct, light brownish-gray (10YR 6/2) mottles; less than 60 percent low-chroma color; weak, coarse, subangular blocky structure; very friable; very strongly acid; clear, wavy boundary.

IIC—30 to 60 inches, strong-brown (7.5YR 5/6) and brown (10YR 5/3), fine and medium sand; single grain; loose; very strongly acid; thin bands of loamy sand and light sandy loam are in the substratum.

The A horizon ranges from 10 to 15 inches in thickness. The A2 horizon ranges from grayish brown (10YR 5/2) to dark brown (10YR 4/3) in color. In some places the C horizon contains sandstone fragments. The solum ranges from 26 to 40 inches in thickness.

In most areas the Shiffer soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use and behavior of the soils.

Shiffer soils are somewhat poorly drained. They are closely associated with the moderately well drained, mottled subsoil variant of the Billett soils, and the poorly drained Lows soils. They are finer textured throughout than the associated liamy subsoil variant of the Morocco soils, and they lack a layer of heavy clay loam in the substratum, which those soils have. Unlike the Shiffer soils, the Poskin soils formed in silty sediments and they lack tonguing in the B horizon. Soils of the Shiffer and Poskin series are underlain by sand and gravel.

Shiffer loam (0 to 2 percent slopes) (Sh).—Included with this soil in mapping are small areas of poorly drained Lows soil and small areas of Billett sandy loam, mottled subsoil variant. Also included are a few areas of sandy soils where the slope is 4 percent.

This Shiffer soil is suited to small grain and clover. Surface drainage is slow. The water table is moderately high. Crop yields are usually reduced during wet seasons because of excess water. Maintenance of fertility level and organic-matter content is desirable. Capability unit IIw–5; woodland group 3w5; tree and shrub group 3; wildlife group 5a; recreation group 5.

Steep Stony Rock Land

Steep stony rock land (20 to 30 percent slopes) (StF) consists of several kinds of soil material and outcrops of limestone and sandstone. The areas are on valley slopes. Intermittent drainageways are numerous.

The soil material ranges from sand to silt in texture. The soil mantle is commonly thicker and more loamy on north- and east-facing slopes and stands of timber are of better quality than on south- and west-facing slopes. Vegetation is more sparse and the soil is more droughty on slopes that faces south and west.

Included with this land type in mapping are small areas of steep to very steep soils of Urne-Norden and Urne-Elkmound complexes.

Nearly all the acreage of Steep stony rock land is in woodland. A few small areas are used for pasture. Pastured areas should be grazed only occasionally to prevent damage to the sod. Fencing wooded areas to exclude grazing animals helps to avoid damage to newly seeded areas and allows leaf mulch to accumulate. Capability unit VIIe–4; woodland group 4d2; tree and shrub group 2; wildlife group 8; recreation group 10.

Stronghurst Series

The Stronghurst series consists of deep, somewhat poorly drained, nearly level, loamy soils on low uplands.

In a representative profile the surface layer is very dark grayish-brown silt loam about 7 inches thick. The subsurface layer is gray silt loam about 1 inch thick. The subsoil is 26 inches thick. The upper 4 inches is grayish-brown silt loam, the next 13 inches is dark grayish-brown silty clay loam to heavy silt loam, and the lower 9 inches is grayish-brown silt loam. The subsoil is underlain by grayish-brown silt loam mottled with yellowish red.

The available water capacity is high, and permeability is moderate to moderately slow. Surface runoff is slow. The water table is moderately high. Natural fertility is high.

Representative profile of Stronghurst silt loam, in a cultivated area, 200 feet south of center of County Highway T and on north-south line between sections 22 and 23, T. 26 N., R. 14 W.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak, fine, subangular blocky structure; friable; neutral; abrupt, smooth boundary.

A2—7 to 8 inches, gray (10YR 5/1) to grayish-brown (10YR 5/2) silt loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, thin, platy structure; friable; medium acid; abrupt, smooth boundary.

B11—8 to 9 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; friable; less than 60 percent of horizon has low-chroma color; medium acid; abrupt, smooth boundary.

B12t—9 to 12 inches, grayish-brown (2.5Y 5/2) to dark grayish-brown (2.5Y 4/2) heavy silt loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, coarse, prismatic structure parting to moderate, medium, angular blocky; friable; thin patchy clay films on surface of peds; less than 60 percent of horizon has low-chroma color; medium acid; clear, smooth boundary.

B21tg—12 to 19 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, coarse, prismatic structure parting to moderate, medium, angular blocky; firm; thin patchy clay films on ped surfaces; few dark-brown (7.5YR 3/2) organic stains on ped faces; less than 60 percent of horizon has low-chroma color; medium acid; clear, smooth boundary.

B22tg—19 to 25 inches, dark grayish-brown (2.5Y 4/2) heavy silt loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) mottles; moderate, medium, angular blocky structure; firm; less than 60 percent of horizon has low-chroma color; slightly acid; clear, smooth boundary.

B3g—25 to 34 inches, grayish-brown (2.5Y 5/2) silt loam; weak, coarse, subangular blocky structure; friable; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; slightly acid; gradual, smooth boundary.

Cg—34 to 60 inches, grayish-brown (2.5Y 5/2) silt loam; thinly laminated; friable; many, medium, prominent, yellowish-red (10YR 5/6) mottles; slightly acid.

The Ap horizon is very dark gray (10YR 3/1), dark gray (10YR 4/1), dark grayish brown (10YR 4/2), or very dark grayish brown (10YR 3/2). The silty material in which the soils formed ranges from 42 to 60 inches in thickness. Sand is at a depth below 42 inches.

In most areas the Stronghurst soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use and behavior of the soils.

Stronghurst soils are similar to the associated dark variant of the Boaz soils, but the surface layer is thinner and lighter colored. They lack the underlying glacial till of the associated Almena soils.

Stronghurst silt loam (0 to 2 percent slopes) (Su).—This soil occupies irregularly shaped tracts 5 to 25 acres in size. In some places the soil is in slight depressions.

Included with this soil in mapping are small areas of Boaz silt loam, dark variant. Also included are small, moderately eroded areas and areas where the slope is 3 to 4 percent.

This Stronghurst soil is suited to corn, small grain, and clover. It is also suited to pasture and water-tolerant trees and wildlife plantings. Poor drainage is the principal limitation. Capability unit IIw–2; woodland group 2w5; tree and shrub group 3; wildlife group 5a; recreation group 5.

Tell Series

The Tell series consists of deep, well-drained, loamy soils on stream terraces and outwash plains. These soils are underlain by sand.

In a representative profile the surface layer is very dark grayish-brown silt loam about 6 inches thick. The subsurface layer is dark grayish-brown silt loam about 6 inches thick. The subsoil is about 15 inches thick. It is mainly dark yellowish-brown silt loam. The underlying material consists of medium acid, dark yellowish-brown fine sand.

The available water capacity is medium, and permeability is moderate. Natural fertility is medium. Drought is a moderate hazard.

Representative profile of Tell silt loam, 0 to 2 percent slopes, in a cultivated field, 75 feet west of center of road and 25 feet north of south line of SE¼NW¼ sec. 36, T. 27 N., R. 14 W.

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, very fine, subangular blocky structure; friable; neutral; abrupt, smooth boundary.

A2—6 to 12 inches, dark grayish-brown (10YR 4/2) silt loam; dark-brown (10YR 4/3) worm casts scattered through the horizon; moderate, thin, platy structure; very friable; slightly vesicular; neutral; abrupt, smooth boundary.

B1—12 to 14 inches, dark yellowish-brown (10YR 4/4) and dark grayish-brown (10YR 4/2) silt loam; moderate, fine, subangular blocky structure parting to weak, medium, platy; friable; neutral; abrupt, smooth boundary.

B21t—14 to 17 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; moderate, fine, angular blocky structure; firm; slightly acid; clear, smooth boundary.

B22t—17 to 21 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; moderate, fine to medium, angular blocky structure; firm; few thin, patchy, dark-brown

(10YR 3/3) clay films on ped faces; strongly acid; clear, smooth boundary.

B23t—21 to 25 inches, dark yellowish-brown (10YR 3/4) heavy silt loam; moderate to strong, medium, angular blocky structure; firm; many thin, patchy, dark-brown (10YR 3/3) clay films on ped faces; strongly acid; abrupt, smooth boundary.

IIB3t—25 to 27 inches, dark yellowish-brown (10YR 4/4) to dark yellowish-brown (10YR 3/4) loam; weak, medium, angular blocky structure that shows few strongly developed, vertical cleavage planes; firm; nearly continuous dark-brown (7.5YR 3/2) clay films along primary vertical cleavages; strongly acid; clear, smooth boundary.

IIC—27 to 60 inches, dark yellowish-brown (10YR 4/4) fine sand; single grain; loose; medium acid.

In most places the A horizon is very dark grayish brown (10YR 3/2), but it ranges from dark grayish brown (10YR 4/2) to dark brown (10YR 3/3). The IIC horizon is stratified sand that contains fine gravel or a pebble line in some places. The lower part formed in sandy outwash. The solum generally ranges from 26 to 36 inches in thickness.

In most areas the Tell soils in this county have a lower soil temperature and are slightly darker colored than is defined in the range for the series, but this does not alter their use or behavior.

Tell soils differ from the associated Pillot soils in having a lighter colored surface layer. They have a finer textured solum than the associated Meridian soils.

Tell silt loam, 0 to 2 percent slopes (TeA).—This soil has the profile described as representative of the series. Included with this soil in mapping are small areas of well-drained Meridian loam and Pillot silt loam.

This Tell soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Drought is a slight hazard, but this is rarely a problem. Capability unit IIs–1; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Tell silt loam, 2 to 6 percent slopes (TeB).—This soil occupies irregularly shaped tracts, 5 to 80 acres in size, on stream terraces. It has a profile similar to the one described as representative of the series, but the solum is slightly thinner. In cultivated areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas where the slope is less than 2 percent or more than 6 percent. Also included are areas of Meridian loam and Seaton silt loam, benches. In addition, areas where the soil is moderately eroded are included.

This Tell soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife habitat, and recreation. Surface runoff is medium, and erosion is a moderate hazard. Capability unit IIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Tell silt loam, 6 to 12 percent slopes, eroded (TeC2).—This soil occurs on sloping stream benches. It has a profile similar to that described as representative of the series, but about half of the original surface layer has been lost through erosion. The present surface layer is lighter colored and lower in organic-matter content and fertility than the uneroded surface layer. Also, it is less friable and more difficult to keep in good tilth.

Included with this soil in mapping are small areas where the slope is less than 6 percent or more than 12 percent. Also included are areas that are slightly or severely eroded. In addition, small areas of Meridian loam are included.

This Tell soil is suited to corn, small grain, soybeans, alfalfa, and clover. It is also suited to pasture, woodland, wildlife plantings, and certain recreational uses. Drought is a slight hazard, and erosion is a hazard. Capability unit IIIe–2; woodland group 2o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Terrace Escarpments, Sandy

Terrace escarpments, sandy (12 to 45 percent slopes) (Tn) consists of long, narrow areas between terraces at different levels or between terraces and bottom lands. Included in the areas mapped are areas of Billett, Hubbard, Plainfield, and other sandy soils.

This land type is suited to trees and shrubs that provide food and cover for wildlife. It is not suitable for cultivation. Drought is a hazard. Soil blowing and water erosion are very severe hazards. Protection from fire and grazing helps to limit damage to seedling plants and preserve the protective cover of leaf mulch. Capability unit VIIs–3; woodland group 4s1; tree and shrub group 2; wildlife group 8; recreation group 10.

Terrace Escarpments, Loamy

Terrace escarpments, loamy (20 to 45 percent slopes) (To) consists of steep or very steep terrace breaks. Soil characteristics and properties are generally variable.

Included in the areas mapped are a few areas of bench phases of Seaton soils. Also included are areas of Meridian, Tell, Billett, and other loamy soils.

The soils of this land type are more productive than the soils of Terrace escarpments, sandy, but they are not suited to cultivated crops. Most areas are in pasture or woodland. Yields of timber are generally better on north- and east-facing slopes than on slopes that face south and west. Erosion and gullying are severe hazards. Capability unit VIIe–4; woodland group 4d2; tree and shrub group 2; wildlife group 8; recreation group 10.

Terril Series

The Terril series consists of deep, moderately well drained, loamy soils in upland drainageways.

In a representative profile the surface layer is very dark brown loam about 25 inches thick. The subsoil is brown and dark-brown loam; it extends to a depth of 60 inches.

The available water capacity is high, and permeability is moderate. Natural fertility is high. Surface runoff is medium.

Representative profile of Terril loam, in a cultivated field, 165 feet south of center of road and 200 feet east of center of County Highway B; NW¼NW¼ sec. 4, T. 28 N., R. 12 W.

Ap—0 to 10 inches, very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; strong, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A12—10 to 16 inches, very dark brown (10YR 2/2) loam; moderate, very fine, granular structure; friable;

slightly porous; slightly acid; clear, smooth boundary.
A13—16 to 25 inches, very dark brown (10YR 2/2) loam; weak, medium, subangular blocky structure; friable; highly porous; slightly acid; clear, smooth boundary.
B2—25 to 45 inches, dark-brown (10YR 3/3) loam; weak, medium, subangular blocky structure; firm, slightly porous; thin bleached silt coatings on ped surfaces; few very dark brown (10YR 2/2) organic stains; medium acid; clear, smooth boundary.
B3—45 to 60 inches, brown (10YR 4/3) loam; weak, fine, subangular blocky structure; friable; slightly acid.

The A horizon ranges from black (10YR 2/1) to very dark brown (10YR 2/2) in color and from 24 to 38 inches in thickness. Its texture ranges from loam to silt loam; the soil material has a moderately high content of sand.

In many areas the Terril soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Terril soils differ from the associated Caryville soils in having formed in thick deposits of loamy material, whereas Caryville soils formed in thin deposits.

Terril loam (0 to 2 percent slopes) (Tr).—This soil occurs as long, narrow areas about 5 to 25 acres in size.

Included with this soil in mapping are small areas of well-drained Dunnville silt loam, silty subsoil variant. Also included are a few areas of Dunnville loam.

This Terrill soil is suited to corn, small grain, soybeans, alfalfa, and clover. Maintenance of the fertility level is desirable. Surface runoff is medium, and flooding is a hazard. Capability unit IIIw–12; woodland group 3o1; tree and shrub group 1; wildlife group 7; recreation group 8.

Urne Series

The Urne series consists of well-drained, loamy soils that are moderately deep over fine-grained glauconitic sandstone. These soils are on uplands.

In a representative profile the surface layer is very dark brown loam about 3 inches thick. The subsurface layer is brown loam about 1 inch thick. The subsoil is dark-brown loam and very fine sandy loam about 18 inches thick. The underlying material is olive-brown very fine sandy loam over fine-grained, weakly cemented sandstone. The sandstone has olive-gray and light olive-brown layers.

The available water capacity is medium, and permeability is moderate. Natural fertility is moderate.

Representative profile of an Urne loam, 20 to 30 percent slopes, in a wooded area, 300 feet east of the west line and 50 feet south of the north line of SW¼SW¼ sec. 31, T. 27 N., R. 12 W.

O1—1 inch to 0, partly decomposed mat of oak leaves, dead grass moss, and small sticks.
A1—0 to 3 inches, very dark brown (10YR 2/2) loam; weak, fine, granular structure; very friable; abundant fine plant roots; few sandstone fragments; neutral; clear, smooth boundary.
A2—3 to 4 inches, brown (10YR 5/3) loam; weak, medium, platy structure; very friable; plentiful fine roots; few small sandstone chips; medium acid; clear, smooth boundary.
B1—4 to 8 inches, dark-brown (10YR 4/3) loam; weak, medium, subangular blocky structure; very friable; medium acid; gradual, wavy boundary.
B2—8 to 22 inches, dark-brown (10YR 4/3) very fine sandy loam; weak, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.
C—22 to 36 inches, olive-brown (2.5Y 4/4) very fine sandy loam; massive; friable; slightly acid; clear, smooth boundary.
R—36 to 60 inches, fine-grained sandstone; weakly cemented layers of olive gray (5Y 5/2), light olive brown (2.5Y 5/4), and pale yellow (2.5Y 7/4).

The depth of the soil mantle over bedrock ranges from 20 to 36 inches. Residuum from the fine-grained sandstone ranges from olive to yellowish brown, and in a few places, to dark red. The number of sandstone fragments in the solum and on the surface ranges from a few to many. The C horizon contains lenses of silty clay loam weathered from thin layers of shale.

In many areas the Urne soils in this county have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Urne soils differ from the associated Norden soils in having a coarser textured solum and also in having sandstone fragments in the upper part of the profile. In contrast with Elkmound soils, they are moderately deep, whereas those soils are shallow.

Urne-Elkmound loams, 12 to 20 percent slopes, eroded (UeD2).—This mapping unit is about 40 to 50 percent Urne loam, 30 to 40 percent Elkmound loam, and small areas of Plainbo loamy sand and Eleva sandy loam. The Urne and Elkmound soils are in such small areas and are so closely intermingled that they cannot be shown individually on the soil map. Small areas of soils that are severely or moderately eroded are included with these soils in mapping.

These soils are well drained. They are underlain by fine-grained sandstone. The Urne soils formed in a mantle of glauconitic loamy residuum that was 20 to 36 inches deep over sandstone. The Elkmound soil is less than 20 inches deep over resistant sandstone.

These soils are suited to pasture, woodland, and wildlife habitat. Runoff is rapid, and erosion is a severe hazard. Capability unit VIe–3; woodland group 3r2; tree and shrub group 1; wildlife group 3; recreation group 3.

Urne-Elkmound loams, 20 to 40 percent slopes (UeF).—These small areas of Urne loam and Elkmound loam are so closely intermingled that they cannot be shown separately on the soil map. About 60 percent of this unit is Urne loam, and about 40 percent is Elkmound loam.

These soils are moderately droughty and are subject to severe erosion. They are suited to pasture, woodland, and wildlife plantings. Most of the acreage is in woodland, but some of it is in pasture. Protection from fire and grazing reduces the damage to new growth and preserves the protective cover of leaf mulch. Capability unit VIIe–2; woodland group 3r2; tree and shrub group 1; wildlife group 3; recreation group 3.

Urne-Norden loams, 2 to 6 percent slopes (UnB).—This mapping unit is 40 to 50 percent Urne loam, 30 to 40 percent Norden silt loam, and small areas of La Farge silt loam and Elkmound loam. These soils are on upland ridgetops. The Urne and Norden soils are in such small areas and are so closely intermingled that they are mapped as one unit.

These soils are suited to corn, small grain, soybeans, alfalfa, and clover. They are also suited to pasture, woodland, wildlife habitat, and recreation. They are moderately droughty. Erosion is a hazard. Capability unit IIe–2; woodland group 3o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Urne-Norden loams, 6 to 12 percent slopes, eroded (UnC2).—This mapping unit is about 40 to 50 percent Urne loam, 30 to 40 percent Norden loam, and small areas of Elkmound loam and La Farge silt loam. These soils are on uplands. They are well drained and are moderately deep over fine-grained, greenish sandstone. The Urne and Norden soils are in such small areas and are so closely intermingled that they cannot be shown separately on the soil map.

These soils are suited to corn, small grain, soybeans, alfalfa, and clover. They are also suited to permanent pasture, woodland, and other less intensive uses. They are moderately droughty. Erosion is a hazard. Capability unit IIIe–2; woodland group 3o1; tree and shrub group 1; wildlife group 1; recreation group 1.

Urne-Norden loams, 12 to 20 percent slopes, eroded (UnD2).—This mapping unit is about 45 to 55 percent Urne loam, 25 to 35 percent Norden silt loam, and small areas of La Farge silt loam and Elkmound loam. It is on ridges. These are well-drained, moderately deep soils so closely intermingled that they cannot be mapped separately.

These soils are suited to hay, pasture, and woodland, and to shrub plantings for wildlife food and cover. They are moderately droughty. Water erosion is a hazard. Capability unit IVe–2; woodland group 3r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Urne-Norden loams, 20 to 30 percent slopes, eroded (UnE2).—This mapping unit is about 60 percent Urne loam and about 40 percent Norden silt loam. It is on ridges. The Urne and Norden soils are well drained and are moderately deep over greenish, fine-grained sandstone. Included in the mapping are small areas of La Farge silt loam and Elkmound loam.

These soils are suited to pasture and woodland. Capability unit VIe–2; woodland group 3r2; tree and shrub group 1; wildlife group 1; recreation group 1.

Urne-Norden loams, 30 to 45 percent slopes (UnF).—This mapping unit is about 70 percent Urne loam and about 30 percent Norden silt loam. It is on upland ridges. These soils are moderately deep over olive-gray or olive-brown, fine-grained sandstone. Small areas of Elkmound loam and La Farge silt loam are included in mapping.

Nearly all the acreage is woodland. Timber stands, mostly oak, maple, and basswood trees, are excellent on north- and east-facing slopes. Protection from fire and grazing and selective cutting are desirable. Capability unit VIIe–2; woodland group 3r3; tree and shrub group 1; wildlife group 1; recreation group 1.

Wallkill Series

The Wallkill series consists of deep, poorly drained, loamy alluvial soils that overlie mucky peat. These soils are on bottom lands and borders of marshes. They formed in recently deposited silty material washed from adjacent uplands and terraces.

In a representative profile the surface layer and the upper part of the underlying material are dark-gray silt loam, about 28 inches thick. Both are mottled with brown, reddish brown, and gray. At a depth of 28 inches, the underlying material is black muck that is moderately alkaline.

The available water capacity is high, and permeability is moderate in the loamy material. Surface runoff is slow. The water table is high, and the soil is subject to flooding. Natural fertility is high.

Most of the acreage of these soils is used for pasture.

Representative profile of Wallkill silt loam, in a pasture, 200 feet east of west line and 200 feet north of south line of NW¼NW¼ sec. 29, T. 29 N., R. 11 W.

A1—0 to 9 inches, dark-gray (10YR 4/1) silt loam; moderate, medium, platy structure; friable; many, medium, distinct mottles of yellowish brown (10YR 5/6), reddish brown (5YR 4/4), and reddish gray (5YR 5/2); neutral; clear, smooth boundary.

C—9 to 28 inches, dark-gray (10YR 4/1–5/1) silt loam; moderate, medium, platy structure; very friable; many, medium, prominent mottles of yellowish brown (10YR 5/6), reddish brown (5YR 4/4), and reddish gray (5YR 5/2); slightly acid; clear, smooth boundary.

IIOa—28 to 50 inches, black (N 2/0) muck; weak, thick, platy structure in place; friable; many, fine, dark grayish-brown (10YR 4/2), fibrous organic remains and old vertical root channels throughout the horizon; vertical streaks of yellowish-brown (10YR 5/6) and grayish-brown (2.5Y 5/2) silt in the upper part of this horizon; moderately alkaline.

The A1 and C horizons combined range from 18 to 42 inches in thickness. The composition of the peat and muck ranges from brownish, raw fibrous peat that contains wood chips to black muck. In some places the soils are somewhat poorly drained to poorly drained.

The Wallkill soils in this county contain less sand in the A1 and C horizons, and in many areas have a lower soil temperature than is defined in the range for the series, but this does not alter the use or behavior of the soils.

Wallkill soils differ from the associated Boaz soils in having an underlying layer of mucky peat.

Wallkill silt loam (0 to 2 percent slopes) (Wa).—This soil occurs as long, narrow tracts about 3 to 10 acres in size. It is on stream bottoms and in upland draws. The surface layer is uniform dark-gray silt loam.

Included with this soil in mapping are small areas of Boaz and Houghton soils.

If drained, this Wallkill soil is suited to corn, small grain, and clover. Flooding and a high water table are the main hazards. Capability unit IIw–13; woodland group 4w5; tree and shrub group 3; wildlife group 5b; recreation group 7.

Use and Management of the Soils for Crops

General practices of good soil management for cultivated crops and pasture are suggested in the pages that follow. The capability groupings used by the Soil Conservation Service, in which the soils are grouped according to their suitability for crops, is explained, and use and management of each soil in the county is suggested by capability unit. Predicted yields of principal crops grown on arable soils are shown in table 2.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used,

and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability systems, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These are described in the following paragraphs.

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

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes.

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

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture or range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are 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 designated by adding an Arabic numeral to the subclass symbol, for example IIe–1 or IIIe–3. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

In the following pages the capability units in Dunn County are described, and suggestions for the use and management of the soils are given. The capability units are not numbered consecutively, because not all of the units in the statewide system are represented in this county.

Discussed for each unit are the characteristics of the soils in the unit, the suitability of these soils for crops, and management suitable for the soils. Although each soil in the county differs somewhat from the others, certain practices of management are needed on all of the soils that are cultivated. Adding manure, using cover crops, and returning crop residue are among the practices that supply organic matter and help to improve fertility, preserve good tilth, and control erosion.

The names of the soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series are in the unit. To find the names of all of the soils in any given capability unit, refer to the "Guide to Mapping Units."

CAPABILITY UNIT I–1

This unit consists of deep, well-drained, nearly level soils of the Campia and Seaton series and the silty subsoil variant of the Dunnville series. These soils have a surface layer of silt loam or loam and a subsoil of heavy loam and heavy silt loam.

These soils are in good tilth, and they are easy to work. The available water capacity is high, and permeability is moderate. Surface drainage is slow. Internal drainage is slightly restricted in a few small areas of Seaton soils.

Corn, soybeans, oats, and alfalfa hay are the main crops. If fertility is maintained at a high level and crop residue is plowed under, row crops can be grown year after year in some areas.

CAPABILITY UNIT IIe–1

This unit consists of deep, well-drained, gently sloping soils of the Seaton, Palsgrove, Otterholt, Amery, Renova, and Santiago series. These soils have a surface layer of silt loam or loam and a subsoil of heavy loam or heavy silt loam.

Permeability is moderate or moderately slow, and the available water capacity is medium to high. Natural fertility is medium to high, and the organic-matter content is easy to maintain. Tilth is generally good if the soils are not worked when too wet. The erosion hazard is moderate.

Corn, oats, and alfalfa are the main crops. Small acreages are used for canning peas and corn. Contour stripcropping (fig. 11), diversions, and sodded waterways can be used to control erosion. The addition of lime, fertilizer, and organic matter helps to maintain the fertility level.

CAPABILITY UNIT IIe-2

This unit consists of moderately deep, well-drained, gently sloping soils of the Dakota, Dubuque, Hixton, La Farge, Meridian, Norden, Tell, and Urne series. These soils have a surface layer of silt loam or loam. The Dubuque soils have a subsoil of heavy silty clay loam to clay, but all the other soils have a subsoil of heavy loam to heavy silt loam. All the soils are underlain by sand, gravel, sandstone, or limestone.

Permeability is moderate to moderately slow, and the available water capacity is medium. Tilth is easy to maintain if the soils are not worked when too wet. Erosion and drought are moderate hazards.

Corn, oats, alfalfa, and soybeans are the main crops. Contour stripcropping, diversions, and sodded waterways can be used to control erosion. The addition of lime, fertilizer, and organic matter helps to maintain the fertility level.

CAPABILITY UNIT IIw-2

This unit consists of deep, poorly drained and somewhat poorly drained, nearly level or gently sloping soils of the Stronghurst and Almena series and the wet variant of the Almena series. The surface layer of these soils is silt loam, and the subsoil is heavy silt loam.

Permeability is moderate to moderately slow, and the available water capacity is high. Natural fertility is high. Wetness is caused by slow surface drainage and slow internal drainage, and, at times, by seepage from adjacent higher lying soils. Tilth is good if the soils are not worked when too wet. Planting is usually delayed in spring to avoid poor seedbeds caused by wetness. Crops respond best if an adequate system of drainage ditches is provided.

If the soils of this capability unit are adequately drained and protected from seepage, corn, small grain, and alfalfa can be grown. Proper application of lime and fertilizer is important.

CAPABILITY UNIT IIw-5

This unit consists of deep and moderately deep, somewhat poorly drained and poorly drained, nearly level soils of the Shiffer, Lows, Marshan, Poskin, and Rib series, the mottled subsoil variant of the Hixton series, and the moderately shallow variant of the Rib series. The surface layer of these soils is loam to silt loam or heavy loam to heavy silt loam. Except for a few areas where the soils are underlain by sandstone and shale, these soils are underlain by sand and gravel.

Figure 11.—Countour stripcropping on Otterholt silt loam.

Permeability is moderate, and surface drainage is slow. The available water capacity is medium, and the water table is high to moderately high. Tilth is good if the soils are not worked when wet; spring planting must be delayed in most years. Crops respond well if an adequate system of drainage ditches has been provided.

Corn, soybeans, small grain, alfalfa, and red clover are the main crops. Proper application of lime and fertilizer is important.

CAPABILITY UNIT IIw–11

This unit consists of deep, silty soils of the Arenzville series. These are moderately well drained and well drained soils that are subject to occasional flooding.

The available water capacity is high, and permeability is moderate. Natural fertility is high.

If these soils are protected from flooding, they are suited to such crops as corn, small grain, alfalfa, and specialty crops.

CAPABILITY UNIT IIw–13

This unit consists of deep, somewhat poorly drained to poorly drained, nearly level soils of the Boaz and Wallkill series and the dark variant of the Boaz series. The surface layer of these soils is silt loam, and the subsoil is heavy silt loam to silty clay loam.

Permeability is moderate, and the available water capacity is high. Natural fertility is high. Tilth is good if the soils are not worked when too wet. Wetness is caused by slow surface runoff, a high water table, flooding, and in some places, by seepage from nearby soils. These soils dry out slowly in spring and after heavy rains.

If the soils of this capability unit are adequately drained and protected from flooding, corn, small grain, and alfalfa can be grown.

CAPABILITY UNIT IIs–1

This unit consists of deep and moderately deep, well-drained, nearly level soils of the Meridian, Dunnville, Dakota, Pillot, and Tell series. The surface layer of these soils is loam or silt loam, and the subsoil is loam to heavy silt loam.

These soils have a friable surface layer and are easy to work. The surface layer of the Tell and Pillot soils is slightly higher in clay content, and these soils are usually worked a few days later in spring than other soils of this capability unit. The available water capacity is medium, and permeability is moderate. Drought is a moderate hazard.

Corn, oats, alfalfa, and soybeans are the main crops. No special management practices are needed other than those that maintain the organic-matter content and fertility.

CAPABILITY UNIT IIIe–1

This unit consists of deep, well-drained, sloping soils of the Otterholt, Amery, Renova, Santiago, and Seaton series. The surface layer of these soils is silt loam or loam, and the subsoil is heavy loam or heavy silt loam.

These soils are easy to keep in good tilth, and they are easy to work. In most cultivated areas they are moderately eroded. The available water capacity is medium or high. Permeability is moderate. Runoff is moderately rapid. Natural fertility is medium to high.

Corn, small grain, and alfalfa are the crops most commonly grown. Contour stripcropping, terraces, and diversions can be used to control erosion in cultivated areas.

CAPABILITY UNIT IIIe–2

This unit consists of moderately deep, well-drained, sloping soils of the Dubuque, Hixton, La Farge, Meridian, Norden, Palsgrove, Tell, and Urne series. These soils have a surface layer of loam or silt loam and a subsoil of loam. They are underlain by sandstone, limestone, or sand.

Permeability is moderate, and the available water capacity is medium. Natural fertility is medium. Tilth is easy to maintain. The erosion hazard is moderate.

Corn, oats, alfalfa, and soybeans are the main crops. Contour stripcropping, diversions, and sodded waterways can be used to control erosion and maintain good yields. The addition of lime, fertilizer, and organic matter helps to maintain the fertility level.

CAPABILITY UNIT IIIe–3

This unit consists of shallow, well-drained and somewhat excessively drained, gently sloping soils of the Burkhardt, Chetek, Dunbarton, Elkmound, and Northfield series. These soils have a surface layer of silt loam or loam and a subsoil of loam to clay. They are commonly underlain by sandstone or limestone or sand and gravel at a depth of less than 20 inches.

Permeability is moderate to moderately rapid, and the available water capacity is low. These soils are generally easy to work, but tilth is poor in a few small, severely eroded areas of the Dunbarton soil because the clay subsoil is exposed. Drought is a moderate to severe hazard.

Corn, soybeans, small grain, clover, and alfalfa are the main crops. Contour stripcropping can be used to control erosion and conserve soil moisture. The soils are generally too shallow for terracing or diversions.

CAPABILITY UNIT IIIw–12

This unit consists of moderately well drained and well drained, nearly level soils of the Caryville, Kickapoo, and Terril series and of Alluvial land, loamy. These soils occur along streams and in upland drainageways. They are subject to occasional flooding.

Permeability is moderate, and the available water capacity is low to high. Natural fertility is medium. Surface runoff is slow, especially where old stream channels and oxbows cross the areas. Frost damage is a hazard.

Some areas of these soils are used for corn, small grain, and alfalfa. Early maturing corn can be grown to avoid damage from early fall frosts. Dikes can be constructed in places to divert floodwaters away from crops. Surface ditches can be used to remove excess water from cultivated areas.

CAPABILITY UNIT IIIs–4

This unit consists of deep and moderately deep, well-drained to somewhat excessively drained, nearly level and gently sloping soils of the Billett, Dakota, Dickinson, and Eleva series, and the mottled subsoil variant of the Billett series. These soils have a surface layer of sandy loam and a subsoil of heavy loam to light sandy loam. They are underlain by sand or sand and gravel.

These soils are easy to keep in good tilth, and they are easy to work. Permeability is moderate or moderately rapid, and the available water capacity is low to medium. Natural fertility is medium. Drought is a moderate hazard, and crops are sometimes damaged by lack of moisture during dry spells.

Corn, soybeans, small grain, alfalfa, and clover are the main crops. Some areas are used for woodland and permanent pasture. Plowing under the crop residue and liberal application of barnyard manure help to maintain the organic-matter content.

CAPABILITY UNIT IIIs–8

This unit consists of shallow, somewhat excessively drained to well-drained, nearly level soils of the Chetek, Elkmound, and Northfield series. These soils have a surface layer of sandy loam or silt loam and a subsoil of sandy loam to heavy silt loam. They are underlain by sand and gravel or sandstone at a depth of less than 20 inches.

Permeability is moderate in the Elkmound and Northfield soils and is moderately rapid to rapid in the Chetek soil. The available water capacity is low. Natural fertility is medium. Drought is a moderate to severe hazard.

Corn, soybeans, small grain, alfalfa, and clover are the main crops. Some areas of these soils are irrigated to offset dry periods during the growing season. The available water capacity can be increased by turning under crop residue and adding barnyard manure.

CAPABILITY UNIT IVe–1

This unit consists of deep, well-drained, moderately steep soils of the Renova, Palsgrove, Amery, and Seaton series. These soils have a surface layer of loam or silt loam and a subsoil of heavy loam or heavy silt loam.

Permeability is moderate or moderately slow, and the available water capacity is high to medium. Natural fertility is medium to high. Tilth is good. Erosion is a severe hazard.

The soils of this unit are commonly used for crops, permanent pasture, and woodland. Corn, small grain, and alfalfa are the main crops.

CAPABILITY UNIT IVe–2

This unit consists of moderately deep, well-drained, sloping and moderately steep soils of the Dubuque, Hixton, La Farge, Norden, and Urne series. These soils have a surface layer of loam to silt loam and a subsoil of very fine sandy loam to clay.

Permeability is moderate, and the available water capacity is medium. Natural fertility is medium. Erosion is a severe hazard. These soils are easy to work.

About half the acreage of these soils is used for crops. The rest is in permanent pasture and woodland. Corn, small grain, and alfalfa are the main cultivated crops. Contour stripcropping, diversions, and sodded waterways can be used to control erosion. Plowing under manure and crop residue helps to increase the available water capacity.

CAPABILITY UNIT IVe–3

This unit consists of shallow, well-drained, sloping soils of the Dunbarton, Elkmound, and Northfield series. These soils have a surface layer of silt loam or loam and a subsoil of loam to clay. They are underlain by sandstone or limestone at a depth of less than 20 inches.

The available water capacity is low, and permeability is moderate. In the Dunbarton soil permeability is moderately slow in the lower part of the subsoil. Erosion and drought are moderate hazards. Tilth is good if the soils are not worked when too wet.

Most areas of these soils are used for crops, but some are used for permanent pasture and woodland. Corn, small grain, soybeans, alfalfa, and clover are the main crops. Contour stripcropping can be used to control erosion. In some areas terraces and diversions are difficult to construct because the soil is shallow over rock.

CAPABILITY UNIT IVe–4

This unit consists of shallow to moderately deep, well-drained, sloping soils of the Arland, Billett, Burkhardt, and Eleva series. These soils have a surface layer of sandy loam and a subsoil of sandy loam to loam. They are underlain by sand and gravel or by sandstone.

These soils are easy to keep in good tilth. The available water capacity is low to medium, and permeability is moderate to moderately rapid. Drought and erosion are moderate hazards.

Most areas of these soils are used for crops, but some are used for permanent pasture or woodland. Corn, soybeans, small grain, alfalfa, and clover are the main crops. Contour stripcropping, terraces, diversions, and sodded waterways can be used to control erosion.

CAPABILITY UNIT IVw–5

This unit consists of deep, somewhat poorly drained and poorly drained, nearly level, sandy soils of the Morocco and Newton series. These soils have a surface layer of loamy sand and a subsurface layer of fine sand to medium sand. In some small areas of the Newton soil, the surface layer is muck.

These soils have a high water table, and ponding is common early in spring and after heavy rains. Permeability is rapid, and the available water capacity is low. Surface drainage is slow. The organic-matter content of the surface layer is high, especially in the Newton soil.

These soils are used for grain and hay. Only a small acreage is cultivated, and except in dry years, yields are usually low. Applications of lime and fertilizer are needed for favorable yields. Most of the acreage of these soils is used for water-tolerant shrubs and trees, such as willow, aspen, elm, and tamarack.

CAPABILITY UNIT IVwc–9

This unit consists of deep, very poorly drained, nearly level organic soils of the Cathro and Houghton series. The Houghton soil is organic material to a depth of 60 inches or more. The Cathro soil is similar, but loamy material begins at a depth of 16 to 42 inches.

The available water capacity is very high, and permeability is moderate to moderately rapid. Natural fertility is medium. The water table is at or near the surface most of the time. Soil blowing is a severe hazard in cultivated areas.

If these soils are properly drained and fertilized, they can be used for crops. Frost late in spring or early in fall is a hazard, however, if row crops are grown. Nearly

all the acreage of these soils is in sedges, marsh grasses, tag alders, willows, and such water-tolerant trees as elm and tamarack.

CAPABILITY UNIT IVs–3

This unit consists of deep to moderately deep, moderately well drained to excessively drained, nearly level to sloping, sandy soils of the Gotham, Hubbard, Brems, Plainfield, and Plainbo series. The surface layer of these soils is loamy fine sand to loamy sand, and the subsoil is loamy fine sand to medium sand.

These soils are low in clay content and, consequently, can be worked earlier in spring than loamy soils. Also, nutrients are leached from these soils faster than from loamy soils. Permeability is rapid, and the available water capacity is low to very low. Natural fertility is low. Soil blowing is a severe hazard. Drought is a severe hazard except in the Brems soil. The Brems soil has a higher water table than the other soils and is less droughty.

Large acreages of these soils are used for corn, alfalfa, and soybeans. Some of the areas are used for turkey farming. Irrigation is used in some areas to reduce the hazard of drought. Plowing under crop residue and manure helps to increase the organic-matter content and improve the available water capacity.

CAPABILITY UNIT Vw–7

Markey muck is the only soil in this unit. This is a very poorly drained organic soil that is 16 to 42 inches deep over sand.

The water table is at or near the surface most of the year. Ponding is common in spring and after heavy rains. Permeability is moderately rapid in the organic material and rapid in the sandy substratum. The available water capacity is high. Natural fertility is medium.

Most of the acreage is in sedges, marsh grasses, willows, tag alders, and such water-tolerant trees as elm and tamarack. Ordinarily, this soil is drained only where it occurs as small areas within cultivated fields. If drained, the muck oxidizes rapidly and sand is left at or near the surface.

CAPABILITY UNIT Vw–14

This unit consists only of Alluvial land, wet. These alluvial sediments range from sandy loam to silt loam in texture. The areas are marked by sloughs, oxbows, and former stream channels.

The available water capacity is medium to high, and permeability is moderate to rapid. The water table is high, and the soil is subject to frequent flooding.

This land type is mainly in bluegrass, marsh grasses, willows, river birch, soft maple, and other water-tolerant plants. It is suited mainly to permanent pasture, wildlife habitat, woodland, and recreation.

CAPABILITY UNIT VIe–1

Seaton silt loam, 20 to 30 percent slopes, eroded, is the only soil in this unit. This soil is deep and well drained. It has a surface layer of silt loam and a subsoil of heavy silt loam.

The available water capacity is high, and permeability is moderate. Natural fertility is high. Erosion is a severe hazard.

Most areas of this soil are in permanent pasture or woodland, but a few areas are used for grain and alfalfa. Permanent hay and pasture can be renewed periodically by liming, fertilizing, and reseeding to a legume-and-grass mixture. Woodland can be protected from fire and grazing to prevent damage to young seedlings and to preserve the leaf cover. The areas are suitable for wildlife habitat and some recreational uses.

CAPABILITY UNIT VIe–2

This unit consists of moderately deep, well-drained, steep soils of the Arland, Dubuque, La Farge, Norden, and Urne series. These soils have a surface layer of silt loam and a subsoil of heavy silt loam to clay. They are underlain by sandstone or limestone.

These soils are moderately droughty, especially on south- and west-facing slopes. The available water capacity is medium. Permeability is moderate, except in the Dubuque soil, which has restricted permeability in the lower part of the subsoil. Erosion is a severe hazard.

Most areas of these soils are in woodland or pasture. They are not suited to row crops. They are suited to permanent pasture, trees, wildlife habitat, and recreation. Permanent pasture can be renewed periodically by reseeding to alfalfa and bromegrass. Lime and fertilizer can be applied at the time the seedbed is prepared if soil tests show the need. Woodland should be protected from fire and grazing to protect seedlings and the water-absorbent leaf cover.

CAPABILITY UNIT VIe–3

This unit consists of shallow, well-drained, moderately steep soils of the Chetek and Dunbarton series and the shallow to moderately deep soils of the Urne and Elkmound series. These soils have a surface layer of silt loam, loam, or sandy loam and a subsoil of loam to clay. Chetek soils are underlain by gravel and sand, the Dunbarton soils by limestone, and the Urne and Elkmound soils by fine-grained sandstone.

The available water capacity is medium to low. Permeability ranges from rapid to moderately rapid in the Chetek soil to moderately slow in the Dunbarton soil. Erosion is a severe hazard, and drought is a severe to moderately severe hazard.

Most areas of these soils are in permanent pasture or woodland. Row crops are not suited, because of the erosion hazard. The areas are suited to permanent pasture, trees, wildlife habitat, and recreation. Permanent pasture can be renewed periodically by reseeding to alfalfa and bromegrass. Woodland should be protected from fire and grazing to protect seedlings and the water-absorbent leaf cover.

CAPABILITY UNIT VIs–3

This unit consists of excessively drained, sloping soils of the Plainfield and Plainbo series. The surface layer of these soils is loamy fine sand or loamy sand, and the subsoil is medium sand to loamy fine sand. Sandstone begins at a depth of 20 to 40 inches in the Plainbo soil; the Plainfield soil is underlain by sandy material.

The available water capacity is low or very low, and permeability is rapid. Natural fertility is low. These soils have a low content of clay and, consequently, can be worked earlier in spring than soils that have a surface layer of silt loam, sandy loam, or loam. Soil blowing, water erosion, and drought are severe hazards. Mainte-

nance of organic-matter content is difficult, and nutrients added to these soils leach faster than from soils that have a higher clay content.

These soils are suited to trees, wildlife habitat, and recreation. The natural vegetation is jack pine and scrub oak. Only a small part of the acreage is used for farming. A large acreage formerly used for cultivated crops has been planted to conifers. Small areas are in permanent hay or pasture, but yields are low.

CAPABILITY UNIT VIIe-2

This unit consists of shallow to moderately deep, well-drained, steep to very steep soils of the Norden, Dunbarton, Urne, and Elkmound series. These soils have a surface layer of silt loam to loam and a subsoil of loam to clay. They are underlain by sandstone or limestone.

These soils are somewhat droughty. The available water capacity is low to medium, and permeability is moderate to moderately slow. Runoff is very rapid, and less water soaks into these soils than into gently sloping soils. Erosion is a severe hazard.

These soils are not suited to cultivated crops. They are suited to trees and can be used for pasture if well managed. Wooded areas need to be protected from damage by fire and grazing. Cutting trees selectively encourages growth of desirable species. Open areas can be planted to suitable trees. Plantings to provide food and shelter for wildlife will encourage desirable kinds of wildlife.

CAPABILITY UNIT VIIe-4

This unit consists of shallow, somewhat excessively drained, steep to very steep soils of the Chetek series and of the land types Terrace escarpments, loamy, and Steep stony rock land. Large gullies have formed in some areas of Terrace escarpments.

The available water capacity is low to medium, and permeability is moderate to moderately rapid.

These soils are not suited to crops. They are suited mainly to pasture and trees. Wooded areas need protection from fire and grazing. Harvesting should be done on a selective basis. Open areas can be planted to suitable trees.

CAPABILITY UNIT VIIs-3

This unit consists of moderately deep, excessively drained, moderately steep, steep, and very steep soils of the Plainbo and Hubbard series and of Terrace escarpments, sandy. The soils have a surface layer of loamy sand. They are underlain by sand or sandstone.

The available water capacity is low or very low, and permeability is rapid. Natural fertility and organic-matter content are low, and the clay content is low. Soil blowing and water erosion are severe hazards. Drought is a severe hazard.

Nearly all the areas are in jack pine and scrub oaks. Some of the areas have been cleared and planted to Norway pine and white pine. The soils are suited to wildlife habitat, trees, and recreation. Recreational uses consist mainly of hunting. Deer and rabbits are the common game animals, and grouse are the common game birds.

CAPABILITY UNIT VIIs-9

This unit consists only of Alluvial land, sandy. This land type is on bottom lands of large streams and rivers. Extensive areas are along the Chippewa and Red Cedar Rivers, where they are subject to frequent flooding. The soil material is nearly level sandy alluvium.

The available water capacity is low, and permeability is rapid. Fertility is low.

The vegetation is mostly trees and wild shrubs. The areas are suited to trees, wildlife habitat, and recreation.

CAPABILITY UNIT VIIIs-9

This unit is made up only of Riverwash. This land type consists of infertile sandy material recently deposited by streams. In places it occurs as sandbars along rivers and creeks, where sand is frequently added.

This land type is very droughty and is subject to frequent flooding. It supports little or no vegetation. It is suited mainly to recreation.

Predicted Yields

Table 2 shows predicted average yields per acre, on arable soils, of the crops commonly grown in the county. The predictions are based on interviews with farmers, on results obtained by the agricultural experiment station on experimental test plots, and on observations made by soil scientists and other farm workers who are familiar with the soils and crops of the county. Irrigation was not considered in making the yield predictions.

For renovated pasture, the yields are about the same as those listed for alfalfa-brome hay. The highest yields of hay are obtained if the crop is cut and used for green feed instead of allowing livestock to graze the pastures.

The yields shown in the table assume the best management practical on these soils. Among these practices are the following:

1. Applying lime and fertilizer as indicated by soil tests, taking into consideration the kind of soil, the cropping history of the field, and the needs of the crop to be grown.
2. Providing adequate drainage and, where needed, protection from flooding.
3. Using timely and adequate methods of preparing seedbeds and planting crops.
4. Harvesting crops carefully and at the right time.
5. Maintaining practices needed to control erosion.
6. Controlling weeds and harmful insects.

Use of the Soils for Woodland [2]

Most of Dunn County was forested at the time of settlement. A small area in the southeastern part of the county was covered with prairie grasses, such as big bluestem, little bluestem, switchgrass, and indiangrass. Nearly half the county, roughly the eastern half, was in open stands of oak, or oak grove cover. Red oak, black oak, bur oak, white oak, and northern pin oak were intermingled with prairie vegetation. The rest of the area, mostly in the western part of the county, was in predominantly hardwood forest. Red oak was the most important species, but also in the stand were white oak,

[2] By GEORGE W. ALLEY, forester, Soil Conservation Service, Madison.

TABLE 2.—*Predicted average yields per acre of principal crops on arable soils*

[Predicted yields are those obtained under improved, or high-level management. Absence of a yield figure indicates that the soil is not suited to the crop or that the crop is not ordinarily grown on the soil]

Soil	Corn for grain	Corn for silage	Oats [1]	Alfalfa-brome hay [2] (dry weight)
	Bu.	*Tons*	*Bu.*	*Tons*
Alluvial land, loamy	85	13	55	3. 5
Almena silt loam, 2 to 6 percent slopes	98	13	68	3. 8
Almena silt loam, wet variant	80	11	60	3. 0
Amery loam, 2 to 6 percent slopes	90	13	70	4. 0
Amery loam, 6 to 12 percent slopes, eroded	80	11	65	3. 5
Amery loam, 12 to 20 percent slopes, eroded	65	10	50	3. 0
Arenzville silt loam	120	14	80	4. 5
Arland sandy loam, 6 to 12 percent slopes, eroded	75	10	55	3. 3
Arland sandy loam, 12 to 20 percent slopes, eroded			50	3. 0
Billett sandy loam, 0 to 2 percent slopes	78	12	65	3. 2
Billett sandy loam, 2 to 6 percent slopes	75	11	60	3. 0
Billett sandy loam, 6 to 12 percent slopes, eroded	70	10	50	2. 8
Billett sandy loam, mottled subsoil variant	78	11	65	3. 2
Boaz silt loam	95	12	58	3. 3
Boaz silt loam, dark variant	100	13	70	4. 0
Brems loamy sand	50	8	40	2. 5
Burkhardt sandy loam, 0 to 6 percent slopes	65	12	50	3. 0
Burkhardt sandy loam, 6 to 12 percent slopes, eroded	53	10	40	2. 5
Campia loam, 0 to 2 percent slopes	120	13	80	4. 5
Caryville loam	65	11	55	3. 0
Cathro muck		15		
Chetek sandy loam, 0 to 2 percent slopes	70	11	50	2. 0
Chetek sandy loam, 2 to 6 percent slopes	68	10	48	2. 0
Chetek sandy loam, 12 to 20 percent slopes, eroded			40	2. 0
Chetek sandy loam, 20 to 30 percent slopes, eroded				1. 5
Dakota sandy loam, 0 to 2 percent slopes	80	12	68	3. 5
Dakota sandy loam, 2 to 6 percent slopes	78	11	65	3. 2
Dakota loam, 0 to 2 percent slopes	88	14	68	4. 0
Dakota loam, 2 to 6 percent slopes	85	13	65	3. 8
Dickinson sandy loam, 0 to 2 percent slopes	65	11	55	2. 5
Dickinson sandy loam, 2 to 6 percent slopes	63	10	53	2. 4
Dubuque silt loam, 2 to 6 percent slopes	88	14	78	3. 8
Dubuque silt loam, 6 to 12 percent slopes, eroded	80	13	75	3. 5
Dubuque silt loam, 12 to 20 percent slopes, eroded	60	11	65	2. 5
Dubuque silt loam, 20 to 30 percent slopes, eroded			45	2. 3
Dunbarton silt loam, 2 to 6 percent slopes, eroded	65	13	45	2. 2
Dunbarton silt loam, 6 to 12 percent slopes, eroded	65	12	45	2. 2
Dunbarton silt loam, 12 to 20 percent slopes, eroded			43	2. 0
Dunbarton silt loam, 20 to 30 percent slopes				1. 5
Dunnville loam	80	13	70	3. 5
Dunnville silt loam, silty subsoil variant	115	13	80	4. 5
Eleva sandy loam, 2 to 6 percent slopes	75	10	60	3. 0
Eleva sandy loam, 6 to 12 percent slopes, eroded	73	9	55	3. 0
Elkmound loam, 0 to 2 percent slopes	60	13	40	2. 0
Elkmound loam, 2 to 6 percent slopes	65	12	45	2. 0
Elkmound loam, 6 to 12 percent slopes, eroded	53	11	38	1. 5
Gotham loamy fine sand, 0 to 2 percent slopes	58	9	45	2. 1
Gotham loamy fine sand, 2 to 6 percent slopes	55	8	40	2. 0
Gotham loamy fine sand, 6 to 12 percent slopes, eroded			35	2. 0
Gotham loamy fine sand, loamy substratum, 0 to 2 percent slopes	70	12	50	2. 5
Gotham loamy fine sand, loamy substratum, 2 to 6 percent slopes	70	11	50	2. 5
Gotham loamy fine sand, loamy substratum, 6 to 12 percent slopes, eroded	50	10	40	2. 0
Hixton loam, 2 to 6 percent slopes	85	13	65	3. 8
Hixton loam, 6 to 12 percent slopes, eroded	80	11	60	3. 5
Hixton loam, 12 to 20 percent slopes, eroded			50	3. 0
Hixton loam, mottled subsoil variant, 2 to 6 percent slopes	95	12	65	3. 5
Houghton peaty muck		15	50	3. 0
Hubbard loamy sand, 0 to 2 percent slopes	55	10	45	3. 0
Hubbard loamy sand, 2 to 6 percent slopes	48	9	38	2. 3
Hubbard loamy sand, 6 to 12 percent slopes, eroded				1. 2
Hubbard loamy sand, loamy substratum	70	12	50	2. 5
Kickapoo fine sandy loam	75	11	70	3. 5
La Farge silt loam, 2 to 6 percent slopes	85	13	65	3. 8
La Farge silt loam, 6 to 12 percent slopes, eroded	80	12	60	3. 5
La Farge silt loam, 6 to 12 percent slopes, severely eroded	75	11	55	3. 3
La Farge silt loam, 12 to 20 percent slopes, eroded	75	10	55	3. 0

See footnotes at end of table.

TABLE 2.—*Predicted average yields per acre of principal crops on arable soils*—Continued

Soil	Corn for grain	Corn for silage	Oats [1]	Alfalfa-brome hay [2] (dry weight)
	Bu.	*Tons*	*Bu.*	*Tons*
La Farge silt loam, 12 to 20 percent slopes, severely eroded			50	3. 0
La Farge silt loam, 20 to 30 percent slopes, eroded			50	3. 0
Lows loam	70	11	60	3. 0
Markey muck		12		
Marshan silt loam	90	13	60	3. 0
Meridian loam, 0 to 2 percent slopes	88	13	68	4. 0
Meridian loam, 2 to 6 percent slopes	85	12	65	3. 8
Meridian loam, 6 to 12 percent slopes, eroded	75	11	60	3. 0
Morocco loamy sand	58	9	45	2. 1
Morocco sandy loam, loamy subsoil variant	70	11	50	3. 0
Newton loamy sand	55	10	45	2. 0
Norden silt loam, 2 to 6 percent slopes	85	13	65	4. 0
Norden silt loam, 6 to 12 percent slopes, eroded	80	11	60	3. 5
Norden silt loam, 12 to 20 percent slopes, eroded	75	10	50	3. 0
Norden silt loam, 20 to 30 percent slopes, eroded			43	2. 3
Northfield silt loam, 0 to 2 percent slopes	78	12	65	3. 2
Northfield silt loam, 2 to 6 percent slopes	75	11	60	3. 0
Northfield silt loam, 6 to 12 percent slopes, eroded	70	10	50	2. 8
Otterholt silt loam, 2 to 6 percent slopes	110	14	75	4. 5
Otterholt silt loam, 6 to 12 percent slopes, eroded	110	13	65	3. 5
Palsgrove silt loam, deep, 2 to 6 percent slopes	110	16	75	4. 5
Palsgrove silt loam, deep, 6 to 12 percent slopes, eroded	100	15	65	3. 5
Palsgrove silt loam, deep, 12 to 20 percent slopes, eroded	95	14	60	5. 5
Pillot silt loam	110	14	70	3. 5
Plainbo loamy sand, 2 to 6 percent slopes	45	7	35	1. 8
Plainbo loamy sand, 6 to 12 percent slopes, eroded				1. 4
Plainfield loamy sand, 0 to 2 percent slopes	48	8	70	2. 3
Plainfield loamy sand, 2 to 6 percent slopes	48	8	38	2. 3
Plainfield loamy sand, 6 to 12 percent slopes, eroded				1. 2
Poskin silt loam	95	12	65	3. 5
Renova silt loam, 2 to 6 percent slopes	100	13	80	4. 0
Renova silt loam, 6 to 12 percent slopes, eroded	85	11	75	3. 5
Renova silt loam, 12 to 20 percent slopes, eroded	80	10	75	3. 5
Rib silt loam	90	11	65	3. 0
Rib silt loam, moderately shallow variant	85	11	65	3. 0
Santiago silt loam, 2 to 6 percent slopes	115	14	70	4. 0
Santiago silt loam, 6 to 12 percent slopes, eroded	105	12	68	3. 5
Seaton silt loam, 2 to 6 percent slopes	110	16	75	4. 5
Seaton silt loam, 6 to 12 percent slopes, eroded	100	14	65	3. 5
Seaton silt loam, 12 to 20 percent slopes, eroded	95	14	60	3. 5
Seaton silt loam, 20 to 30 percent slopes, eroded			45	2. 6
Seaton silt loam, benches, 0 to 2 percent slopes	125	13	80	4. 5
Seaton silt loam, benches, 2 to 6 percent slopes	120	16	75	4. 3
Shiffer loam	90	12	60	3. 5
Stronghurst silt loam	100	12	70	3. 5
Tell silt loam, 0 to 2 percent slopes	80	14	68	4. 0
Tell silt loam, 2 to 6 percent slopes	83	13	63	3. 5
Tell silt loam, 6 to 12 percent slopes, eroded	85	12	63	3. 5
Terrace escarpments, loamy				2. 5
Terril loam	120	14	80	4. 5
Urne-Elkmound loams, 12 to 20 percent slopes, eroded			35	2. 3
Urne-Elkmound loams, 20 to 40 percent slopes				2. 1
Urne-Norden loams, 2 to 6 percent slopes	85	13	65	3. 5
Urne-Norden loams, 6 to 12 percent slopes, eroded	75	12	55	2. 8
Urne-Norden loams, 12 to 20 percent slopes, eroded				2. 5
Wallkill silt loam	110	11	75	4. 0

[1] Yields are for oats seeded with a grass-legume mixture.

[2] Yields are for hay cut from first- or second-year stands.

black oak, maple, basswood, elm, and aspen. Some native species of pine, such as red pine, white pine, and jack pine, were scattered throughout the county on sandy soils but pines were not of major importance (*2*).

In 1957 about 30 percent, or 170,000 acres, of the county was in commercial timber. Approximately 100,000 acres of this forested land was nonstocked or was poorly stocked. Of this acreage, some 70,000 acres was not suitable for planting, 26,000 acres was restocking naturally, and 4,000 acres was suitable for planting for reforestation.

The net volume by species of the commercial forest was as follows: red oak, 32 percent; white oak, 15 percent; aspen, 10 percent; elm, 9 percent; maple, 8 percent; softwood pine, 7 percent; and basswood, 7 percent. The rest was birch, 5 percent, and other hardwoods, 7 percent.

A large acreage that was formerly used for farming has been planted to red pine, white pine, and some jack pine. These plantings help to conserve soil and water and provide habitat for wildlife, which adds to the esthetic value of the land. The plantings have been especially important on sandy soils, such as those of the Plainfield, Hubbard, Burkhardt, and Gotham series. Some of the planted areas are being managed for the production of Christmas trees.

As a guide to the landowner, tree species suitable for wood crops and factors in management are shown in table 3. In this table the soils of the county have been placed in 23 woodland groups. Each group is made up of soils that are suited to the same kinds of trees, that need about the same management where the vegetation is similar, and that have about the same potential productivity. The soils in each woodland group can be learned by referring to the "Guide to Mapping Units."

The table gives an average site index for the soils in each group. The site index is the average height the dominant and codominant trees of a given species will reach at 50 years of age. Site index has been determined by field measurements for some of the more important species and soils; it has been estimated from measurements made on similar soils and species for others.

Site indexes given in the table are based on standard site index curves for silver maple, red oak, sugar maple, red maple, white oak, black oak, northern pin oak, bur oak, aspen, and tamarack (*3*, *4*, *5*, and *10*). The annual yields given in the table were estimated from yield tables based on site indexes for silver maple, upland oak, northern hardwoods, aspen, and tamarack (*6*, *7*, *8*, *9*, and *10*).

Each woodland group is identified by a three-part symbol, for example, 2o1 or 3r2. The first number in the symbol indicates the relative potential productivity of the soils in the group: 1, high; 2, moderately high; 3, moderate; 4, moderately low; 5 low; and 6, unproductive. These ratings are based on growth potential, expressed as the site index.

The second part of the symbol is a small letter. This letter shows the subclass, which indicates an important soil property that imposes a slight to severe limitation in managing the soils of the group for wood crops. The subclasses are defined as follows:

Subclass w (excessive wetness). Soils in which excessive water, either seasonally or the year around, causes significant limitations for woodland use or management. These soils have restricted drainage, have a high water table, or are subject to a flooding hazard, which adversely affects the development of the stand or its management.

Subclass d (restricted rooting depth). Soils that have restrictions or limitations for woodland use and management because of restricted rooting depth. These are soils that are shallow to hard rock or to a hardpan, or that have other layers in the soil that restrict the penetration of roots.

Subclass c (clayey soils). Soils that have restrictions or limitations for woodland use and management because of the kind or amount of clay in the upper part of the soil.

Subclass s (sandy soils). Dry, sandy soils that have little or no textural B horizon and have moderate to severe restrictions or limitations for woodland use and management. These soils impose equipment limitations, have low available water capacity, and normally are low in available plant nutrients.

Subclass f (fragmental or skeletal soils). Soils that have restrictions or limitations for woodland use or management because they contain large amounts of coarse fragments more than 2 millimeters but less than 10 inches in size. Flaggy soils are included.

Subclass r (relief or slope). Soils that have restrictions or limitations for woodland use or management because of slope.

Subclass o (slight or no limitations). Soils that have no significant restrictions or limitations for woodland use or management.

The third part of the woodland group symbol indicates the degree of hazard or limitation to be considered in management. The numerals 1, 2, and 3 indicate slope factors and apply to subclasses d, c, s, f, r, and o.

The numeral 1 indicates that the slope is less than 12 percent and, therefore, the erosion hazard and equipment limitations are generally slight. The numeral 2 indicates that the slope is between 12 and 30 percent and the erosion hazard and equipment limitations are moderate to severe, depending on the subclass. The numeral 3 indicates that the slope is more than 30 percent and the erosion hazard and equipment limitations are severe. Numerals 4, 5, and 6 indicate soil factors and apply only to the "w" subclass. The numeral 4 indicates deep, sandy soils that are poorly drained to somewhat poorly drained. The numeral 5 indicates soils that have a loamy or clayey subsoil and are poorly drained to somewhat poorly drained. The numeral 6 indicates deep organic soils.

The limitations or hazards that affect management of the soils for woodland are the equipment limitation, the erosion hazard, and the hazard of seedling mortality. Table 3 gives a rating for these limitations and hazards for each woodland group. The ratings are slight, moderate, or severe.

Equipment limitations are rated on the basis of soil characteristics that restrict or prohibit the use of equipment commonly used in tending and harvesting trees. In this county the soil characteristics that have the most limiting effect are excessive soil wetness, slope, and texture of the surface layer. A rating of *slight* means that there is no restriction on the kind of equipment or the time of year it is used. A rating of *moderate* means that the use of equipment is restricted less than 3 months of the year. A rating of *severe* means that special equipment is needed and its use is restricted for more than 3 months of the year.

Erosion hazard refers to potential soil erosion in areas used for woodland. A rating of slight indicates little or no erosion hazard. A rating of moderate indicates that some soil loss can be expected and care is needed during logging and construction. A rating of severe indicates that special methods of operation are necessary to avoid excessive soil loss.

TABLE 3.—*Wood crops and factors in management*

Woodland group and map symbols	Potential productivity				Equipment limitations	Hazards		Species for reforestation
	Tree species	Average site index	Number of plots	Yearly growth per acre		Erosion	Seedling mortality	
				Board feet				
Group 1r2: SeD2, SeE2	Red oak	72	2	250	Moderate	Moderate	Slight on north- and east-facing slopes. Moderate on south- and west-facing slopes.	Red pine, white pine, white spruce.
Group 1o1: SeB, SeC2, SfA, SfB.	Red oak	76	2	285	Slight	Slight	Slight	Red pine, white pine, white spruce.
	Sugar maple	66	1	240				
Group 2w5: AmB, An, Po, Su	Red maple	65	5	120	Slight	Slight	Moderate plant competition.	Soft maple, cottonwood.
	Basswood	72	3	270				
Group 2r2: AsD2, AuD2, DfD2, DfE2, HfD2, LfD2, LfD3, LfE2, NrD2, NrE2, PaD2, RaD2.	Red oak	66	3	200	Moderate	Moderate	Slight on north- and east-facing slopes. Moderate on south- and west-facing slopes.	Red pine, white pine.
	Aspen	76	4	270				
Group 2o1: AsB, AsC2, At, AuC2, CaA, DfB, DfC2, HfB, HfC2, LfB, LfC2, LfC3, MeA, MeB, MeC2, NrB, NrC2, OsB, OsC2, PaB, PaC2, RaB, RaC2, SaB, SaC2, TeA, TeB, TeC2.	Red oak	65	9	200	Slight	Slight	Slight	Red pine, white pine, white spruce.
	Aspen	77	8	280				
Group 3w4: Mo, Mr	Jack pine	63	2	105	Moderate	Slight	Moderate	Jack pine, poplar.
	Aspen	65	(1)	190				
Group 3w5: Ad, Bm, Bo, Br, HmB, Lo, Rb, Rc, Sh.	Aspen	71	1	235	Moderate	Slight	Moderate	Soft maple, white ash.
	Soft maple	65	(1)	120				
Group 3d1: BuB, BuC2, CkA, CkB, DnB2, DnC2, EmA, EmB, EmC2, NtA, NtB, NtC2.	Red oak	53	8	150	Slight	Slight	Slight	Red pine, jack pine.
Group 3d2: CkD2, CkE2, DnD2, DnE.	Red oak	50	(1)	130	Moderate	Moderate	Slight on north- and east-facing slopes. Moderate on south- and west-facing slopes.	Red pine, jack pine, eastern redcedar.

Group 3s1: Bs, GoA, GoB, GoC2, HuA, HuB, HuC2, PdB, PdC2, PfA, PfB, PfC2.	Jack pine White pine Northern pin oak.	59 57 45	4 3 2	95 350 100	Slight	Slight	Slight	Jack pine, red pine.
Group 3s2: PdF	Jack pine	60	(1)	95	Moderate	Moderate	Slight on north- and east-facing slopes. Moderate on south- and west-facing slopes.	Jack pine, red pine.
Group 3o1: BlA, BlB, BlC2, Ce, DdA, DdB, Du, Dv, ElB, ElC2, GsA, GsB, GsC2, Hv, Kc, Tr, UnB, UnC2.	Red oak Jack pine	50 57	3 1	130 85	Slight	Slight	Slight	Red pine, jack pine.
Group 3r2: UeD2, UeF, UnD2, UnE2.	Red oak	45	2	105	Moderate	Moderate	Slight on north- and east-facing slopes. Moderate on south- and west-facing slopes.	Red pine, jack pine, eastern redcedar.
Group 3r3: UnF	Red oak	38	2	75	Severe	Severe	Severe	Red pine, jack pine, eastern redcedar.
Group 4w4: Ne	Aspen White pine	66 53	1 1	200 240	Moderate	Slight	Moderate	Jack pine, poplar.
Group 4w5: Af, Mc, Wa	Soft maple	50	(1)	75	Moderate	Slight	Moderate	Soft maple, cottonwood.
Group 4d2: StF, To	Upland oaks	43	2	95	Severe	Severe	Severe	Red pine, jack pine, eastern redcedar.
Group 4s1: HwC, Tn	Jack pine Black oak	45 52	3 1	50 140	Moderate	Moderate	Moderate	Red pine, jack pine.
Group 4o1: DaA, DaB, DbA, DbB, Pc.	Upland oaks	45	(1)	105	Slight	Slight	Moderate plant competition.	Red pine, white pine, white spruce.
Group 5w6: Ch, Ho, Ma	Tamarack	48	5	200	Severe	Severe	Severe	Not suitable for planting.
Group 6s1: Ae, Re. Soils of this group are not suited to trees.								

[1] Site index estimated.

Seedling mortality refers to the expected degree of mortality of planted seedlings as a result of unfavorable soil characteristics. Factors considered in the ratings are excessive soil wetness, hazard of flooding, slope and aspect, soil texture and structure, and plant competition. Normal rainfall, good planting stock, and proper planting are assumed. A rating of *slight* indicates an expected loss of less than 25 percent of the planted seedlings. A rating of *moderate* means that a loss of 25 to 50 percent of the seedlings can be expected, and a rating of *severe* means that a loss of more than 50 percent of the seedlings can be expected.

Use of the Soils for Landscaping and Windbreaks

This section gives information about some of the trees, shrubs, and vines used in landscaping sites for homes, schools, industry, and recreational areas. It also gives information on species suitable for windbreaks around farmsteads or open fields.

A large acreage in Dunn County is subject to soil blowing. Sandy soils of the Billett, Burkhardt, Chetek, Gotham, Plainfield, and Hubbard series need the protection of windbreaks, as well as careful cropping, to limit soil loss. Farmers of the county have been planting trees for windbreaks, generally native pine, since the 1930's.

The growth of trees in these windbreaks [3] has been measured on several of the soils of the county, mostly Plainfield and Hubbard soils. On Plainfield soils red pine ranges from 33 to 45 feet in height at 25 years of age. White pine shows similar growth. On Hubbard soils red pine ranges from 33 to 40 feet in height at 25 years of age, white pine from 35 to 42 feet, and jack pine from 36 to 40 feet. On the basis of limited measurements, these species have made similar growth on Burkhardt, Billett, Chetek, and Gotham soils.

Tree and shrub species range widely in their suitability to different soils and to site conditions. The soils have been placed in four tree and shrub groups, mainly on the basis of the degree and length of time that the soils are saturated with water, and on the available water capacity. All the soils in a tree and shrub group have similar suitability for trees, shrubs, and vines. The tree and shrub group for any given soil can be learned by referring to the "Guide to Mapping Units."

Table 4 lists trees suitable for planting on soils in the four tree and shrub groups. Table 5 is a shrub and vine planting guide. Plants listed in the tables are only a partial list of the plants suited to the soils of the county. Many of the plants serve the dual purpose of landscaping and of providing food and cover for wildlife.

Use of the Soils for Recreation

Table 6 in this section gives ratings of the soils of Dunn County for recreational purposes. These ratings are given in terms of degree and kind of limitation, and are predictions of the behavior of specific kinds of soil when used for specific kinds of recreation. In making the evaluations, no consideration was given to esthetic values, to the size or shape of the soil areas, or to the pattern of the soils on the landscape. The information given in the table can serve as a general guide for evaluating the soils for recreational uses, but the ratings are not intended to eliminate the need for onsite investigation.

Four degrees of limitation were used in evaluating the soils. A rating of *slight* means that the soils have no limitations or have limitations for a given use that are easily overcome. A rating of *moderate* means that the soils have limitations for a given use that can be overcome by average management and careful design. A rating of *severe* means that the soils have limitations for a given use that are difficult to overcome. A rating of *very severe* means that the soils have limitations that generally preclude use for a given purpose.

Intensive play areas.—Ratings of soils for playgrounds, athletic fields, and other intensive play areas were made for sites that are 2 acres or larger in size and are to be used mainly for providing nearly level areas for organized games. Most playgrounds are subjected to relatively heavy foot traffic. Soils that are well suited to this use are nearly level, have good drainage, are free from flooding during periods of use, and have soil texture and consistence that provide a firm surface. The areas should be free of coarse fragments and hard rock. They must be capable of supporting vegetation in all areas that have not been surfaced.

Extensive play areas.—Sites used for this purpose should be 3 to 5 acres or larger in size. The most suitable soils are nearly level to gently sloping, have good drainage, and are not subject to flooding during the season of use. They should have soil texture and consistence that provide a firm surface, and they must be capable of supporting a varied vegetative cover. The areas should be free of coarse fragments and rock outcrops.

Golf fairways.—The ratings of the soils for use as golf fairways are based on those features that affect their use for fairways. Soils suitable for fairways should be gently undulating, well drained and firm, and free of flooding during the seasons of use. They should have good trafficability and contain a minimum of coarse fragments or stones. They should be capable of supporting a good turf and be well suited to many kinds of trees and shrubs. Loamy soils generally have only slight limitations, but coarser textured soils are suitable if they are irrigated. Poorly drained mineral and organic soils have severe limitations, but they can be used for pond sites or for storing water for turf maintenance.

Tent and trailer campsites.—The ratings in the table for this purpose are for areas suitable for pitching tents, for parking camp trailers, and for short-period outdoor living. The best areas require little site preparation, and cars and camp trailers can be parked on the natural surface. Well-suited soils are loamy, well drained, and level to gently sloping. They have good trafficability and are not subject to flooding during the period of use. On the

[3] Unpublished data from Windbreak-Soil Site Study, Soil Conservation Service, Madison. 1972.

best sites an adequate vegetative cover is easy to maintain, erosion is not a hazard, and the surface is free of coarse fragments, stones, and rock outcrops.

Use of the Soils for Wildlife[4]

The soils of Dunn County vary widely in physical and chemical characteristics, and this, in turn, affects the kinds and amounts of vegetation the soils produce and the kinds and numbers of wildlife they support. The abundance of wildlife in an area has a direct relationship to the fertility of the soils. Wildlife are more numerous where the soils are fertile because food and cover are generally plentiful.

About 10 percent of the county, or 55,150 acres, is wet, and about 90 percent, or 490,642 acres, is well drained or moderately well drained. Most of the major soils have high potential for wildlife habitat, but they are not used for wildlife, because they are suitable for fairly intensive farming.

The wetlands of Dunn County are of primary importance for wildlife habitat. Also important are woodlots and small marshes.

Land management practices for the improvement of wildlife habitat include food and cover plantings where wildlife is of secondary importance. Wildlife also benefit from many soil and water conservation practices, such as stripcropping, fertilization, and planting of trees on soils used for pasture and forest.

Table 7 groups the soils of the county according to their suitability for producing elements of wildlife habitat. The groups in the table are part of a statewide system of grouping. Group 2 in this system is not listed in the table, because the soils of this group are not represented in this county.

The soils in the wildlife groups are rated *good*, *fair*, *poor*, or *unsuitable* for each element of wildlife habitat. A rating of *good* means that the soil has no limitations or it has limitations for a given use that are easily overcome. A rating of *fair* means that the soil has limitations for a given use that can be overcome by average management and careful design. A rating of *poor* means that the soil has limitations for a given use that are difficult to overcome. A rating of *unsuitable* means that the soil has limitations that generally preclude its use for a given purpose. The elements of wildlife habitat for which the soils are rated are the following:

Grain and seed crops.—In this group are such crops as corn, oats, sorghums, wheat, barley, rye, or soybeans that are used for food and cover by wildlife.

Grasses and legumes.—In this group are such grasses as bluegrass, bromegrass, timothy, and fescue, and such legumes as alfalfa, birdsfoot trefoil, red clover, sweetclover, and vetch.

Wild herbaceous upland plants.—In this group are native or introduced grasses, legumes, and forbs that provide food and cover for upland wildlife and are mainly established by natural means. Such plants as bluegrass, prairie grasses, rounded lespedeza, beggarticks, aster, and goldenrod are important in this group.

Hardwoods (trees and shrubs).—In this group are hardwood trees, shrubs, and conifers less than 8 feet in height. Such hardwoods as oaks, maples, cherry, and nut trees furnish mast, fruit, seeds, dens, cover, and browse for wildlife. Such woody plants as viburnums, dogwood, and hazelnut furnish fruit, seeds, browse, and cover.

Conifers.—In this group are coniferous trees more than 8 feet in height. Such trees as pine, fir, spruce, tamarack, and cedar furnish seeds, fruit, browse, and cover for wildlife.

Wetland food and cover plants.—In this group are forbs, grasses, sedges, aquatic plants, and woody plants that grow well in wet areas. They furnish fruit, seeds, browse, and cover for wildlife that live in wet areas and on or near open water. Examples are smartweed, canarygrass, sedges, and sagittaria. These plants grow well in type 1, 2, and 6 wetlands as defined in U.S. Department of The Interior Circular 39. Type 1 wetlands are seasonally flooded basins and nearly level areas that are covered with water or are saturated during seasonal wet periods but are usually relatively dry during much of the growing season. Type 2 wetlands are fresh meadows that are usually not covered by water during the growing season but are saturated within a few inches of the surface of the soil. Type 6 wetlands are shrubby swamp areas in which the soil is usually saturated during the growing season and is often covered with as much as 6 inches of water.

Shallow and deep water developments.—Shallow water areas in this group are less than 5 feet deep. These are mainly natural and dug-out water areas or water areas formed by a combination of dug-out areas and low embankments. Common plants are cattails, bulrushes, sedges, and reeds. These plants grow well in type 3 and 4 wetlands as defined by the U.S. Department of The Interior. Type 3 wetlands are of shallow marshes in which the soil is saturated or covered with as much as 6 inches of water during the growing season. Type 4 wetlands are deep marshes that are covered by 6 inches to about 3 feet of water during the growing season.

Deep water areas are more than 5 feet deep. They consist of natural water areas, dug-out areas, or water areas formed by a combination of dug-out areas and embankments. Common plants are coontail, water lilies, milfoil, and water weeds. These plants grow well in type 5 wetlands as defined by the Department of The Interior. Type 5 wetlands are open fresh water areas, such as shallow ponds and reservoirs or wet areas where water is less than 10 feet deep. Deep water areas are mainly ponds and lakes.

Table 8 lists species of wildlife important in the county and rates the various elements of wildlife habitat according to their importance for each species. The suitability of any given soil for a species of wildlife can be determined by using both tables 7 and 8. For example, table 8 shows that critical elements of habitat for pheasants are grasses and legumes, wild herbaceous upland plants, and herbaceous wetland plants. Table 7 shows that the soils in groups 1 and 5 are suitable for all these elements of wildlife habitat.

[4] LAVERNE C. STRICKER, biologist, Soil Conservation Service, prepared this section.

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TABLE 4.—*Trees suitable for planting*

[The first letter in parentheses following the species indicates tree height; S is less than 30 feet; M, 30 to 60; L, more than 60. The second letter indicates shape; C is columnar; O, oval; P, pyramidal; Pe, pendulous; R, round. The land types Alluvial land, sandy, and Riverwash are not in a tree and shrub group]

Tree and shrub group, soil series, and map symbols	Trees suitable for—				
	Shade	Street borders	Lawns	Hedges and screens	Windbreaks
	SUNNY SITES				
Group 1: Moderately deep and deep, moderately well drained or well drained, medium-textured soils that have moderate to high available water capacity. Amery: AsB, AsC2, AsD2. Arenzville: At. Arland: AuC2, AuD2. Billett: BlA, BlB, BlC2. Campia: CaA. Caryville: Ce. Dakota: DaA, DaB, DbA, DbB. Dickinson: DdA, DdB. Dubuque: DfB, DfC2, DfD2, DfE2. Dunnville: Du, Dv. Eleva: ElB, ElC2. Gotham: GsA, GsB, GsC2. Hixton: HfB, HfC2, HfD2. Hubbard: Hv. Kickapoo: Kc. La Farge: LfB, LfC2, LfC3, LfD2, LfD3, LfE2. Meridian: MeA, MeB, MeC2. Norden: NrB, NrC2, NrD2, NrE2. Otterholt: OsB, OsC2. Palsgrove: PaB, PaC2, PaD2. Pillot: Pc. Renova: RaB, RaC2, RaD2. Santiago: SaB, SaC2. Seaton: SeB, SeC2, SeD2, SeE2, SfA, SfB. Tell: TeA, TeB, TeC2. Terril: Tr. Urne: UeD2, UeF, UnB, UnC2, UnD2, UnE2, UnF.	American beech (LO) Sugar maple (LO) Red maple (MO) Red oak (LR) White oak (LR) Basswood (LO) Hackberry (MR) White ash (LO) Sycamore (LO) Bur oak (LR) Norway maple (MR) Silver maple (LO) Thornless honey-locust (MO)	Norway maple (MR) Southern pin oak (MP). Thornless honey-locust (MO) Basswood (LO) White ash (LO) Sugar maple (LO) Hackberry (MR) Red maple (MO)	Flowering crab (SR) Mountain-ash (SO) Blue beech (SR) Paper birch (MO) River birch (MO) Russian-olive (SR) Southern pin oak (MP) Serviceberry (SR) Horse chestnut (LR) Norway spruce (LP) Red pine (LP) White pine (LP) White spruce (MP) Black cherry (LO) Blue spruce (LP) Norway spruce (LP) Hawthorn (SR)	Redcedar (SP) White-cedar (MC, P) White pine (LP) White spruce (MP) Lombardy poplar (LC) Russian-olive (SR) Upright yew (SP)	White spruce (MP). White-cedar (MC, P). White pine (LP). Red pine (LP). Norway spruce (LP).
	PARTIAL SHADE				
	American beech (LO) Sugar maple (LO) Red maple (MO) Red oak (LR) Hackberry (MR) White ash (LO) Basswood (LO)	Norway maple (MP) White ash (LO) Basswood (LO) Sugar maple (LO)	Blue beech (SP) Serviceberry (SR) White pine (LP) White spruce (MP) Blue spruce (LP) Norway spruce (LP)	White-cedar (MC) White pine (LP) White spruce (MP) Upright yew (SP)	White-cedar (MC, P). White pine (LP). White spruce (MP).

Group 2: Somewhat excessively drained to excessively drained coarse-textured or shallow soils that have low available water capacity. Brems: Bs. Burkhardt: BuB, BuC2. Chetek: CkA, CkB, CkD2, CkE2. Dunbarton: DnB2, DnC2, DnD2, DnE. Elkmound: EmA, EmB, EmC2. Gotham: GoA, GoB, GoC2. Hubbard: HuA, HuB, HuC2, HwC. Northfield: NtA, NtB, NtC2. Plainbo: PdB, PdC2, PdF. Plainfield: PfA, PfB, PfC2. Steep stony rock land: StF. Terrace escarpments: Tn, To.	**Sunny sites**				
	Bur oak (LR) Hackberry (MR) Black oak (LR) Silver maple (LO) Green ash (MO) Thornless honeylocust (MO)	Green ash (MO) White ash (LO) Hackberry (MR) Thornless honey-locust (MO)	Flowering crab (SR) Paper birch (MO) Redcedar (SP) White pine (LP) White spruce (MP) Red pine (LP) Russian-olive (SR)	Redcedar (SP) Russian-olive (SR) Red pine (LP) White pine (LP) Upright yew (SP) White spruce (MP)	Red pine (LP). White pine (LP). Redcedar (SP).
	Partial shade				
	Hackberry (MR)	Hackberry (MR)	White pine (LP) White spruce (MP)	Upright yew (SP) White pine (LP) White spruce (MP)	White pine (LP).
Group 3: Somewhat poorly drained and poorly drained mineral soils. Alluvial land: Ad, Af. Almena: AmB, An. Billett: Bm. Boaz: Bo, Br. Hixton: HmB. Lows: Lo. Marshan: Mc. Morocco: Mo, Mr. Newton: Ne. Poskin: Po. Rib: Rb, Rc. Shiffer: Sh. Stronghurst: Su. Wallkill: Wa.	**Sunny sites**				
	Swamp white oak (LR) Hackberry (MR) Red maple (MO) Basswood (LO) Green ash (MO) White ash (LO) Silver maple (LO) Cottonwood (LO)	Green ash (MO) Basswood (LO) Red maple (MO)	White spruce (MP) Paper birch (MO) Mountain-ash (SO) Weeping willow (MPe) White-cedar (MP) River birch (MO)	White-cedar (MC) White spruce (MP) Lombardy poplar (LC) Laurel willow (MO)	White-cedar (MC). White spruce (MP). White pine (LP).
	Partial shade				
	Swamp white oak (LR) Hackberry (MR) Red maple (MO) Basswood (LO) Green ash (MO) White ash (LO)	Green ash (MO) Basswood (LO) Red maple (MO)	White spruce (MP) Mountain-ash (SO)	White-cedar (MC) White spruce (MP)	White-cedar (MC). White spruce (MP).
Group 4: Poorly drained organic soils. Cathro: Ch. Houghton: Ho. Markey: Ma.	**Sunny sites**				
	Silver maple (LO) Red maple (MO)	Red maple (MO) Laurel willow (MO)	White-cedar (MC) White spruce (MP) Weeping willow (MPe)	White-cedar (MC) Laurel willow (MO)	Laurel willow (MO). Poplar (LP). Tree lilac (SO). White-cedar (MC).
	Partial shade				
	Red maple (MO)	None	White-cedar (MC) White spruce (MP)	White-cedar (MC)	White-cedar (MC).

TABLE 5.—*Shrub and vine*

[The letter X means that the plant has the kind of characteristics,

Tree and shrub group	Plant species	Shade tolerance
Group 1: Moderately deep and deep, moderately well drained or well drained, medium-textured soils that have moderate to high available water capacity.[1]	Arborvitae (shrub type) (*Thuja* spp.)	Some
	Barberry, Japanese (*Berberis thunbergi*)	X
	Bittersweet (*Celastrus scandens*)	X
	Blackberry, dewberry, blackcap raspberry (*Rubus* spp.)	
	Chokeberry, black (*Aronia melanocarpa*)	X
	Cotoneaster (*Cotoneaster* spp.)	
	Crabapple (*Malus* spp.)	
	Currant, alpine (*Ribes alpinum*)	X
	Dogwood, gray (*Cornus racemosa*)	X
	Dogwood, pagoda (*Cornus alternifolia*)	X
	Dogwood, red-osier (*Cornus stolonifera*)	X
	Dogwood, roundleaf (*Cornus rugosa*)	X
	Dogwood, silky (*Cornus amomum*)	X
	Elder, American (*Sambucus canadensis*)	
	Filbert (hazelnut) (*Corylus americana*)	X
	Forsythia (*Forsythia* spp.)	X
	Grape, wild (*Vitis* spp.)	X
	Hawthorn or thornapple (*Crataegus* spp.)	X
	Honeysuckle (shrub type) (*Lonicera* spp.)	X
	Juniper, creeping (*Juniperus horizontalis*)	
	Juniper, Pfitzer (*Juniperus chinensis pfitzeriana*)	
	Lilac (*Syringa* spp.)	
	Maple, Amur (*Acer ginnala*)	
	Mockorange (*Philadelphus* spp.)	
	Myrtle or periwinkle (*Vinca minor*)	X
Group 2: Somewhat excessively drained to excessively drained, coarse-textured or shallow soils that have low available water capacity.[1]	Ninebark, common (*Physocarpus opulifolius*)	X
	Arborvitae (shrub type) (*Thuja* spp.)	Some
	Barberry, Japanese (*Berberis thunbergi*)	X
	Bayberry or waxmyrtle (*Myrica pensylvanica*)	X
	Bittersweet (*Celastrus scandens*)	X
	Blackberry, dewberry, blackcap raspberry (*Rubus* spp.)	
	Cotoneaster (*Cotoneaster* spp.)	
	Crabapple (*Malus* spp.)	
	Currant, alpine (*Ribes alpinum*)	X
	Dogwood, gray (*Cornus racemosa*)	X
	Filbert (hazelnut) (*Corylus americana*)	X
	Forsythia (*Forsythia* spp.)	X
	Grape (*Vitis* spp.)	X
	Hawthorn or thornapple (*Crataegus* spp.)	X
	Honeysuckle (shrub type) (*Lonicera* spp.)	X
	Juniper, creeping (*Juniperus horizontalis*)	
	Juniper, Pfitzer (*Juniperus chinensis pfitzeriana*)	
	Lilac (*Syringa* spp.)	
	Maple, Amur (*Acer ginnala*)	
	Mockorange (*Philadelphus* spp.)	
	Myrtle or periwinkle (*Vinca minor*)	X
	Ninebark, common (*Physocarpus opulifolius*)	X
	Olive, autumn (*Elaeagnus umbellata*)	X
	Peashrub, Siberian (*Caragana arborescens*)	
	Pine, mugho (*Pinus mugo mughus*)	
	Plum, American (*Prunus americana*)	X

See footnotes at end of table.

planting guide

features, or suitability indicated by the column heading]

Growth characteristics				Esthetic value			Suitable for—			
Type of plant	Potential height	Thorny	Thicket forming	Flowers	Fruit or berries	Fall color	Land-scaping	Hedge, screens, wind-break	Road-side planting	Ground cover
	Feet									
Shrub	3–7					X	X	X		
Shrub	6	X			X	X	X	X		
Vine	(2)				X	X	Some		X	X.
Bramble	1–5	X	X	X	X	X			X	X.
Shrub	1–3		X		X	X	X		X	X.
Shrub	4–8				X	X	X	X		
Shrub	To 25			X	X	X	X	X	X	
Foliage shrub	6–7			X			X	X		
Shrub	6–10			X	X	X			X	
Shrub	10–15			X	X	X			X	
Shrub	3–9		X	X	X	X	Some			
Shrub	3–9			X	X	X			X	X.
Shrub	6–10			X	X	X		X	X	
Shrub	3–10		X	X	X				X	
Shrub	5–8		X		X	X			X	
Shrub	4–8			X			X			
Vine	(2)				X	X			X	X.
Shrub	5–20	X			X	X	X		X	
Shrub	6–12			X	X	X	X	X		
Shrub	1–2	To touch			X	X	X		X	X.
Shrub	8–10					X	X			
Shrub	8–10		Some	X			X	X	X	
Tall shrub	15+					X	X	X		
Shrub	6–9			X			X	X		
Short vine	1		Forms mat.	X			X		X	X.
Shrub	6–9		X	X		X	X	X	X	
Shrub	3–7					X	X	X		
Shrub	6	X			X	X	X	X		
Shrub	5–9				X	X	X			X.
Vine	(2)				X	X	Some		X	X.
Bramble	1–5	X	X	X	X	X			X	X.
Shrub	4–8				X	X	X	X		
Shrub	To 25			X	X	X	X	X	X	
Foliage shrub	6–7			X			X	X		
Shrub	6–10			X	X	X			X	
Shrub	5–8		X		X	X			X	
Shrub	4–8			X			X			
Vine	(2)				X	X			X	X.
Shrub	5–20	X			X	X	X		X	
Shrub	6–12			X	X	X	X	X		
Shrub	1–2	To touch			X	X	X		X	X.
Shrub	8–10		Some			X	X			
Shrub	8–10		Some	X			X	X	X	
Tall shrub	15+					X	X	X		
Shrub	6–9			X			X	X		
Short vine	1		Forms mat.	X			X		X	X.
Shrub	6–9			X		X	X	X	X	
Shrub	10–15				X	X	X	X		
Shrub	10–15				X	X	X	X	X	
Shrub	6–9					X	X			
Shrub	10–15	Some	X	X	X	X		X	X	

TABLE 5.—*Shrub and vine*

Tree and shrub group	Plant species	Shade tolerance
Group 3: Somewhat poorly drained and poorly drained mineral soils.[1]	Arborvitae (shrub type) (*Thuja* spp.)	Some
	Bayberry or waxmyrtle (*Myrica pensylvanica*)	X
	Chokeberry, black (*Aronia melanocarpa*)	X
	Dogwood, gray (*Cornus racemosa*)	X
	Dogwood, pagoda (*Cornus alternifolia*)	X
	Dogwood, red-osier (*Cornus stolonifera*)	X
	Dogwood, roundleaf (*Cornus rugosa*)	X
	Dogwood, silky (*Cornus amomum*)	X
	Elder, American (*Sambucus canadensis*)	
	Hawthorn or thornapple (*Crataegus* spp.)	X
	Honeysuckle (shrub type) (*Lonicera* spp.)	X
	Ninebark, common (*Physocarpus opulifolius*)	X
	Olive, autumn (*Elaegnus umbellata*)	X
	Plum, American (*Prunus americana*)	X
	Russian-olive (*Elaeagnus angustifolia*)	
	Spirea, narrowleaf meadowsweet (*Spirea alba*)	
	Spirea, Vanhoutte (*Spirea van houtei*)	X
	Viburnum, American cranberrybush (*Viburnum trilobum*).	X
	Viburnum, mapleleaf (*Viburnum acerifolium*)	X
	Viburnum, nannyberry (*Viburnum lentago*)	X
	Viburnum, wayfaringtree (*Viburnum lantana*)	X
	Willow (shrub type, including pussywillow) (*Salix* spp.)	
	Winterberry, common (*Ilex verticillata*)	X
Group 4: Poorly drained organic soils [1]	Arborvitae (shrub type) (*Thuja* spp.)	Some
	Dogwood, red-osier (*Cornus stolonifera*)	X
	Dogwood, roundleaf (*Cornus rugosa*)	X
	Dogwood, silky (*Cornus amomum*)	X
	Elder, American (*Sambucus canadensis*)	
	Honeysuckle (shrub type) (*Lonicera* spp.)	X
	Ninebark, common (*Physocarpus opulifolius*)	X
	Spirea, narrowleaf meadowsweet (*Spirea alba*)	
	Viburnum, American cranberrybush (*Viburnum trilobum*).	X
	Viburnum, mapleleaf (*Viburnum acerifolium*)	X
	Viburnum, nannyberry (*Viburnum lentago*)	X
	Viburnum, wayfaringtree (*Viburnum lantana*)	X
	Willow (shrub type, including pussywillow) (*Salix* spp.)	
	Winterberry, common (*Ilex verticillata*)	X

[1] See table 4, Trees suitable for planting, for the names of the soils in the tree and shrub groups.

planting guide—Continued

Growth characteristics				Esthetic value			Suitable for—			
Type of plant	Potential height	Thorny	Thicket forming	Flowers	Fruit or berries	Fall color	Land-scaping	Hedge, screens, wind-break	Road-side planting	Ground cover
Shrub	3–7					X	X	X		
Shrub	5–9				X	X	X			X.
Shrub	1–3				X	X			X	X.
Shrub	6–10			X	X	X			X	
Shrub	10–15			X	X	X			X	
Shrub	3–9			X	X	X	Some		X	
Shrub	3–9			X	X	X			X	
Shrub	6–10				X	X		X	X	
Shrub	3–10			X	X				X	
Shrub	5–20				X	X			X	
Shrub	6–12			X	X	X	X	X		
Shrub	6–9			X		X	X	X	X	
Shrub	10–15				X	X		X		
Shrub	10–15	X	X	X	X	X		X	X	
Shrub	15+	X			X	X	X	X		
Shrub	3–4			X		X			X	
Shrub	5–6			X		X	X	X		
Shrub	7–9			X	X	X	X	X	X	
Shrub	3–5			X	X	X			X	
Shrub	9–12			X	X	X		X	X	
Shrub	8–10			X	X	X		X	X	
Shrub	2–8							X	X	
Shrub	6–9				X	X			X	
Shrub	3–7					X	X	X		
Shrub	3–9			X	X	X	Some		X	
Shrub	3–9			X	X	X			X	
Shrub	6–10				X	X		X	X	
Shrub	3–10			X	X				X	
Shrub	6–12			X	X	X	X	X		
Shrub	6–9			X		X	X	X	X	
Shrub	3–4			X		X			X	
Shrub	7–9			X	X	X	X	X	X	
Shrub	3–5			X	X	X			X	
Shrub	9–12			X	X	X		X	X	
Shrub	8–10			X	X	X		X	X	
Shrub	2–8							X	X	
Shrub	6–9				X	X			X	

[2] Climbs.

TABLE 6.—*Degree and kind of limitations for recreational uses*

Recreation groups, descriptions of soils, and map symbols	Playgrounds, athletic fields, and intensive play areas	Picnic grounds, parks, and extensive play areas	Golf fairways	Tent and trailer campsites
Group 1: Deep to moderately deep, well-drained loams and silt loams. Amery: AsB, AsC2, AsD2. Campia: CaA. Dakota: DaA, DaB, DbA, DbB. Dubuque: DfB, DfC2, DfD2, DfE2. Dunnville: Du, Dv. Hixton: HfB, HfC2, HfD2. La Farge: LfB, LfC2, LfC3, LfD2, LfD3, LfE2. Meridian: MeA, MeB, MeC2. Norden: NrB, NrC2, NrD2, NrE2. Otterholt: OsB, OsC2. Palsgrove: PaB, PaC2, PaD2. Pillot: Pc. Renova: RaB, RaC2, RaD2. Santiago: SaB, SaC2. Seaton: SeB, SeC2, SeD2, SeE2, SfA, SfB. Tell: TeA, TeB, TeC2. Urne: UnB, UnC2, UnD2, UnE2, UnF.	Slight if slope is 0 to 2 percent, moderate if 2 to 6, severe if more than 6.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Moderate if slope is 0 to 6 percent, severe if more than 6; slippery when wet.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.
Group 2: Moderately deep, well-drained sandy loams. Arland: AuC2, AuD2. Billett: BlA, BlB, BlC2, Bm. Dickinson: DdA, DdB. Eleva: ElB, ElC2.	Slight if slope is 0 to 2 percent, moderate if 2 to 6, severe if more than 6.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.
Group 3: Shallow, well-drained, loamy soils. Burkhardt: BuB, BuC2. Chetek: CkA, CkB, CkD2, CkE2. Dunbarton: DnB2, DnC2, DnD2, DnE. Elkmound: EmA, EmB, EmC2. Northfield: NtA, NtB, NtC2. Urne: UeD2, UeF.	Slight if slope is 0 to 2 percent, moderate if 6 to 12, severe if more than 12.	Moderate if slope 0 to 6 percent, severe if more than 6: low available water capacity; difficult to maintain vegetation.	Moderate if slope is 0 to 6 percent, severe if more than 6; low available water capacity; difficult to maintain vegetation.	Moderate if slope is 0 to 6 percent, severe if more than 6: low available water capacity; difficult to maintain. vegetation.
Group 4: Moderately well drained to excessively drained, sandy soils. Brems: Bs. Gotham: GoA, GoB, GoC2, GsA, GsB, GsC2. Hubbard: HuA, HuB, HuC2, Hv, HwC. Plainbo: PdB, PdC2, PdF. Plainfield: PfA PfB, PfC2.	Moderate if slope is 0 to 6 percent, severe if more than 6; droughty; erodible; difficult to maintain vegetation.	Moderate if slope is 0 to 12 percent, severe if more than 12; erodible; difficult to maintain vegetation.	Severe: erodible; droughty; difficult to maintain turf; some small areas suitable for sand traps and hazards.	Moderate if slope is 0 to 6 percent, severe if more than 6; droughty; erodible; difficult to maintain vegetation.

TABLE 6.—*Degree and kind of limitations for recreational uses*—Continued

Recreation groups, descriptions of soils, and map symbols	Playgrounds, athletic fields, and intensive play areas	Picnic grounds, parks, and extensive play areas	Golf fairways	Tent and trailer campsites
Group 5: Somewhat poorly drained, mainly loamy soils. Almena: AmB, An. Hixton: HmB. Morocco: Mo, Mr. Poskin: Po. Shiffer: Sh. Stronghurst: Su.	Moderate: seasonal water table; easily compacted when wet.	Moderate: seasonal water table; easily compacted when wet.	Moderate: seasonal water table; turf easily damaged when wet; low relief.	Moderate: soils are wet and soft for short periods; poor trafficability when wet; walks and roads slippery when wet.
Group 6: Poorly drained, loamy and sandy soils. Lows: Lo. Marshan: Mc. Newton: Ne. Rib: Rb, Rc.	Severe: high water table; hazard of ponding.	Severe: high water table; heavy foot traffic damages sod in places; hazard of ponding.	Severe: high water table; poor trafficability when wet; heavy traffic during wet periods damages turf in places; hazard of ponding.	Severe: high water table; soils are wet and soft for long periods; poor trafficability when wet.
Group 7: Poorly drained, loamy and sandy soils on flood plains. Alluvial land: Af. Boaz: Bo, Br. Riverwash: Re. Wallkill: Wa.	Severe: frequent flooding; easily compacted when wet.	Severe: frequent flooding; easily compacted when wet.	Severe: frequent flooding; very low relief; poor trafficability and turf easily damaged when wet.	Very severe: frequent flooding.
Group 8: Well drained to moderately well drained, loamy and sandy soils. Alluvial land: Ad, Ae. Arenzville: At. Caryville: Ce. Kickapoo: Kc. Terril: Tr.	Moderate: occasional flooding.	Moderate: occasional flooding.	Moderate: occasional flooding.	Severe: occasional flooding.
Group 9: Very poorly drained, organic soils. Cathro: Ch. Houghton: Ho. Markey: Ma.	Very severe: high water table; poor trafficability; sod easily damaged.	Severe: high water table; poor trafficability.	Severe: high water table; surface ponding.	Very severe: high water table; surface very soft; poor trafficability.
Group 10: Steep miscellaneous land types. Steep stony rock land: StF. Terrace escarpments: Tn, To.	Very severe: too steep; erosion hazard.	Very severe: too steep; erosion hazard.	Very severe: too steep; erosion hazard.	Very severe: too steep; erosion hazard.

TABLE 7.—*Suitability of the soils for producing*

[Group 2 soils in the Wisconsin system are omitted

Wildlife group, description of soils, series, and map symbols	Grain and seed crops	Grasses and legumes
Group 1: Well drained and moderately well drained, loamy soils that are not subject to flooding. Amery: AsB, AsC2, AsD2. Arland: AuC2, AuD2. Billett: BlA, BlB, BlC2, Bm. Campia: CaA. Dubuque: DfB, DfC2, DfD2, DfE2. Dunnville: Du, Dv. Eleva: ElB, ElC2. Hixton: HfB, HfC2, HfD2. La Farge: LfB, LfC2, LfC3, LfD2, LfD3, LfE2. Meridian: MeA, MeB, MeC2. Norden: NrB, NrC2, NrD2, NrE2. Otterholt: OsB, OsC2. Palsgrove: PaB, PaC2, PaD2. Pillot: Pc. Renova: RaB, RaC2, RaD2. Santiago: SaB, SaC2. Seaton: SeB, SeC2, SeD2, SeE2, SfA, SfB. Tell: TeA, TeB, TeC2. Urne: UnB, UnC2, UnD2, UnE2, UnF.	Good if slope is 0 to 6 percent, fair if 6 to 12, poor if more than 12; water erosion hazard.	Good if slope is 0 to 12 percent, fair if 12 to 20, poor if more than 20.
Group 3: Excessively drained, sandy soils and soils that have a shallow root zone. Brems: Bs. Burkhardt: BuB, BuC2. Chetek: CkA, CkB, CkD2, CkE2. Dunbarton: DnB2, DnC2, DnD2, DnE. Elkmound: EmA, EmB, EmC2. Gotham: GoA, GoB, GoC2, GsA, GsB, GsC2. Hubbard: HuA, HuB, HuC2, Hv. Northfield: NtA, NtB, NtC2. Plainbo: PdB, PdC2, PdF. Plainfield: PfA, PfB, PfC2. Urne: UeD2, UeF.	Good if slope is 0 to 6 6 percent, fair if 6 to 12, poor if more than 12; water erosion hazard.	Good if slope is 0 to 12 percent, fair if 12 to 20, poor if more than 20.
Group 4: Well drained to moderately well drained, loamy soils that have a thick, dark-colored surface layer. Dakota: DaA, DaB, DbA, DbB. Dickinson: DdA, DdB.	Good if slope is 0 to 6 percent, fair if 6 to 12, poor if more than 12; water erosion hazard.	Good if slope is 0 to 12 percent, fair if 12 to 20, poor if more than 20.
Group 5a: Somewhat poorly drained, loamy and sandy soils Almena: AmB, An. Hixton: HmB. Morocco: Mo, Mr. Poskin: Po. Shiffer: Sh. Stronghurst: Su.	Good if drained; fair if not drained; seasonally wet.	Good if drained; fair if not drained; seasonally wet; some species not suited.
Group 5b: Poorly drained, loamy and sandy soils Alluvial land: Af. Boaz: Bo, Br. Lows: Lo. Marshan: Mc. Newton: Ne. Rib: Rb, Rc. Wallkill: Wa.	Good if drained; unsuitable if not drained; very wet.	Fair if drained; poor if not drained; very wet.
Group 6: Organic soils Cathro: Ch. Houghton: Ho. Markey: Ma.	Fair if drained; unsuitable if not drained; wetness.	Fair if drained; unsuitable if not drained; wetness; few species suited.

elements of wildlife habitat

because they are not represented in Dunn County]

Wild herbaceous upland plants	Hardwoods (trees and shrubs)	Conifers	Wetland food and cover plants	Shallow and deep water developments
Good if slope is 0 to 20 percent, fair if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.	Poor if slope is 0 to 2 percent, unsuitable if more than 2 percent; few species suited.	Poor if slope is 0 to 2 percent, unsuitable if more than 2 percent; moderate permeability in subsoil.
Good if slope is 0 to 20 percent, fair if more than 20 percent.	Good if slope is 0 to 20 percent, fair if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.	Poor if slope is 0 to 2 percent, unsuitable if more than 2 percent; few species suited.	Poor if slope is 0 to 2 percent, unsuitable if more than 2 percent; moderate permeability in subsoil.
Good if slope is 0 to 20 percent, fair if more than 20.	Fair if slope is 0 to 20 percent, poor if more than 20 percent; grass competition.	Fair; grass competition.	Poor if slope is 0 to 2 percent, unsuitable if more than 2 percent; few species suited.	Poor if slope is 0 to 2 percent, unsuitable if more than 2 percent; moderate permeability.
Fair; seasonally wet; some species not suited.	Fair; seasonally wet; some species not suited.	Fair; seasonally wet; some species not suited.	Fair if slope is 0 to 2 percent, poor if more than 2 percent; some species not suited.	Fair if slope is 0 to 2 percent, poor if more than 2 percent; moderately slow permeability.
Unsuitable; very few species suited.	Poor; very wet; few species suited.	Poor; very wet; few species suited.	Good	Good.
Unsuitable; wetness; few species suited.	Poor; wetness; few species suited.	Fair; wetness; some species not suited.	Good if slope is 0 to 2 percent, fair if more than 2 percent; wetness.	Good if slope is 0 to 2 percent, fair if more than 2 percent; wetness.

TABLE 7.—*Suitability of the soils for producing*

Wildlife group, description of soils, series, and map symbols	Grain and seed crops	Grasses and legumes
Group 7: Well drained and moderately well drained, sandy to clayey soils that are subject to flooding. Alluvial land: Ad, Ae. Arenzville: At. Caryville: Ce. Kickapoo: Kc. Terril: Tr.	Good; water erosion hazard; flooding hazard.	Good; flooding hazard.
Group 8: Droughty or stony and rocky land types and very shallow soils Hubbard: HwC. Riverwash: Re. Steep stony rock land: StF. Terrace escarpments: Tn, To.	Poor if slope is 0 to 6 percent, unsuitable if more than 6 percent; droughty; water erosion hazard.	Fair if slope is 0 to 12 percent, poor if more than 12 percent; droughty; some species not suited.

TABLE 8.—*Importance of selected*

[Numeral 1 indicates little or no value; 2, some value; 3, important; and 4,

Wildlife species	Grain and seed crops		Grasses and legumes	
	Harvested	Unharvested	Harvested	Unharvested
Migratory waterfowl:				
Ducks	3	3	1	3
Geese	4	4	4	1
Upland game birds:				
Pheasants	4	4	----	*4
Quail	4	4	2	4
Ruffed grouse	1	1	1	2
Woodcock	----	----	1	3
Small game:				
Rabbits, cottontail	3	4	3	*4
Rabbits, snowshoe	----	----	----	1
Raccoon	3	4	----	1
Squirrels, fox and gray	3	4	----	1
Big game: Deer	3	4	3	3
Furbearers:				
Beaver	----	----	----	----
Fox, red	2	3	2	3
Mink	----	----	----	----
Muskrat	1	1	----	----

elements of wildlife habitat—Continued

Wild herbaceous upland plants	Hardwoods (trees and shrubs)	Conifers	Wetland food and cover plants	Shallow and deep water developments
Good; flooding hazard	Fair; flooding hazard	Fair; flooding hazard; some species not suited.	Poor if slope is 0 to 2 percent, unsuitable if more than 2 percent; few species suited.	Poor if slope is 0 to 2 percent, unsuitable if more than 2 percent; moderate permeability.
Fair if slope is 0 to 20 percent, poor if more than 20 percent; droughty; some species not suited.	Poor; droughty; few species suited.	Poor; droughty; few species suited.	Unsuitable; droughty	Unsuitable; rapid permeability.

elements of wildlife habitat

very important. Asterisk indicates a key or critical element]

Wild herbaceous upland plants	Woody plants			Herbaceous wetland plants	Water areas	
	Shrubs	Hardwoods	Conifers		Shallow water	Deep water
3		1		*4	*4	4
				2	3	4
*4	4		1	*4	3	
4	*4	2	1	4	3	
2	*4	*4	3			
3	4	4	2	3		
*4	*4	3	1	2	3	
1	*4	3	*4	1		
1	2	4		1	*4	4
1	2	*4	1			
4	4	4	4	3	3	2
	4	*4		4	4	*4
3	3	2	1	3	3	1
	2	1	1	3	*4	*4
	1			4	*4	*4

Engineering Uses of the Soils [5]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. Among the soil properties most important to the engineer are permeability to water, shear strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and reaction (pH). Also important are the depth to the water table, flooding hazard, depth to bedrock or to sand and gravel, and relief.

Information in this section can be used to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in planning agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables, and in planning detailed investigations at the selected locations.
4. Locate probable sources of gravel and other construction materials.
5. Correlate performance of engineering structures with soil mapping units to develop information for overall planning that will be useful in designing and maintaining certain engineering practices and structures.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and reports and from aerial photographs.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

With the use of the soil map for identification, the engineering interpretations here reported can be useful for many purposes. It should be emphasized that they do not eliminate the need for sampling and testing at

[5] ROBERT C. BINTZLER, assistant state conservation engineer, helped prepare this section.

TABLE 9.—*Engineering*

[Tests performed by the State Highway Commission of Wisconsin in cooperation with the U.S. Department of Commerce, Bureau of

Soil name and location	Parent material	Depth from surface	Moisture density data [1]		Mechanical analysis [2]			
			Maximum dry density	Optimum moisture	Percentage passing sieve—			
					2-in.	1-in.	¾-in.	⅜-in.
		Inches	*Lb. per cu. ft.*	*Percent*				
Chetek sandy loam:								
SW¼NE¼ sec. 33, T. 27 N., R. 14 W. (modal profile)	Sandy drift.	6–12	132	9	100	96	95	92
		12–30	122	10	100	98	97	97
Dunnville loam:								
SE¼NE¼ sec. 26, T. 30 N., R. 13 W. (modal profile)	Loamy outwash over sand.	24–28	125	10	----------	----------	----------	----------
		28–40	111	12	----------	----------	----------	----------
NE¼SE¼ sec. 3, T. 26 N., R. 11 W. (nonmodal, fine-textured solum)	Loamy outwash over sand.	18–23	----------	----------	----------	----------	----------	----------
		23–48	----------	----------	----------	----------	----------	----------
Santiago silt loam:								
NE¼SW¼ sec. 14, T. 31 N., R. 14 W. (modal profile)	Silt over sandy loam.	15–20	114	14	----------	----------	100	99
		20–25	124	11	----------	100	99	98
		28–60	129	9	100	97	97	95

[1] Based on AASHO Designation: T 99–70, Method C (*1*).

[2] Mechanical analyses according to AASHO Designation: T 88–70 (*1*). Results by this procedure may differ somewhat from results 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

the site of specific engineering works involving heavy loads or excavations deeper than the depths of layers here reported. Even in these situations, however, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

More than one kind of soil may occur within short distances at many construction sites in this county because soil mapping units generally include small areas of a different kind of soil. These areas of included soils may be as much as 2 acres in size. Although the differences may not be significant in farming, they may be important in planning engineering works.

Some of the terms used in this soil survey have a special meaning to soil scientists and a different meaning to engineers. The Glossary defines many of these terms according to their meaning in soil science.

Much of the information in this section is presented in tables 9 through 13, inclusive. Only the data in table 9 are from actual laboratory tests. Table 10 gives estimates of soil properties significant in engineering. Tables 11 and 12 give interpretations of the soils for engineering uses and for farm uses, and table 13 gives the degree and kind of limitations of the soils for nonfarm uses.

Engineering Classification Systems

Soil scientists of the U.S. Department of Agriculture classify soils according to texture. In this system the textural class of a soil is based on the proportions of sand, silt, and clay in the soil.

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (AASHO) (*1*). In this system soil materials are classified in seven principal groups based on the size gradation, liquid limit, and plasticity index of the soils. The groups are designated A–1 through A–7. The best soils for subgrade (gravelly soils of high bearing capacity) are classified as A–1; the next best, A–2; and so on to the poorest, A–7, which are clayey 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 materials to 20 for the poorest. The group index number is shown in parentheses after the soil group symbol. It is given in table 9 for the soils tested.

test data

Public Roads (BPR), in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [2]—Continued								Liquid limit	Plasticity index	AASHO	Unified [3]
Percentage passing sieve—Continued				Percentage smaller than—							
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.				
								Percent			
91	89	56	19	18	15	11	10	20	6	A–2–4(0)	SC–SM
97	96	56	9	8	7	6	6	----------	[4] NP	A–3(0)	SP–SM
----------	100	91	22	21	16	8	4	----------	NP	A–2–4(0)	SM
----------	100	76	4	3	2	2	2	----------	NP	A–3(0)	SP
----------	100	97	51	41	23	11	7	----------	----------	----------	
----------	100	84	4	4	3	2	1	----------	----------	----------	
98	97	92	78	72	42	19	16	25	7	A–4(8)	CL–ML
96	93	82	43	39	26	18	14	23	9	A–4(2)	SC
93	89	74	29	26	8	13	10	18	5	A–2–4(0)	SC–SM

millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for naming textural classes for soils.

[3] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of A-line are to be given a borderline classification. An example of a borderline classification so obtained is SC–SM.

[4] Nonplastic.

TABLE 10.—*Estimated properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that appear in the first column of this table. Dashed lines mean

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (representative profile)	Classification	
			Dominant USDA texture	Unified
	Feet	*Inches*		
Alluvial land: Ad, Ae, Af. Properties are too variable for reliable evaluation.				
Almena: AmB	1–3	0–18	Silt loam	ML
		18–60	Silt loam	CL
		60–100	Sandy clay loam	SC
Almena, wet variant: An	0–1	0–12	Silt loam	ML
		12–31	Heavy silt loam	CL
		31–60	Gravelly sandy loam	SM
Amery: AsB, AsC2, AsD2	>5	0–26	Loam	ML
		26–60	Sandy loam	SM
Arenzville: At	>5	0–9	Silt loam	ML–CL
		9–60	Silt loam	CL
Arland: AuC2, AuD2	>5	0–10	Sandy loam	SM
		10–23	Heavy sandy loam	SM
		23–60	Gravelly loamy sand and sandstone.	
Billett: BlA, BlB, BlC2	>5	0–11	Sandy loam	SM
		11–28	Loam	ML
		28–60	Sand	SP
Billett, mottled subsoil variant: Bm	>5	0–28	Sandy loam	SM
		28–42	Loamy sand	SM
		42–60	Sand	SP
Boaz: Bo	1–3	0–9	Silt loam	ML
		9–35	Heavy silt loam	ML–CL
		35–60	Silt loam	ML
Boaz, dark variant: Br	0–1	0–11	Silt loam	CL–ML
		11–15	Silty clay loam	CH
		15–60	Silt loam	CL
Brems: Bs	3–5	0–7	Loamy sand	SM
		7–60	Sand	SP
Burkhardt: BuB, BuC2	>5	0–10	Sandy loam	SM
		10–20	Sandy loam	SM
		20–60	Sand and gravel	SP–SM
Campia: CaA	>5	0–26	Loam	ML
		26–60	Silty clay loam	CL
Caryville: Ce	>5	0–18	Loam	ML
		18–60	Sand	SP
Cathro: Ch	0–1	0–32	Muck	Pt
		32–52	Silt loam	ML
Chetek: CkA, CkB, CkD2, CkE2	>5	0–8	Sandy loam	SM
		8–19	Sandy loam	SM–SC
		19–60	Sand and gravel	SP–SM
Dakota: DaA, DaB, DbA, DbB	>5	0–14	Loam	ML
		14–32	Loam	ML–CL
		32–60	Sand and gravel	SP
Dickinson: DdA, DdB	>5	0–16	Sandy loam	SC–SM
		16–31	Loamy sand	SM
		31–60	Sand	SP

significant in engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions that information is not available or does not apply. The symbol > means more than]

Classification—Continued	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
	Percent	*Percent*	*Percent*	*Inches per hour*	*Inches per inch of soil*	*pH vaule*	
A-4		95–100	90–100	0. 63–2. 0	0. 18–0. 22	5. 6–7. 3	Low.
A-7		90–100	90–100	0. 20–0. 63	0. 18–0. 22	5. 6–7. 3	Moderate.
A-4 or A-2	85–90	70–85	30–40	0. 63–2. 0	0. 10–0. 14	5. 6–6. 0	Low.
A-4		95–100	90–100	0. 63–2. 0	0. 18–0. 22	5. 1–5. 5	Low.
A-7		95–100	90–100	0. 20–0. 63	0. 18–0. 22	5. 1–5. 5	Moderate.
A-2	70–80	65–75	25–35	2. 0–6. 3	0. 08–0. 12	5. 1–5. 5	Low.
A-4	90–100	85–95	55–65	0. 63–2. 0	0. 16–0. 20	5. 1–6. 0	Low.
A-2	85–95	85–95	30–35	0. 63–2. 0	0. 08–0. 12	5. 1–5. 5	Low.
A-4	100	95–100	70–100	0. 63–2. 0	0. 20–0. 24	6. 6–7. 3	Low.
A-4	100	95–100	70–100	0. 63–2. 0	0. 18–0. 22	6. 6–7. 3	Low.
A-4	90–100	75–85	35–45	0. 63–2. 0	0. 13–0. 15	5. 1–6. 5	Low.
A-4	90–100	70–80	45–50	0. 63–2. 0	0. 16–0. 20	5. 1–5. 5	Low.
A-2	90–100	75–85	25–35	2. 0 –6. 3	0. 12–0. 16	6. 1–7. 3	Low.
A-4	90–100	90–100	55–65	0. 63–2. 0	0. 16–0. 20	5. 6–6. 0	Low.
A-3	80–90	65–75	1–5	6. 3 –20. 0	0. 02–0. 04	5. 6–6. 0	Low.
A-2	90–100	75–85	25–35	2. 0 –6. 3	0. 12–0. 16	4. 6–5. 5	Low.
A-2	90–100	70–80	15–25	2. 0 –6. 3	0. 10–0. 12	5. 1–5. 5	Low.
A-3	80–90	65–75	1–5	6. 3 –20. 0	0. 02–0. 04	5. 1–5. 5	Low.
A-4		95–100	90–95	0. 63–2. 0	0. 23–0. 25	6. 6–7. 3	Low.
A-6		95–100	90–95	0. 63–2. 0	0. 20–0. 22	6. 1–7. 3	Moderate.
A-4		95–100	90–95	0. 63–2. 0	0. 20–0. 22	6. 1–6. 5	Moderate.
A-7		95–100	90–95	0. 63–2. 0	0. 20–0. 24	7. 4–7. 8	Low.
A-7		95–100	90–95	0. 63–2. 0	0. 16–0. 20	7. 4–7. 8	High
A-6		95–100	90–100	0. 20–0. 63	0. 18–0. 22	7. 4–7. 8	Moderate.
A-2		90–100	20–25	6. 3–20. 0	0. 10–0. 12	5. 1–5. 5	Low.
A-3	95–100	85–95	1–5	6. 3–20. 0	0. 05–0. 07	5. 1–6. 0	Low.
A-2	90–100	70–80	25–35	2. 0–6. 3	0. 12–0. 16	6. 1–7. 3	Low.
A-2	85–95	65–75	25–35	2. 0–6. 3	0. 10–0. 12	6. 1–6. 5	Low.
A-1	85–95	30–40	5–10	6. 3–20. 0	0. 02–0. 04	6. 1–6. 5	Low.
A-4	90–100	90–100	90–100	0. 63–2. 0	0. 18–0. 22	4. 6–7. 3	Low.
A-6 or A-7		95–100	90–100	0. 63–2. 0	0. 16–0. 20	4. 6–5. 0	Moderate.
A-4	90–100	80–90	55–65	0. 63–2. 0	0. 20–0. 22	5. 6–7. 3	Low.
A-3	90–100	75–85	1–5	6. 3–20. 0	0. 06–0. 08	6. 1–6. 5	Low.
				2. 0–6. 3	0. 25–0. 35	6. 6–7. 8	Low.
A-4	90–100	80–90	75–85	0. 63–2. 0	0. 18–0. 20	7. 4–7. 8	Low.
A-2	90–100	70–80	25–35	2. 0–6. 3	0. 10–0. 16	6. 1–6. 5	Low.
A-2 or A-4	85–95	65–75	30–40	2. 0–6. 3	0. 08–0. 12	5. 1–5. 5	Low.
A-3	80–90	30–40	5–10	6. 3–20. 0	0. 02–0. 04	5. 1–5. 5	Low.
A-4	90–100	85–95	55–65	0. 63–2. 0	0. 18–0. 22	6. 6–7. 3	Low.
A-4	90–100	80–90	55–65	0. 63–2. 0	0. 16–0. 20	5. 6–6. 5	Low.
A-3	70–80	60–70	1–5	6. 3–20. 0	0. 04–0. 06	5. 6–6. 0	Low.
A-2		90–100	25–35	2. 0–6. 3	0. 12–0. 16	5. 6–6. 0	Low.
A-2		90–100	15–25	2. 0–6. 3	0. 08–0. 12	5. 1–5. 5	Low.
A-3	90–100	70–90	1–5	6. 3–20. 0	0. 04–0. 06	5. 6–6. 0	Low.

TABLE 10.—*Estimated properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (representative profile)	Classification	
			Dominant USDA texture	Unified
	Feet	*Inches*		
Dubuque: DfB, DfC2, DfD2, DfE2	>5	0–17	Silt loam	CL–ML
		17–30	Clay	CH
		30–60	Dolomite.	
Dunbarton: DnB2, DnC2, DnD2, DnE	>5	0–10	Silt loam	CL–ML
		10–18	Clay	CH
		18	Dolomite.	
Dunnville: Du	>5	0–24	Loam	ML
		24–32	Sandy loam	SM
		32–60	Sand	SP
Dunnville, silty subsoil variant: Dv	>5	0–32	Silt loam	ML
		32–45	Very fine sandy loam	SM
		45–60	Sand	SP
Eleva: ElB, ElC2	>6	0–7	Sandy loam	SM
		7–32	Sandy loam	SM
		32–38	Sand	SP–SM
		38–60	Sandstone.	
Elkmound: EmA, EmB, EmC2	>5	0–7	Loam	ML
		7–14	Loam	ML
		14	Sandstone.	
Gotham:				
GoA, GoB, GoC2	>5	0–16	Loamy sand	SM
		16–60	Sand	SP–SM
GsA, GsB, GsC2	>5	0–14	Loamy sand	SM
		14–46	Sand	SP
		46–56	Silt loam	ML
		56–60	Sand	SP
Hixton: HfB, HfC2, HfD2	>5	0–12	Loam	ML
		12–31	Loam	CL–ML
		31–60	Sandstone.	
Hixton, mottled subsoil variant: HmB	>5	0–10	Loam	ML
		10–21	Loam	CL–ML
		21–38	Sand	SP
		38–60	Sandstone.	
Houghton: Ho	0–1	0–28	Muck	Pt
		28–60	Mucky peat	Pt
Hubbard: HuA, HuB, HuC2, Hv, HwC	>5	0–24	Loamy sand	SM
		24–60	Sand	SP
Kickapoo: Kc	>6	0–26	Fine sandy loam	SM
		26–52	Loam	ML
		52–60	Sand	SP–SM
La Farge: LfB, LfC2, LfC3, LfD2, LfD3, LfE2	>5	0–12	Silt loam	ML–CL
		12–36	Silty clay loam	CL
		36–60	Sandstone.	
Lows: Lo	0–1	0–13	Loam	ML–CL
		13–28	Loam	ML–CL
		28–60	Sand	SP
Markey: Ma	0–1	0–25	Muck	Pt
		25–60	Sand	SP
Marshan: Mc	0–1	0–16	Silt loam	ML–CL
		16–39	Silt loam	ML
		39	Sand	SP
Meridian: MeA, MeB, MeC2	>5	0–11	Loam	ML
		11–36	Loam	ML–CL
		36–60	Sand	SP–SM

significant in engineering—Continued

Classification—Continued	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm)				
	Percent	*Percent*	*Percent*	*Inches per hour*	*Inches per inch of soil*	*pH value*	
A–4		95–100	90–100	0. 63–2. 0	0. 18–0. 22	5. 6–6. 0	Low.
A–7	95–100	85–95	80–90	0. 20–0. 63	0. 10–0. 14	5. 6–6. 0	High.
A–4	95–100	90–100	90–100	0. 63–2. 0	0. 20–0. 24	5. 6–7. 3	Low.
A–7	95–100	90–100	85–95	0. 20–0. 63	0. 10–0. 14	6. 6–7. 3	High.
A–4		80–100	55–65	0. 63–2. 0	0. 18–0. 22	5. 6–6. 5	Low.
A–2		80–100	20–30	2. 0–6. 3	0. 10–0. 14	5. 6–6. 0	Low.
A–3	100	80–100	1–5	6. 3–20. 0	0. 04–0. 06	5. 6–6. 0	Low.
A–4		95–100	90–100	0. 63–2. 0	0. 20–0. 24	5. 1–6. 0	Low.
A–4		85–95	40–50	0. 63–2. 0	0. 10–0. 14	5. 1–6. 5	Low.
A–3	95–100	85–95	1–5	6. 3–20. 0	0. 04–0. 06	6. 1–6. 5	Low.
A–2	90–100	85–95	25–35	2. 0–6. 3	0. 12–0. 16	5. 6–6. 0	Low.
A–4	90–100	85–95	35–45	2. 0–6. 3	0. 10–0. 14	5. 1–5. 5	Low.
A–3	80–90	85–95	5–10	6. 3–20. 0	0. 04–0. 06	5. 1–5. 5	Low.
A–4	90–100	80–90	55–65	0. 63–2. 0	0. 18–0. 22	6. 1–6. 5	Low.
A–4	90–100	75–85	55–65	0. 63–2. 0	0. 18–0. 22	5. 6–6. 0	Low.
A–2		90–100	20–25	6. 3–20. 0	0. 08–0. 12	5. 6–6. 0	Low.
A–3		90–100	5–10	6. 3–20. 0	0. 04–0. 06	5. 1–5. 5	Low.
A–2		90–100	20–25	6. 3–20. 0	0. 08–0. 12	5. 6–6. 0	Low.
A–3	95–100	85–95	1–5	6. 3–20. 0	0. 04–0. 06	5. 6–6. 0	Low.
A–4		95–100	95–000	0. 63–2. 0	0. 20–0. 24		Low.
A–3	95–100	85–95	1–5	6. 3–20. 0	0. 04–0. 06		Low.
A–4		90–100	55–65	0. 63–2. 0	0. 16–0. 20	5. 6–6. 0	
A–4		90–100	55–65	0. 63–2. 0	0. 16–0. 20	4. 6–5. 5	Low.
A–4		90–100	55–65	0. 63–2. 0	0. 16–0. 20	5. 6–6. 0	
A–4		90–100	55–65	0. 63–2. 0	0. 16–0. 20	4. 6–5. 5	Low.
A–3		95–100	1–5	6. 3–20. 0	0. 05 0. 07	5. 6–6. 0	Low.
				2. 0–6. 3	0. 25–0. 35	5. 6–6. 0	
				2. 0–6. 3	0. 25–0. 35	6. 1–7. 3	
A–2	95–100	85–95	20–25	2. 0–6. 3	0. 08–0. 12	5. 1–6. 0	
A–3	95–100	85–95	1–5	6. 3–20. 0	0. 04–0. 06	5. 6–6. 0	Low.
A–2	100	90–100	25–35	2. 0–6. 3	0. 14–0. 16	5. 6–6. 0	Low.
A–4	90–100	90–100	60–70	0. 63–2. 0	0. 16–0. 20	5. 6–6. 0	
A–3	95–100	85–95	5–10	6. 3–20. 0	0. 04–0. 06	5. 6–6. 0	Low.
A–4		95–100	85–95	0. 63–2. 0	0. 20–0. 24	5. 1–7. 8	
A–7		95–100	85–95	0. 63–2. 0	0. 16–0. 20	5. 1–5. 5	Moderate.
A–4	90–100	90–100	70–80	0. 63–2. 0	0. 18–0. 22	5. 1–6. 0	Low.
A–4	90–100	90–100	55–65	0. 63–2. 0	0. 16–0. 20	5. 1–6. 5	Low.
A–3	90–100	85–95	1–5	6. 3–20. 0	0. 04–0. 06	6. 1–6. 5	Low.
				2. 0–6. 3	0. 25–0. 35	6. 6–7. 3	Low.
A–3	90–100	70–90	1–5	6. 3–20. 0	0. 04–0. 06	7. 4–7. 8	Low.
A–7	90–100	85–95	80–90	0. 63–2. 0	0. 20–0. 24	6. 1–7. 3	Low.
A–4	90–100	85–95	70–80	0. 63–2. 0	0. 18–0. 22	5. 6–6. 0	Low.
A–3	95–100	85–95	1–5	6. 3–20. 0	0. 04–0. 06	5. 6–6. 0	Low.
A–4	90–100	90–100	60–70	0. 63–2. 0	0. 18–0. 22	5. 6–6. 5	Low.
A–4	90–100	90–100	55–65	0. 63–2. 0	0. 16–0. 20	5. 1–5. 5	Low.
A–3	95–100	85–95	5–10	6. 3–20. 0	0. 03–0. 05	5. 6–6. 0	Low.

TABLE 10.—*Estimated properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (representative profile)	Classification	
			Dominant USDA texture	Unified
	Feet	*Inches*		
Morocco: Mo	0–3	0–10	Loamy sand	SM
		10–18	Sand	SP–SM
		18–60	Sand	SP
Morocco, loamy subsoil variant: Mr	0–3	0–23	Sandy loam	SM
		23–36	Loamy sand	SM
		36–50	Clay loam	ML–CL
		50–60	Sand	SP
Newton: Ne	0–1	0–11	Loamy sand	SM
		11–60	Sand	SP
Norden: NrB, NrC2, NrD2, NrE2	>5	0–11	Silt loam	ML
		11–29	Loam	CL
		29	Sandstone.	
Northfield: NtA, NtB, NtC2	>5	0–16	Silt loam	ML
		16–60	Sandstone.	
Otterholt: OsB, OsC2	>5	0–7	Silt loam	ML
		7–42	Silt loam	CL
		42–60	Loam	ML
Palsgrove: PaB, PaC2, PaD2	>5	0–17	Silt loam	CL or ML
		17–30	Silty clay loam	CL
		30–46	Clay	CH
		46–60	Limestone.	
Pillot: Pc	>5	0–20	Silt loam	ML
		20–32	Heavy silt loam	CL
		32–60	Sand	SP
Plainbo: PdB, PdC2, PdF	>5	0–8	Loamy sand	SM
		8–35	Sand	SP
		35–60	Sandstone.	
Plainfield: PfA, PfB, PfC2	>5	0–10	Loamy sand	SM
		10–60	Sand	SP
Poskin: Po	1–3	0–14	Silt loam	ML
		14–30	Heavy silt loam	CL
		30–60	Sand and gravel	SP
Renova: RaB, RaC2, RaD2	>5	0–16	Silt loam	CL or ML
		16–33	Heavy loam	ML–CL
		33–60	Loam	ML
Rib: Rb	0–1	0–14	Silt loam	ML
		14–25	Heavy silt loam	CL or ML
		25–60	Sand and gravel	SP–SM
Rib, moderately shallow variant: Rc	0–1	0–13	Silt loam	CL or ML
		13–23	Silty clay loam	CL
		23–60	Sandstone.	

significant in engineering—Continued

Classification—Continued	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHO	No 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
	Percent	*Percent*	*Percent*	*Inches per hour*	*Inches per inch of soil*	*pH value*	
A-2	95-100	85-95	20-25	2. 0-6. 3	0. 10-0. 14	5. 1-5. 5	Low.
A-3	95-100	85-95	5-10	6. 3-20. 0	0. 04-0. 08	5. 1-5. 5	Low.
A-3	95-100	85-95	1-5	6. 3-20. 0	0. 04-0. 06	5. 6-6. 0	Low.
A-2		80-100	25-35	0. 63-2. 0	0. 12-0. 16	5. 1-6. 0	Low.
A-2	95-100	85-95	20-25	6. 3-20. 0	0. 08-0. 12	5. 6-6. 0	Low.
A-4		90-100	65-75	0. 20-0. 63	0. 14-0. 18	5. 6-6. 0	Moderate.
A-3	95-100	85-95	1-5	6. 3-20. 0	0. 04-0. 06	5. 6-6. 5	Low.
A-2	95-100	85-95	20-25	2. 0-6. 3	0. 12-0. 16	5. 6-6. 0	Low.
A-3	95-100	85-95	1-5	6. 3-20. 0	0. 04-0. 06	4. 6-6. 0	Low.
A-4		95-100	55-65	0. 63-2. 0	0. 20-0. 24	5. 6-6. 0	Low.
A-6		95-100	55-65	0. 63-2. 0	0. 16-0. 20	5. 1-6. 0	Moderate.
A-4		90-100	80-90	0. 63-2. 0	0. 20-0. 24	5. 1-6. 0	Low.
A-4		95-100	90-100	0. 63-2. 0	0. 20-0. 24	6. 6-7. 3	Low.
A-4		95-100	90-100	0. 63-2. 0	0. 16-0. 20	4. 6-6. 0	Low.
A-4		95-100	55-65	0. 63-2. 0	0. 16-0. 20	5. 1-5. 5	Low.
A-4		95-100	90-100	0. 63-2. 0	0. 20-0. 24	5. 6-6. 0	Low.
A-6		95-100	90-100	0. 63-2. 0	0. 16-0. 20	5. 1-5. 5	Moderate.
A-7	95-100	85-95	80-90	0. 20-0. 63	0. 12-0. 16	5. 6-6. 0	High.
A-4		95-100	90-100	0. 63-2. 0	0. 22-0. 26	5. 1-6. 5	Low.
A-7		90-100	85-95	0. 63-2. 0	0. 20-0. 24	5. 1-5. 5	Moderate.
A-3	95-100	85-95	1-5	6. 3-20. 0	0. 04-0. 06	5. 1-5. 5	Low.
A-2	95-100	85-95	20-25	6. 3-20. 0	0. 08-0. 12	6. 6-7. 3	Low.
A-3	90-100	70-90	1-5	6. 3-20. 0	0. 04-0. 06	6. 1-6. 5	Low.
A-2	95-100	85-95	20-25	6. 3-20. 0	0. 08-0. 12	6. 1-7. 3	Low.
A-3	95-100	85-95	1-5	6. 3-20. 0	0. 04-0. 06	5. 1-6. 5	Low.
A-4		90-100	85-95	0. 63-2. 0	0. 20-0. 24	5. 1-6. 5	Low.
A-6	95-100	90-100	80-90	0. 63-2. 0	0. 22-0. 24	5. 1-5. 5	Moderate.
A-3	90-100	70-90	1-5	6. 3-20. 0	0. 02-0. 04	5. 6-6. 0	Low.
A-4		90-100	85-95	0. 63-2. 0	0. 20-0. 24	5. 1-6. 5	
A-4		90-100	65-75	0. 20-0. 63	0. 16-0. 20	4. 6-5. 5	Moderate.
A-4	90-100	85-95	55-65	0. 20-0. 63	0. 16-0. 20	5. 1-5. 5	Moderate.
A-4		90-100	85-95	0. 63-2. 0	0. 20-0. 24	5. 1-6. 5	
A-4		90-100	70-80	0. 63-2. 0	0. 22-0. 24	5. 1-5. 5	Low.
A-1	85-95	75-85	5-10	0. 63-2. 0	0. 02-0. 04	5. 6-6. 0	Low.
A-4			95-100	0. 63-2. 0	0. 22-0. 24	5. 1-6. 5	
A-7			95-100	0. 63-2. 0	0. 16-0. 20	4. 6-5. 5	Moderate

TABLE 10.—*Estimated properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (representative profile)	Classification	
			Dominant USDA texture	Unified
	Feet	*Inches*		
Riverwash: Re. Properties are too variable for reliable evaluation.				
Santiago: SaB, SaC2	>5	0–20 20–33 33–60	Silt loam Heavy sandy loam Sandy loam	ML SC SM
Seaton: SeB, SeC2, SeD2, SeE2, SfA, SfB	>5	0–10 10–35 35–60	Silt loam Silt loam Silt loam	ML CL ML–CL or CL.
Shiffer: Sh	1–3	0–14 14–30 30–60	Loam Loam Sand	ML ML–CL SP
Steep stony rock land: StF. Properties are too variable for reliable evaluation.				
Stronghurst: Su	1–3	0–9 9–25 25	Silt loam Silty clay loam Silt loam	CL or ML CL CL or ML
Tell: TeA, TeB, TeC2	>5	0–12 12–27 27	Silt loam Heavy silt loam Sand	CL or ML CL SP
Terrace escarpments: Tn, To. Properties are too variable for reliable evaluation.				
Terril: Tr	>5	0–60	Loam	ML
*Urne: UeD2, UeF, UnB, UnC2, UnD2, UnE2, UnF For properties of Elkmound part of UeD2 and UeF, see Elkmound series; for Norden part of UnB, UnC2, UnD2, UnE2, and UnF, see Norden series.	>5	0–8 8–36 36	Loam Very fine sandy loam Sandstone.	ML ML or SM
Wallkill: Wa	0–1	0–28 28–60	Silt loam Mucky peat	ML Pt

significant in engineering—Continued

Classification—Continued	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
	Percent	*Percent*	*Percent*	*Inches per hour*	*Inches per inch of soil*	*pH value*	
A–4		90–100	85–95	0. 63–2. 0	0. 20–0. 24	4. 6–6. 5	
A–4 or A–6		90–100	35–50	0. 63–2. 0	0. 16–0. 20	4. 6–5. 5	Low.
A–2	90–95	90–100	25–35	2. 0–6. 3	0. 12–0. 16	5. 6–6. 0	Moderate.
A–4		95–100	95–100	0. 63–2. 0	0. 20–0. 24	6. 6–7. 3	
A–6		95–100	95–100	0. 63–2. 0	0. 18–0. 22	5. 6–6. 0	Low.
A–6 or A–4		95–100	95–100	0. 63–2. 0	0. 18–0. 22	5. 6–6. 0	Low.
A–4	90–100	90–100	55–65	0. 63–2. 0	0. 18–0. 22	5. 6–6. 0	
A–4	90–100	90–100	55–65	0. 63–2. 0	0. 16–0. 20	4. 6–5. 0	Low.
A–3	95–100	90–100	1–5	6. 3–20. 0	0. 02–0. 04	4. 6–5. 0	Low.
A–4			95–100	0. 63–2. 0	0. 20–0. 24	5. 6–6. 0	
A–7			95–100	0. 63–2. 0	0. 18–0. 20	5. 6–6. 5	Moderate.
A–6			95–100	0. 63–2. 0	0. 18–0. 22	6. 1–6. 5	Low.
A–4			95–100	0. 63–2. 0	0. 20–0. 24	6. 6–7. 3	
A–7		90–100	85–95	0. 63–2. 0	0. 20–0. 24	5. 1–6. 5	Moderate.
A–3	95–100	85–95	1–5	6. 3–20. 0	0. 04–0. 06	5. 6–6. 0	Low.
A–4		90–100	55–65	0. 63–2. 0	0. 18–0. 22	5. 6–6. 5	
A–4		90–100	55–65	0. 63–2. 0	0. 18–0. 22	5. 6–7. 3	
A–4		95–100	45–55	0. 63–2. 0	0. 14–0. 18	5. 6–6. 5	Low.
A–4	95–100	90–100	85–95	0. 63–2. 0 2. 0–6. 3	0. 20–0. 24 0. 25–0. 35	6. 1–7. 3 7. 4–7. 8	

TABLE 11.—*Engineering interpretations for specified uses*

[An asterisk, in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column in this table]

Soil series and map symbols	Suitability as a source of—			Limitations affecting foundations for low buildings [1]	Corrosion potential for metal conduits
	Topsoil	Sand and gravel	Road fill [1]		
Alluvial land:					
Ad	Fair: subject to frequent flooding.	Unsuitable	Poor: low stability; erodible.	Very severe: frequent flooding.	Low.
Ae	Unsuitable: low available water capacity; subject to frequent flooding.	Unsuitable: variable soil material; frequent flooding.	Poor: stability and bearing capacity variable; frequent flooding.	Very severe: frequent flooding.	Moderate.
Af	Fair: poorly drained; subject to frequent flooding.	Unsuitable: variable soil material.	Poor: stability and bearing capacity variable; flooding.	Very severe: high water table; frequent flooding.	Moderate: wetness.
Almena: AmB	Good	Poor: pockets of poorly graded sand and gravel in substratum.	Fair: low bearing capacity; fair stability.	Moderate: moderate bearing capacity; severe for basements; seasonally saturated at a depth of 1 to 3 feet.	Moderate: medium acid; seasonally saturated at a depth of 1 to 3 feet.
Almena, wet variant: An.	Fair: low fertility; seasonally saturated throughout.	Poor: pockets of sand and gravel in substratum.	Poor: low bearing capacity; fair stability.	Severe: high water table; very severe for basements; seasonally saturated throughout.	Moderate: medium acid; seasonally saturated throughout.
Amery: AsB, AsC2, AsD2.	Good	Poor: pockets of poorly graded sand and gravel in substratum.	Good	Slight	Low.
Arenzville: At	Good	Unsuitable: silty	Poor: low bearing capacity; fair stability; highly susceptible to frost action; subject to flooding.	Severe: subject to flooding.	Low.
Arland: AuC2, AuD2.	Good	Fair: weakly cemented sandstone bedrock; poorly graded sand.	Fair in subsoil; fair stability and bearing capacity; weakly cemented bedrock.	Moderate: sandstone bedrock at a depth of 2 to 4 feet hinders excavation in places.	Low.
Billett: BlA, BlB, BlC2.	Good	Good: pockets of gravel in substratum.	Good	Slight	Low.
Billett, mottled subsoil variant: Bm.	Good	Good	Fair: seasonal high water table.	Moderate: seasonal high water table.	Low.
Boaz: Bo	Good	Unsuitable: silty	Poor: moderate bearing capacity; highly susceptible to frost action; fair stability; subject to flooding.	Severe: moderate compressibility; low bearing capacity; subject to flooding.	Low.
Boaz, dark variant: Br.	Poor: seasonally saturated throughout.	Unsuitable: silty	Poor: low bearing capacity and stability; high compressibility and elasticity.	Severe: high compressibility; subject to flooding.	Moderate: high carbonate content; seasonally saturated throughout.

See footnote at end of table.

TABLE 11.—*Engineering interpretations for specified uses*—Continued

Soil series and map symbols	Suitability as a source of—			Limitations affecting foundations for low buildings [1]	Corrosion potential for metal conduits
	Topsoil	Sand and gravel	Road fill [1]		
Brems: Bs	Poor: sandy; droughty; erodible.	Good	Good	Slight	Low.
Burkhardt: BuB, BuC2.	Fair in surface layer, poor in subsoil: shallow; gravelly or sandy.	Good	Good	Slight	Low.
Campia: CaA	Good in surface layer, fair in subsoil: slopes are unstable.	Unsuitable: silty	Fair: moderate bearing capacity; fair stability; highly susceptible to frost action.	Moderate: moderate bearing capacity; subject to liquefaction; fair stability.	Moderate: strongly acid.
Caryville: Ce	Fair in surface layer, poor in subsoil: shallow; erodible; droughty.	Fair: poorly graded sand with some fines in substratum.	Good	Severe: subject to flooding.	Low.
Cathro: Ch	Poor: seasonally saturated throughout.	Unsuitable: organic material over loam.	Unsuitable: high compressibility; fair stability; very low bearing capacity; seasonally saturated throughout.	Very severe: low bearing capacity; high water table.	Moderate: wetness.
Chetek: CkA, CkB, CkD2, CkE2.	Good in surface layer, poor in subsoil: shallow; gravelly or sandy.	Good	Good	Slight	Low.
Dakota: DaA, DaB, DbA, DbB.	Good in surface layer; fair in subsoil: low fertility; shallow to sand.	Good	Fair: fair stability and compaction.	Slight	Low.
Dickinson: DdA, DdB.	Fair in surface layer: sandy loam; poor in subsoil: sandy; droughty; erodible.	Fair: poorly graded sand in substratum.	Good	Slight	Low.
Dubuque: DfB, DfC2, DfD2, DfE2.	Good in surface layer, poor in subsoil: shallow; clayey; firm consistence.	Unsuitable: clayey subsoil over dolomite bedrock.	Poor: high shrink-swell potential; high compressibility and elasticity; substratum is dolomite bedrock.	Slight if footings rest on dolomite bedrock; severe if excavation is needed.	Moderate: high carbonate content.
Dunbarton: DnB2, DnC2, DnD2, DnE.	Good in surface layer, poor in subsoil: shallow; clayey; firm consistence.	Unsuitable: clayey subsoil over dolomite bedrock.	Poor: high shrink-swell potential; high compressibility and elasticity; substratum is dolomite bedrock.	Slight if footings rest on dolomite bedrock; severe if excavation is needed.	Moderate: high carbonate content.
Dunnville: Du	Good in surface layer, fair in subsoil: low fertility; shallow to sand.	Good	Good	Slight	Low.
Dunnville, silty subsoil variant: Dv.	Good	Good	Fair: fair stability and compaction.	Slight	Low.

See footnote at end of table.

TABLE 11.—*Engineering interpretations for specified uses*—Continued

Soil series and map symbols	Suitability as a source of—			Limitations affecting foundations for low buildings [1]	Corrosion potential for metal conduits
	Topsoil	Sand and gravel	Road fill [1]		
Eleva: ElB, ElC2	Fair in surface layer, poor in subsoil; shallow to bedrock; low fertility.	Poor: poorly graded sandstone that contains shaly layers in substratum.	Good	Slight	Low.
Elkmound: EmA, EmB, EmC2.	Fair: shallow over sandstone.	Fair: sandstone bedrock is weakly cemented; poorly graded sand.	Good	Slight	Low.
Gotham: GoA, GoB, GoC2	Poor: sandy; erodible; droughty.	Good	Good	Slight	Low.
GsA, GsB, GsC2	Poor: sandy	Good	Good	Slight	Low.
Hixton: HfB, HfC2, HfD2.	Good	Fair: sandstone bedrock is weakly cemented; poorly graded sand.	Fair: fair stability and compaction.	Slight	Low.
Hixton, mottled subsoil variant: HmB.	Good	Fair: sandstone bedrock is weakly cemented; poorly graded sand.	Fair: somewhat poorly drained; substratum is sand over weakly cemented sandstone bedrock.	Severe: seepage; high water table.	Low.
Houghton: Ho	Poor: erodible; oxidizes rapidly; seasonally saturated throughout.	Unsuitable: organic material.	Unsuitable in subsoil and substratum; high compressibility; low stability; very low bearing capacity.	Very severe: low bearing capacity; seasonally saturated throughout.	Low.
Hubbard: HuA, HuB, HuC2, Hv, HwC.	Poor: droughty; erodible; sandy.	Good	Good	Slight	Low.
Kickapoo: Kc	Good	Unsuitable: variable soil material; occasional flooding.	Fair: fair stability and compaction; occasional flooding.	Severe: occasional flooding.	Low.
La Farge: LfB, LfC2, LfC3, LfD2, LfD3, LfE2.	Fair: firm consistance.	Poor: poorly graded sand that contains silt and shale.	Fair: moderate bearing capacity; fair stability; weakly cemented sandstone bedrock.	Slight	Low.
Lows: Lo	Fair: sandy substratum; seasonally saturated throughout.	Fair: poorly graded sand in substratum.	Poor: high compressibility and elasticity; fair stability; seasonally saturated throughout.	Severe: moderate bearing capacity; very severe for basements; seasonally saturated throughout.	Moderate: seasonally saturated throughout.
Markey: Ma	Poor: erodible; oxidizes rapidly.	Fair: poorly graded sand in substratum.	Unsuitable: unstable; high compressibility, very low bearing capacity; low stability; seasonally saturated throughout.	Very severe: low bearing capacity; seasonally saturated throughout.	Moderate: seasonally saturated throughout.

See footnote at end of table.

TABLE 11.—*Engineering interpretations for specified uses*—Continued

Soil series and map symbols	Suitability as a source of—			Limitations affecting foundations for low buildings [1]	Corrosion potential for metal conduits
	Topsoil	Sand and gravel	Road fill [1]		
Marshan: Mc	Fair: seasonally saturated throughout.	Fair: poorly graded sand in substratum.	Poor: fair stability; seasonally saturated throughout.	Severe: moderate bearing capacity; subject to liquefaction and piping; very severe for basements; seasonally saturated throughout.	Moderate: seasonally saturated throughout.
Meridian: MeA, MeB, MeC2.	Good	Good	Good	Slight	Low.
Morocco: Mo	Poor: sandy; droughty; erodible.	Good	Fair: seasonally saturated at a depth of 1 to 3 feet.	Moderate: subject to liquefaction and piping; severe for basements; seasonally saturated at a depth of 1 to 3 feet.	Low.
Morocco, loamy subsoil variant: Mr.	Fair in surface layer and subsoil; poor in substratum; sandy.	Good	Fair: seasonally saturated at a depth of 1 to 3 feet.	Moderate: subject to liquefaction and piping; severe for basements; seasonally saturated at a depth of 1 to 3 feet.	Low.
Newton: Ne	Poor: sandy; droughty; erodible; seasonally saturated throughout.	Fair: poorly graded sand in substratum.	Poor: seasonally saturated throughout.	Severe: subject to liquefaction and piping; very severe for basements; seasonally saturated throughout.	Moderate: seasonally saturated throughout.
Norden: NrB, NrC2, NrD2, NrE2.	Good	Poor: poorly graded sand that contains layers of silt and shale.	Fair: fair stability; weakly cemented sandstone bedrock.	Slight	Low.
Northfield: NtA, NtB, NtC2.	Fair: shallow over bedrock.	Fair: sandstone bedrock is weakly cemented; poorly graded sand.	Fair: fair stability; weakly cemented sandstone bedrock.	Slight where footings rest on sandstone bedrock, moderate where bedrock must be excavated.	Low.
Otterholt: OsB, OsC2.	Good	Poor: pockets of poorly graded sand and gravel occur in places.	Fair: moderate bearing capacity; fair stability.	Slight	Low.
Palsgrove: PaB, PaC2, PaD2.	Good in surface layer; fair in subsoil; shallow; clayey.	Unsuitable: silty soil over dolomite bedrock.	Poor: moderate to high shrink-swell potential; fair stability.	Moderate: high shrink-swell potential; low bearing capacity.	Low.
Pillot: Pc	Good	Good	Fair: fair stability	Slight	Low.
Plainbo: PdB, PdC2, PdF.	Poor: sandy	Good	Good	Slight	Low.
Plainfield: PfA, PfB, PfC2.	Poor: sandy; droughty; erodible.	Good	Good	Slight	Low.

See footnote at end of table.

TABLE 11.—*Engineering interpretations for specified uses*—Continued

Soil series and map symbols	Suitability as a source of—			Limitations affecting foundations for low buildings [1]	Corrosion potential for metal conduits
	Topsoil	Sand and gravel	Road fill [1]		
Poskin: Po	Good in surface layer, fair in subsoil: shallow; low fertility; slopes are erodible.	Good	Poor: highly susceptible to frost action; fair stability and compaction.	Moderate: seasonal water table hinders installation; severe for basements; seasonally saturated at a depth of 1 to 3 feet.	Low.
Renova: RaB, RaC2, RaD2.	Good	Unsuitable: loam	Fair: fair stability and compaction.	Moderate: moderate bearing capacity; fair stability.	Low.
Rib: Rb	Poor: seasonally saturated throughout.	Fair: poorly graded to well-graded sand and gravel in substratum.	Poor: highly susceptible to frost action; fair stability.	Severe: high water table; very severe for basements; seasonally saturated throughout.	Low.
Rib, moderately shallow variant: Rc.	Poor: high water table.	Poor: poorly graded sand; layers of shale in substratum.	Poor: moderate bearing capacity; seasonally saturated throughout; fair stability; substratum is shale and sandstone bedrock.	Severe: moderate shrink-swell potential; moderate bearing capacity; seasonally saturated throughout; very severe for basements.	Moderate: seasonally saturated throughout.
Riverwash: Re	Unsuitable: gravelly; frequent flooding.	Good	Poor: lacks stability.	Severe: subject to flooding.	High: seasonally saturated throughout.
Santiago: SaB, SaC2.	Good	Poor: pockets of poorly graded sand and gravel in substratum.	Fair: low bearing capacity; fair stability; moderately susceptible to frost action.	Slight	Low.
Seaton: SeB, SeC2, SeD2, SeE2, SfA, SfB.	Good in surface layer.	Unsuitable; silty except bench phases, where sand is at a depth of 4 to 6 feet in some places.	Fair: moderate bearing capacity; moderately susceptible to frost action; fair stability.	Moderate: moderate bearing capacity and compressibility; fair stability.	Low.
Shiffer: Sh	Good	Good	Fair: moderate bearing capacity; fair stability.	Slight: moderate for basements; seasonally saturated at a depth of 1 to 3 feet.	Low.
Steep stony rock land: StF.	Poor: steep and rocky.	Unsuitable: steep and rocky.	Poor: sandstone and limestone.	Severe: steep and rocky.	Low.
Stronghurst: Su	Good in surface layer, fair in subsoil: shallow; firm consistence.	Unsuitable: silty	Fair: moderate bearing capacity; fair stability; moderately susceptible to frost action.	Moderate: moderate bearing capacity; fair stability; severe for basements; seasonally saturated at a depth of 1 to 3 feet.	Low.
Tell: TeA, TeB, TeC2.	Good	Good	Fair: moderate shrink-swell potential and bearing capacity; wetness; fair stability.	Slight	Low.

See footnote at end of table.

TABLE 11.—*Engineering interpretations for specified uses*—Continued

Soil series and map symbols	Suitability as a source of—			Limitations affecting foundations for low buildings [1]	Corrosion potential for metal conduits
	Topsoil	Sand and gravel	Road fill [1]		
Terrace escarpments: Tn	Poor: sandy	Fair: poorly graded to well-graded sand that contains some gravel.	Good	Severe: steep	Low.
To	Good	Good	Fair: fair stability	Severe: steep	Low.
Terril: Tr	Good	Unsuitable: silty	Poor: subject to flooding; high frost-heave potential.	Severe: subject to flooding.	Low.
*Urne: UeD2, UeF, UnB, UnC2, UnD2, UnE2, UnF. For Elkmound part of UeD2, and UeF, see Elkmound series. For Norden part of UnB, UnC2, UnD2, UnE2, and UnF, see Norden series.	Good	Poor: poorly graded fine sand that contains layers of silty and shaly material.	Good: substratum is weakly cemented sandstone bedrock.	Slight	Low.
Wallkill: Wa	Poor: seasonally saturated throughout.	Unsuitable: silty soil over organic material.	Poor: high compressibility and elasticity; seasonally saturated throughout.	Very severe: low bearing capacity; high compressibility; seasonally saturated throughout.	High: wet soil; high carbonate content.

[1] Engineers and others should not apply specific values to the estimates given for bearing capacity of soils.

TABLE 12.—*Engineering interpretations for farm uses*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Soil series and map symbols	Soil features affecting—				
	Agricultural drainage	Irrigation	Terraces and diversions	Farm ponds	
				Reservoir area	Embankments
Alluvial land: Ad	Moderate permeability; subject to frequent flooding.	Medium available water capacity; deep soil; rapid water intake rate; subject to frequent flooding.	Not applicable; subject to frequent flooding.	Moderate permeability; subject to frequent flooding.	Fair to good stability; fair to good compaction.
Ae	Natural drainage is excessive; frequent flooding.	Low available water capacity; frequent flooding.	Not applicable; sandy material difficult to vegetate and stabilize.	Rapid permeability	Poor stability and fair compaction.
Af	Rapid permeability; substratum generally unstable; frequent flooding.	High available water capacity; frequent flooding.	Nearly level; frequent flooding.	Subject to frequent flooding; seasonally saturated throughout.	Subject to frequent flooding; seasonally saturated throughout.
Almena: AmB	Moderately slow permeability; seasonally saturated at a depth of 1 to 3 feet.	High available water capacity; deep soil; slow water intake rate; seasonally saturated at a depth of 1 to 3 feet.	Wetness hinders construction.	Moderately slow permeability in subsoil; seasonally saturated at a depth of 1 to 3 feet.	Fair to good stability and compaction characteristics in subsoil; fair stability and fair to good compaction characteristics in substratum; stony in places.
Almena, wet variant: An.	Moderately slow permeability; seasonally saturated throughout.	High available water capacity; deep soil; slow water intake rate; seasonally saturated throughout.	Wetness hinders construction.	Moderately slow permeability in subsoil; seasonally saturated throughout.	Fair to good stability and compaction characteristics in subsoil; fair stability in substratum; stony in places.
Amery: AsB, AsC2, AsD2.	Natural drainage is adequate.	Medium available water capacity; deep soil; moderate water intake rate; slope.	Sandy loam at a depth below 26 inches; stones hinder construction in places.	Moderate permeability in subsoil and substratum.	Fair stability and fair to good compaction characteristics in subsoil and substratum; semipervious; stony in places.
Arenzville: At	Moderate permeability; subject to flooding.	High available water capacity; deep soil; moderate water intake rate; subject to flooding.	Subject to flooding	Moderate permeability; subject to flooding.	Poor stability and compaction characteristics in subsoil and substratum; pervious; piping hazard.
Arland: AuC2, AuD2.	Natural drainage is adequate.	Medium available water capacity; moderately deep soil; moderate water intake rate; slope.	Sandy substratum; erosion hazard.	Moderate permeability through subsoil; rapid permeability in sandstone substratum.	Fair to good stability and compaction characteristics in subsoil; semipervious; substratum is weakly cemented sandstone bedrock.

TABLE 12.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting—				
	Agricultural drainage	Irrigation	Terraces and diversions	Farm ponds	
				Reservoir area	Embankments
Billett: BlA, BlB, BlC2.	Natural drainage is excessive.	Medium available water capacity; deep soil; rapid water intake rate; nearly level.	Sandy substratum; difficult to vegetate and stabilize; erosion hazard.	Moderately rapid permeability through subsoil; rapid permeability in sandy substratum.	Fair stability and fair to good compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; pervious in subsoil; very pervious in substratum; piping hazard.
Billett, mottled subsoil variant: Bm.	Moderately rapid permeability.	Medium available water capacity; deep soil; rapid water intake rate; nearly level.	Sandy material; difficult to vegetate and stabilize.	Moderately rapid permeability through subsoil; rapid permeability in sandy substratum.	Fair stability and fair to good compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; subsoil is pervious; substratum is very pervious.
Boaz: Bo	Moderate permeability; seasonally saturated at a depth of 1 to 3 feet; subject to flooding.	High available water capacity; deep soil; moderate water intake rate; seasonally saturated at a depth of 1 to 3 feet; subject to flooding.	Subject to frequent flooding.	Moderate permeability; seasonally saturated at a depth of 1 to 3 feet; subject to flooding.	Poor stability and compaction characteristics in subsoil and substratum; pervious; piping hazard.
Boaz, dark variant: Br.	Moderately slow permeability; seasonally saturated at a depth of 1 to 3 feet; subject to flooding.	High available water capacity; deep soil; moderate water intake rate; seasonally saturated at a depth of 1 to 3 feet; subject to flooding.	Subject to frequent flooding; seasonally saturated at a depth of 1 to 3 feet.	Moderate permeability; seasonally saturated at a depth of 1 to 3 feet; subject to flooding.	Fair to good stability and compaction characteristics in subsoil and substratum; semipervious; medium to high compressibility.
Brems: Bs	Rapid permeability; seasonally saturated at a depth of 3 to 5 feet.	Low available water capacity; deep soil; rapid water intake rate; nearly level; hazard of soil blowing.	Sandy material; difficult to vegetate and stabilize.	Rapid permeability	Poor stability and fair compaction characteristics in subsoil and substratum; very pervious; erodible; piping hazard.
Burkhardt: BuB, BuC2.	Natural drainage is adequate.	Medium available water capacity; shallow soil; rapid water intake rate.	Shallow to sand and gravel; difficult to vegetate and stabilize.	Moderately rapid permeability through subsoil; rapid permeability in sand and gravel substratum.	Fair stability and fair to good compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; subsoil is pervious; substratum is very pervious; piping hazard.

TABLE 12.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting—				
	Agricultural drainage	Irrigation	Terraces and diversions	Farm ponds	
				Reservoir area	Embankments
Campia: CaA	Natural drainage is adequate.	High available water capacity; deep soil; moderate water intake rate.	Few or no limiting features.	Moderate permeability.	Fair to good stability and compaction characteristics in subsoil and substratum; semipervious.
Caryville: Ce	Rapid permeability; subject to flooding.	Low available water capacity; deep soil; rapid water intake rate; subject to flooding.	Subject to occasional flooding; shallow to sandy substratum.	Moderately rapid permeability in sand substratum; subject to flooding.	Poor stability and fair compaction characteristics in substratum; very pervious; erodible; piping hazard.
Cathro: Ch	Moderately rapid permeability; seasonally saturated throughout.	Very high available water capacity; deep soil; rapid water intake rate; hazard of soil blowing; seasonally saturated throughout.	Unstable organic material; nearly level.	Moderately rapid permeability in organic material; seasonally saturated throughout.	Organic material not suitable for embankments; poor to fair stability and compaction characteristics in substratum; pervious to semipervious.
Chetek: CkA, CkB, CkD2, CkE2.	Natural drainage is adequate.	Low available water capacity; shallow soil; rapid water intake rate; nearly level.	Shallow to sand and gravel.	Moderately rapid permeability through subsoil; rapid permeability in sand and gravel substratum.	Fair stability and fair to good compaction characteristics in subsoil; poor stability and compaction characteristics in substratum; pervious in subsoil; very pervious in substratum.
Dakota: DaA, DaB, DbA, BbB.	Natural drainage is adequate.	Medium available water capacity; moderately deep soil; moderate water intake rate; nearly level.	Moderately deep over sandy material.	Moderate permeability through subsoil; rapid permeability in sand substratum.	Fair to good stability and compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; semipervious in subsoil; very pervious in substratum; piping hazard.
Dickinson: DdA, DdB.	Natural drainage is adequate.	Low available water capacity; deep soil; rapid water intake rate; nearly level.	Sandy material; difficult to vegetate and stabilize.	Moderately rapid permeability through subsoil; rapid permeability in sand substratum.	Fair stability and fair to good compaction characteristics in subsoil: poor stability and fair compaction characteristics in substratum; pervious in subsoil; very pervious in substratum.

TABLE 12.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting—				
	Agricultural drainage	Irrigation	Terraces and diversions	Farm ponds	
				Reservoir area	Embankments
Dubuque: DfB, DfC2, DfD2, DfE2.	Natural drainage is adequate.	Medium available water capacity; moderately deep soil; moderate water intake rate; slope.	Dolomite bedrock at a depth below 20 inches.	Moderately slow permeability in clayey residuum over fractured dolomite.	Fair to poor stability and compaction characteristics in subsoil; semipervious; moderate shrink-swell potential; substratum is fractured dolomite bedrock.
Dunbarton: DnB2, DnC2, DnD2, DnE.	Natural drainage is adequate.	Low available water capacity; shallow soil; moderate water intake rate; slope.	Shallow to dolomite bedrock.	Moderate permeability through subsoil; less than 2 feet to fractured dolomite.	Fair to poor stability and compaction characteristics in subsoil; very shallow; substratum is factured dolomite bedrock.
Dunnville: Du-----	Natural drainage is adequate.	Medium available water capacity; deep soil; rapid water intake rate; nearly level.	Sand and gravel at a depth of 20 to 40 inches; poor stability; highly erodible.	Moderately rapid permeability through subsoil; rapid permeability in sand substratum.	Fair stability and fair to good compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; pervious in subsoil; very pervious in substratum; piping hazard.
Dunnville, silty subsoil variant: Dv.	Natural drainage is adequate.	High available water capacity; moderately deep soil; moderate water intake rate.	Sand at a depth of 20 to 40 inches; poor stability.	Moderate permeability through subsoil; rapid permeability in sand substratum.	Fair stability and fair to good compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; pervious in subsoil; very pervious in substratum; erodible; piping hazard.
Eleva: ElB, ElC2..	Natural drainage is adequate.	Low available water capacity; moderately deep soil; rapid water intake rate.	Sandy substratum; erosion hazard.	Moderately rapid permeability through subsoil; slow permeability in sandstone and shale substratum.	Fair stability and fair to good compaction characteristics in subsoil; pervious to semipervious; substratum is weakly cemented sandstone and shale bedrock.
Elkmound: EmA, EmB, EmC2.	Natural drainage is adequate.	Low available water capacity; shallow soil; moderate water intake rate.	Moderately deep to sandstone bedrock.	Moderate permeability through subsoil; less than 2 feet to sandstone.	Poor stability and compaction characteristics in subsoil; very shallow; pervious; piping hazard; substratum is sandstone bedrock.

TABLE 12.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting—				
	Agricultural drainage	Irrigation	Terraces and diversions	Farm ponds	
				Reservoir area	Embankments
Gotham: GoA, GoB, GoC2.	Natural drainage is adequate.	Low available water capacity; deep soil; rapid water intake rate; hazard of soil blowing.	Sandy material; difficult to vegetate and stabilize.	Rapid permeability in subsoil; rapid permeability in sandy substratum.	Fair stability and fair to good compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; pervious in subsoil; very pervious in substratum; piping hazard.
GsA, GsB, GsC2.	Natural drainage is adequate.	Low available water capacity; rapid water intake rate.	Sandy material; difficult to vegetate and stabilize.	Rapid permeability in surface layer and subsoil; moderate permeability in silty substratum.	Fair to good stability in substratum; poor stability in surface layer and subsoil.
Hixton: HfB, HfC2, HfD2.	Natural drainage is adequate.	Medium available water capacity; moderately deep soil; moderate water intake rate.	Sandy substratum; erosion hazard.	Moderate permeability through subsoil; rapid permeability in sandy substratum at a depth of 20 to 40 inches.	Fair to good stability and compaction characteristics in subsoil; semipervious; pervious in substratum; sandstone bedrock.
Hixton, mottled subsoil variant: HmB.	Slow permeability; seasonally high water table; shallow to bedrock.	Medium available water capacity; moderate water intake rate; somewhat poorly drained.	Sandy substratum; wetness hinders construction in places.	Moderate permeability through subsoil; slow permeability in sandstone and shale substratum; seasonally high water table.	Fair to good stability and compaction characteristics in subsoil; semipervious; substratum is weakly cemented sandstone and shale bedrock.
Houghton: Ho----	Moderately rapid permeability; seasonally saturated throughout.	Very high available water capacity; deep soil; rapid water intake rate; hazard of soil blowing; seasonally saturated throughout.	Unstable organic soil; nearly level; seasonally saturated throughout.	Moderately rapid permeability; seasonally saturated throughout.	Organic material; not suitable for embankments.
Hubbard: HuA, HuB, HuC2.	Natural drainage is adequate.	Medium available water capacity; deep soil; rapid water intake rate; hazard of soil blowing; nearly level.	Sandy material; difficult to vegetate and stabilize.	Rapid permeability--	Fair stability and fair to good compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; pervious in subsoil; very pervious in substratum; erodible; piping hazard.
Hv----------	Natural drainage is adequate.	Low available water capacity; rapid water intake rate.	Sandy material; difficult to vegetate and stabilize.	Rapid permeability in surface layer and subsoil; moderate permeability in silty substratum.	Poor stability in surface layer and subsoil; fair to good stability in substratum.

TABLE 12.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting—				
	Agricultural drainage	Irrigation	Terraces and diversions	Farm ponds	
				Reservoir area	Embankments
HwC	Natural drainage is adequate.	Low available water capacity; deep soil; rapid water intake rate; hazard of soil blowing; nearly level.	Difficult to vegetate and stabilize.	Rapid permeability through subsoil; rapid permeability in sandy substratum.	Fair stability and fair to good compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; pervious in subsoil; very pervious in substratum; erodible; piping hazard.
Kickapoo: Kc	Moderate permeability; subject to flooding.	Medium available water capacity; deep soil; rapid water intake rate; subject to flooding.	Subject to flooding	Moderate permeability; subject to flooding.	Fair to good stability; fair to good compaction characteristics.
La Farge: LfB, LfC2, LfC3, LfD2, LfD3, LfE2.	Natural drainage is adequate.	Medium available water capacity; moderately deep soil; moderate water intake rate; slope.	Sandy substratum; erosion hazard.	Moderate permeability through subsoil; substratum is sandstone.	Fair to good stability and compaction characteristics in subsoil; semipervious; substratum is weakly cemented, fine-grained sandstone bedrock.
Lows: Lo	Moderate permeability; seasonally saturated throughout; substratum is generally unstable.	Medium available water capacity; moderately deep soil; moderate water intake rate; seasonally saturated throughout.	Nearly level; seasonally saturated throughout.	Moderate permeability through subsoil; sandy substratum; seasonally saturated throughout.	Fair to good stability and compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; semipervious in subsoil; very pervious in substratum.
Markey: Ma	Rapid permeability; substratum generally unstable.	High available water capacity; moderately deep soil; rapid water intake rate; hazard of soil blowing; seasonally saturated throughout.	Nearly level; seasonally saturated throughout.	Moderate to rapid permeability; seasonally saturated throughout.	Organic material not suitable for embankments; poor stability in substratum; slight compressibility; very pervious; piping hazard.
Marshan: Mc	Moderate permeability; substratum generally unstable; seasonally saturated. throughout.	Medium available water capacity; moderately deep soil; moderate water intake rate; seasonally saturated throughout.	Nearly level; seasonally saturated throughout.	Moderate permeability through subsoil; sand and gravel substratum; seasonally saturated throughout.	Fair to good stability and compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; semipervious in subsoil; very pervious in substratum; piping hazard.

TABLE 12.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting—				
	Agricultural drainage	Irrigation	Terraces and diversions	Farm ponds	
				Reservoir area	Embankments
Meridian: MeA, MeB, MeC2.	Natural drainage is adequate.	Medium available water capacity; moderately deep soil; moderate water intake rate.	Sandy substratum; little or no erosion hazard.	Moderate permeability through subsoil; rapid permeability in sandy substratum.	Fair to good stability and compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; semipervious in subsoil; very pervious in substratum; piping hazard.
Morocco: Mo	Rapid permeability; substratum generally unstable; seasonally saturated throughout.	Low available water capacity; deep soil; rapid water intake rate; hazard of soil blowing; seasonally saturated at a depth of 1 to 3 feet.	Sandy material; difficult to vegetate and stabilize.	Rapid permeability; seasonally saturated at a depth of 1 to 3 feet.	Poor stability and fair compaction characteristics in subsoil and substratum; very pervious; erodible; piping hazard.
Morocco, loamy subsoil variant: Mr.	Moderate permeability; seasonally saturated at a depth of 1 to 3 feet.	Low available water capacity; seasonally saturated at a depth of 1 to 3 feet.	Nearly level; seasonally saturated at a depth of 1 to 3 feet.	Rapid permeability: seasonally saturated at a depth of 1 to 3 feet.	Poor stability and fair compaction characteristics in subsoil and substratum; very pervious; erodible; piping hazard.
Newton: Ne	Natural drainage is poor; seasonally saturated throughout.	Low available water capacity; moderate water intake rate.	Nearly level; seasonally saturated throughout.	Rapid permeability through subsoil; substratum is sand and is rapidly permeable.	Poor stability and fair compaction characteristics in subsoil and substratum; very pervious; erodible; piping hazard.
Norden: NrB, NrC2, NrD2, NrE2.	Natural drainage is adequate.	Medium available water capacity; moderately deep soil; moderate water intake rate.	Sandstone bedrock at a depth of 20 to 40 inches.	Moderate permeability through subsoil; substratum is sandstone at a depth of 20 to 40 inches.	Fair to good stability and compaction characteristics in subsoil; semipervious; substratum is weakly cemented, fine-grained sandstone bedrock.
Northfield: NtA, NtB, NtC2.	Natural drainage is adequate.	Low available water capacity; shallow soil; moderate water intake rate.	Shallow to sandstone bedrock.	Moderate permeability through subsoil; sandstone at a depth of 12 to 24 inches.	Fair to good stability and compaction characteristics in subsoil; semipervious; shallow; substratum is sandstone bedrock.

TABLE 12.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting—				
	Agricultural drainage	Irrigation	Terraces and diversions	Farm ponds	
				Reservoir area	Embankments
Otterholt: OsB, OsC2.	Natural drainage is adequate.	High available water capacity; deep soil; moderate water intake rate.	Moderate permeability.	Moderate permeability.	Fair to good stability and compaction characteristics in subsoil; fair stability and fair to good compaction characteristics in substratum; semipervious in subsoil: pervious to semipervious in substratum.
Palsgrove: PaB, PaC2, PaD2.	Natural drainage is adequate.	High available water capacity; deep soil; moderate water intake rate; slope.	Moderate permeability; deep soil.	Moderate permeability through subsoil; moderately slow permeability in clayey residuum over fractured dolomite.	Fair to good stability and compaction characteristics in subsoil; fair to poor stability and compaction characteristics in substratum; semipervious in subsoil and substratum.
Pillot: Pc	Natural drainage is adequate.	Medium available water capacity; moderately deep soil; moderate water intake rate.	Moderately deep over sand and gravel.	Moderate permeability through subsoil; rapid permeability in sand and gravel substratum.	Fair to good stability and compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; semipervious in subsoil; very pervious in substratum; piping hazard.
Plainbo: PbB, PdC2, PdF.	Natural drainage is adequate.	Low available water capacity; shallow soil: rapid water intake rate.	Sandy material; difficult to vegetate and stabilize.	Rapid permeability; sandstone at a depth of less than 4 feet.	Poor stability and fair compaction characteristics in subsoil; very pervious; piping hazard; substratum is weakly cemented sandstone bedrock.
Plainfield: PfA, PfB, PfC2.	Natural drainage is adequate.	Low available water capacity; deep soil; rapid water intake rate; hazard of soil blowing.	Sandy material; difficult to vegetate and stabilize.	Rapid permeability	Poor stability and fair compaction characteristics in subsoil and substratum; very pervious.
Poskin: Po	Moderate permeability; seasonally saturated at a depth of 1 to 3 feet.	Medium available water capacity; moderately deep soil; moderate water intake rate; seasonally saturated at a depth of 1 to 3 feet.	Sandy substratum; wetness hinders construction.	Moderate permeability through subsoil; sand and gravel substratum; seasonally saturated at a depth of 1 to 3 feet.	Fair to good stability and compaction characteristics in subsoil; poor to fair compaction characteristics in substratum; semipervious in subsoil; very pervious in substratum.

TABLE 12.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting—				
	Agricultural drainage	Irrigation	Terraces and diversions	Farm ponds	
				Reservoir area	Embankments
Renova: RaB, RaC2, RaD2.	Natural drainage is adequate.	High available water capacity; deep soil; moderate water intake rate; slope.	Erosion hazard; stones hinder construction.	Moderately slow permeability in subsoil and substratum.	Fair stability and compaction characteristics in subsoil; fair stability and fair to good compaction characteristics in substratum; semipervious in subsoil and substratum.
Rib; Rb	Moderate permeability; seasonally saturated throughout.	Medium available water capacity; moderately deep soil; moderate water intake rate; seasonally saturated throughout.	Sandy substratum; seasonally saturated throughout.	Moderate permeability through subsoil; seasonally saturated throughout.	Fair to good stability and compaction characteristics in subsoil; poor to fair stability and fair to good compaction characteristics in substratum; semipervious in subsoil; very pervious in substratum; piping hazard.
Rib, moderately shallow variant: Rc.	Moderate permeability; seasonally saturated throughout.	Medium available water capacity; moderately deep soil; moderate water intake rate; seasonally saturated throughout.	Seasonally saturated throughout; sandstone and shale substratum.	Moderate permeability through subsoil; seasonally saturated throughout.	Fair to good stability and compaction characteristics in subsoil; poor to fair stability and fair to good compaction characteristics in substratum; semipervious in subsoil; very pervious in substratum; piping hazard.
Riverwash: Re	Rapid permeability; subject to flooding; sandy soil.	Frequently flooded	Frequently flooded	Frequently flooded	Poor stability and compaction characteristics; frequently flooded.
Santiago: SaB, SaC2.	Natural drainage is adequate.	High available water capacity; deep soil; moderate water intake rate.	Sandy loam substratum; stony in places.	Moderate permeability.	Fair to good stability and compaction characteristics in subsoil; fair stability and fair to good compaction characteristics in substratum; semipervious in subsoil; pervious in substratum.
Seaton: SeB, SeC2, SeD2, SeE2, SfA, SfB.	Natural drainage is adequate.	Very high available water capacity; deep soil; moderate water intake rate.	Deep silty soil; erosion hazard.	Moderate permeability.	Fair to good stability and compaction characteristics in subsoil and substratum; semipervious.

TABLE 12.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting—				
	Agricultural drainage	Irrigation	Terraces and diversions	Farm ponds	
				Reservoir area	Embankments
Shiffer: Sh	Moderate permeability; seasonally saturated at a depth of 1 to 3 feet.	Medium available water capacity; moderately deep soil; moderate water intake rate; seasonally saturated at a depth of 1 to 3 feet.	Sandy substratum; wetness hinders construction.	Moderate permeability through subsoil; sandy substratum; seasonally saturated at a depth of 1 to 3 feet.	Fair to good stability and compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; semipervious in subsoil; very pervious in substratum; piping hazard.
Steep stony rock land: StF.	Excessively drained	Steep; many outcrops.	Steep; many outcrops.	Steep; many outcrops.	Steep; many outcrops.
Stronghurst: Su	Moderate permeability; seasonally saturated at a depth of 1 to 3 feet.	High available water capacity; deep soil; moderate water intake rate; seasonally saturated at a depth of 1 to 3 feet.	Wetness hinders construction.	Moderate permeability; seasonally saturated at a depth of 1 to 3 feet.	Fair to good stability and compaction characteristics in subsoil and substratum; semipervious.
Tell: TeA, TeB, TeC2.	Natural drainage is adequate.	Medium available water capacity; moderately deep soil; moderate water intake rate; slope.	Sandy substratum; moderately deep soil; little or no erosion hazard.	Moderate permeability through subsoil; rapid permeability in sandy substratum.	Fair to good stability and compaction characteristics in subsoil; poor stability and fair compaction characteristics in substratum; semipervious in subsoil; very pervious in substratum; erodible; piping hazard.
Terrace escarpments: Tn, To.	Natural drainage is adequate.	Moderately steep to very steep.	Moderately steep to very steep.	Moderately steep to very steep.	Variable; moderately steep to very steep.
Terril: Tr	Moderate permeability; subject to flooding.	High available water capacity; deep soil; moderate water intake rate; subject to flooding.	Subject to flooding	Moderate permeability; subject to flooding.	Poor stability and compaction characteristics in subsoil and substratum; pervious; piping hazard.
*Urne: UeD2, UeF, UnB, UnC2, UnD2, UnE2, UnF. For Elkmound part of UeD2 and UeF, see Elkmound series. For Norden part of UnB, UnC2, UnD2, UnE2, and UnF, see Norden series.	Natural drainage is adequate.	Medium available water capacity; moderately deep soil; moderate water intake rate; slope.	Moderately deep soil; sandstone bedrock at a depth of 20 to 40 inches.	Moderate permeability through subsoil; moderately slow permeability at a depth of 20 to 40 inches.	Poor stability and compaction characteristics in subsoil; semipervious; piping hazard; substratum is fine-grained sandstone bedrock.

TABLE 12.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting—				
	Agricultural drainage	Irrigation	Terraces and diversions	Farm ponds	
				Reservoir area	Embankments
Wallkill: Wa	Moderate permeability; subject to flooding; seasonally saturated throughout.	Very high available water capacity; deep soil; moderate water intake rate; subject to flooding; seasonally saturated throughout.	Nearly level; seasonally saturated throughout.	Moderate permeability in mineral soil; moderately rapid permeability in underlying material; subject to flooding; seasonally saturated throughout.	Fair stability and compaction characteristics in subsoil; semipervious organic material in substratum is not suitable for embankments.

TABLE 13.—*Degree and kind of limitations for nonfarm uses*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Soil series and map symbols	Highway location	Sanitary landfill [1]	Septic tank filter field	Sewage lagoons
Alluvial land:				
Ad	Severe: seasonal water table.	Severe: frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.
Ae	Severe: seasonal water table; frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.
Af	Severe: permanent water table at a depth of less than 1 foot.	Severe: frequent flooding.	Very severe: high water table.	Severe: high water table.
Almena: AmB	Moderate: seasonal water table at a depth of 1 to 3 feet; moderate frost heave potential.	Moderate: seasonal high water table; difficult to work when wet.	Severe: seasonal high water table; moderately slow permeability.	Moderate: moderate permeability.
Almena, wet variant: An.	Severe: permanent or seasonal water table at a depth of less than 1 foot; hauling and excavating difficult.	Severe: high water table.	Very severe: high water table.	Severe: high water table; moderately slow permeability.
Amery: AsB, AsC2, AsD2.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; stones hinder hauling and grading.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Moderate if slope is 0 to 6 percent, severe if more than 6; moderate permeability; stony in places.
Arenzville: At	Severe: subject to flooding; high frost heave potential.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: moderate permeability; subject to flooding.
Arland: AuC2, AuD2	Moderate if slope is 6 to 12 percent, severe if more than 12; sandstone bedrock at a depth of 2 to 4 feet.	Moderate: weakly cemented sandstone at a depth of 2 to 4 feet.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in sandstone substratum.
Billett: BlA, BlB, BlC2.	Slight if slope is 0 to 6 percent, moderate if more than 6.	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in substratum.

See footnotes at end of table.

TABLE 13.—*Degree and kind of limitations for nonfarm uses*—Continued

Soil series and map symbols	Highway location	Sanitary landfill [1]	Septic tank filter field	Sewage lagoons
Billett, mottled subsoil variant: Bm.	Slight	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in substratum.
Boaz: Bo	Severe: subject to flooding; high frost heave potential; seasonal water table at a depth of 1 to 3 feet.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding; unstable when wet.
Boaz, dark variant: Br	Severe: permanent or seasonal water table at a depth of 1 foot; subject to flooding.	Severe: high water table; subject to flooding.	Very severe: subject to flooding; high water table.	Moderate: high water table; subject to flooding.
Brems: Bs	Slight: seasonal water table within 3 feet of surface; loose sand hinders hauling; subject to soil blowing.	Severe: little amelioration of leachate.	Moderate: seasonal high water table; hazard of contamination of ground water.	Severe: rapid permeability.
Burkhardt: BuB, BuC2	Slight if slope is 0 to 6 percent, moderate if more than 6.	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in substratum.
Campia: CaA	Moderate: fair stability; high frost heave potential; slopes are highly erodible.	Slight	Slight	Moderate: moderate permeability; poor stability when wet.
Caryville: Ce	Severe: subject to flooding; loose sand hinders hauling; subject to soil blowing.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding; rapid permeability.
Cathro: Ch	Severe: permanent or seasonal water table at a depth of less than 1 foot; organic material less than 40 inches thick over loam.	Severe: high water table.	Very severe: high water table.	Severe: high water table; moderate permeability in substratum; subsoil is organic material.
Chetek: CkA, CkB, CkD2, CkE2.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Severe: little amelioration of leachate.	Moderate if slope is 0 to 12 percent, severe if more than 12; hazard of contamination of ground water.	Severe: rapid permeability in substratum.
Dakota: DaA, DaB, DbA, DbB.	Slight	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in substratum.
Dickinson: DdA, DdB	Slight	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability.
Dubuque: DfB, DfC2, DfD2, DfE2.	Moderate if slope is 2 to 12 percent, severe if more than 12; dolomite bedrock at a depth of 2 to 4 feet; lower part of subsoil is plastic.	Severe: hazard of contamination of ground water.	Severe: bedrock at a depth of 2 to 4 feet.	Severe: bedrock at a depth of 2 to 4 feet.
Dunbarton: DnB2, DnC2, DnD2, DnE.	Severe: dolomite bedrock at a depth of less than 2 feet; subsoil is plastic.	Severe: hazard of contamination of ground water.	Severe: bedrock at a depth of less than 2 feet; hazard of contamination of ground water.	Severe: bedrock at a depth of less than 2 feet.
Dunnville: Du	Slight	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in substratum.

See footnote at end of table.

TABLE 13.—*Degree and kind of limitations for nonfarm uses*—Continued

Soil series and map symbols	Highway location	Sanitary landfill [1]	Septic tank filter field	Sewage lagoons
Dunnville, silty subsoil variant: Dv.	Moderate: moderate frost heave potential in subsoil.	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in substratum.
Eleva: ElB, ElC2	Moderate: sandstone at a depth of 2 to 4 feet.	Severe: little amelioration of leachate.	Severe	Moderate if slope is 0 to 6 percent, severe if more than 6; moderately rapid permeability in subsoil.
Elkmound: EmA, EmB, EmC2.	Moderate: sandstone bedrock at a depth of less than 2 feet.	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability.
Gotham: GoA, GoB, GoC2	Slight	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in substratum.
GsA, GsB, GsC2	Slight	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Moderate: silty substratum.
Hixton: HfB, HfC2, HfD2.	Moderate: sandstone bedrock at a depth of 2 to 4 feet.	Severe: little amelioration of leachate.	Moderate if slope is 0 to 12 percent, severe if more than 12; hazard of contamination of ground water.	Severe: rapid permeability in sandstone substratum.
Hixton, mottled subsoil variant: HmB.	Severe: seepage	Severe: seepage	Severe: seepage	Severe: sandstone substratum; seepage.
Houghton: Ho	Severe: organic material is more than 40 inches thick; permanent or seasonal water table at a depth of less than 1 foot.	Severe: high water table.	Severe: high water table.	Severe: organic material; moderately rapid permeability; high water table.
Hubbard: HuA, HuB, HuC2, Hv, HwC.	Slight	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability.
Kickapoo: Kc	Severe: seasonal water table; occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasiona flooding.
La Farge: LfB, LfC2, LfC3, LfD2, LfD3, LfE2.	Moderate: sandstone bedrock at a depth of 24 to 40 inches; springs and seeps in places.	Moderate if slope is 0 to 12 percent, severe it more than 12; partial amelioration of leachate.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Moderate if slope is 0 to 6 percent, severe if more than 6; moderate permeability; bedrock restricts use in places.
Lows: Lo	Severe: permanent or seasonal water table at a depth of less than 1 foot; hauling and excavation difficult.	Severe: high water table.	Very severe: high water table.	Severe: high water table; rapid permeability in substratum.
Markey: Ma	Severe: organic material is less than 40 inches thick; permanent or seasonal water table at a depth of less than 1 foot.	Severe: high water table.	Very severe: high water table.	Severe: high water table; rapid permeability.

See footnote at end of table.

TABLE 13.—*Degree and kind of limitations for nonfarm uses*—Continued

Soil series and map symbols	Highway location	Sanitary landfill [1]	Septic tank filter field	Sewage lagoons
Marshan: Mc	Severe: permanent or seasonal water table at a depth of less than 1 foot; hauling and excavation difficult.	Severe: high water table.	Very severe: high water table.	Severe: high water table; rapid permeability in substratum.
Meridian: MeA, MeB, MeC2.	Slight if nearly level; moderate if steeper.	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in substratum.
Morocco: Mo	Moderate: seasonal water table at a depth of 1 to 3 feet; loose sand hinders hauling; subject to soil blowing.	Severe: little amelioration of leachate; seasonal high water table.	Severe: seasonal high water table; hazard of contamination of ground water.	Severe: rapid permeability.
Morocco, loamy subsoil variant: Mr.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Newton: Ne	Severe: permanent or seasonal water table at a depth of less than 1 foot; hauling and excavating difficult.	Severe: high water table.	Very severe: high water table.	Severe: high water table; rapid permeability.
Norden: NrB, NrC2, NrD2, NrE2.	Moderate: sandstone bedrock at a depth of 2 to 4 feet; seeps and springs in places.	Moderate if slope is 0 to 12 percent, severe if more than 12; partial amelioration of leachate.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Moderate if slope is 0 to 6 percent, severe if more than 6; moderate permeability.
Northfield: NtA, NtB, NtC2.	Moderate: sandstone bedrock at a depth of less than 2 feet.	Severe: bedrock restricts use; little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in sandstone bedrock.
Otterholt: OsB, OsC2	Moderate: high frost heave potential in subsoil.	Slight if slope is 0 to 6 percent, moderate if more than 6.	Slight if slope is 0 to 6 percent, moderate if more than 6.	Moderate if slope is 0 to 6 percent, severe if more than 6; moderately rapid permeability in substratum.
Palsgrove: PaB, PaC2, PaD2.	Moderate if slope is 0 to 12 percent, severe if more than 12; highly plastic; moderate frost heave potential.	Moderate if slope is 0 to 12 percent, severe if more than 12, hazard of unameliorated leachate containing ground water.	Moderate if slope is 0 to 12 percent, severe if more than 12; moderately slow permeability in substratum.	Slight if slope is 0 to 2 percent, moderate if 2 to 6, severe if more than 6; moderate permeability in subsoil.
Pillot: Pc	Moderate: moderate frost heave potential in subsoil.	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in substratum.
Plainbo: PdB, PdC2, PdF.	Moderate if slope is 0 to 12 percent, severe if more than 12; loose sand hinders hauling; sandstone bedrock at a depth of 20 to 40 inches.	Severe: little amelioration of leachate.	Moderate if slope is 0 to 12 percent, severe if more than 12; hazard of contamination of ground water.	Severe: rapid permeability in sandstone bedrock.
Plainfield: PfA, PfB, PfC2.	Slight if slope is 0 to 6 percent, moderate if more than 6; loose sand hinders hauling; subject to soil blowing.	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability.
Poskin: Po	Moderate: seasonal water table at a depth of 1 to 3 feet; high frost heave potential in subsoil.	Severe: little amelioration of leachate.	Severe: seasonal high water table; hazard of contamination of ground water.	Severe: rapid permeability in substratum.

See footnote at end of table.

TABLE 13.—*Degree and kind of limitations for nonfarm uses*—Continued

Soil series and map symbols	Highway location	Sanitary landfill [1]	Septic tank filter field	Sewage lagoons
Renova: RaB, RaC2, RaD2.	Moderate frost heave potential; plastic.	Moderate if slope is 0 to 12 percent, severe if more than 12; water ponds in clayey substratum.	Moderate if slope is 0 to 12 percent, severe if more than 12; moderately slow permeability.	Moderate if slope is 0 to 6 percent, severe if more than 6; moderate permeability.
Rib: Rb	Severe: permanent or seasonal water table at a depth of less than 1 foot; high frost heave potential in subsoil.	Severe: high water table.	Severe: high water table; hazard of contamination of ground water.	Severe: high water table; rapid permeability in substratum.
Rib, moderately shallow variant: Rc.	Severe: permanent or seasonal water table at a depth of less than 1 foot; shale and sandstone bedrock at a depth of 2 to 4 feet.	Severe: high water table.	Severe: high water table.	Moderate: high water table; moderate permeability in subsoil.
Riverwash: Re	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Santiago: SaB,, SaC2	Moderate: high frost heave potential in subsoil.	Slight if slope is 0 to 6 percent, moderate if more than 6.	Slight if slope is 0 to 6 percent, moderate if more than 6.	Moderate if slope is 0 to 6 percent, severe if more than 6; moderate permeability.
Seaton: SeB, SeC2, SeD2, SeE2, SfA, SfB.	Moderate if slope is 0 to 12 percent, severe if more than 12; high frost heave potential; highly erodible.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Moderate if slope is 0 to 6 percent, severe if more than 6; moderate permeability.
Shiffer: Sh	Moderate: seasonal water table at a depth of 1 to 3 feet.	Severe: little amelioration of leachate; seasonal high water table.	Severe: seasonal high water table; hazard of contamination of ground water.	Severe: rapid permeability in substratum.
Steep stony rock land: StF.	Severe: shallow to sandstone and limestone.	Severe: bedrock restricts use.	Severe: steep	Severe: steep and rocky.
Stronghurst: Su	Moderate: seasonal water table at a depth of 1 to 3 feet; moderate frost heave potential.	Moderate: seasonal high water table; difficult to work when wet.	Severe: seasonal high water table.	Moderate: moderate permeability.
Tell: TeA, TeB, TeC2	Slight if slope is 0 to 6 percent, moderate if more than 6; moderate frost heave potential in subsoil.	Severe: little amelioration of leachate.	Moderate: hazard of contamination of ground water.	Severe: rapid permeability in substratum.
Terrace escarpments:				
Tn	Severe: steep, unstable sandy material.	Severe: little amelioration of leachate.	Severe: steep	Severe.
To	Severe: steep	Severe: little amelioration of leachate.	Severe: hazard of contamination of ground water.	Severe: rapid permeability in substratum; stony in places.
Terril: Tr	Severe: subject to flooding; high frost heave potential.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: moderate permeability; subject to flooding.

See footnote at end of table.

TABLE 13.—*Degree and kind of limitations for nonfarm uses*—Continued

Soil series and map symbols	Highway location	Sanitary landfill [1]	Septic tank filter field	Sewage lagoons
*Urne: UeD2, UeF, UnB, UnC2, UnD2, UnE2, UnF. For Elkmound part of UeD2 and UeF, see Elkmound series. For Norden part of UnB, UnC2, UnD2, UnE2, and UnF, see Norden series.	Moderate if slope is 0 to 12 percent, severe if more than 12; sandstone bedrock at a depth of 2 to 4 feet; high frost heave potential in subsoil.	Moderate if slope is 0 to 12 percent, severe if more than 12; amelioration of leachate.	Moderate if slope is 0 to 12 percent, severe if more than 12; bedrock restricts use.	Moderate if slope is 0 to 6 percent, severe if 6 to 12, very severe if more than 12; moderate permeability.
Wallkill: Wa	Severe: seasonal water table at a depth of less than 1 foot; high frost heave potential; organic material at a depth below 2 to 3 feet.	Severe: high water table; subject to flooding.	Very severe: high water table.	Severe: high water table; substratum is organic material.

[1] Onsite investigation is needed for landfills deeper than 5 or 6 feet. These studies should be made to determine the characteristics of the underlying strata, the fluctuation of the water table, and the hazard of aquifer pollution and drainage into ground water.

In the Unified system (*14*) soils are classified on the basis of particle size distribution, plasticity, liquid limit, and organic-matter content. They are grouped according to their performance as material for engineering construction. Soils are grouped in 15 classes—eight classes of coarse-grained soils, six classes of fine-grained soils, and one class of highly organic soils. Table 10 gives the classification of all soils of the county according to all three classification systems.

Engineering Test Data

Table 9 gives test data for samples of soils of the Dunnville, Santiago, and Chetek series. The soils were sampled at representative locations, and the samples were tested by the State Highway Commission of Wisconsin under a cooperative agreement with the U.S. Department of Commerce, Bureau of Public Roads. Testing was in accordance with standard procedures of the American Association of State Highway Officials. The results of these tests and the classification of each soil sample according to both the AASHO and Unified systems are given in the table. Test data for soils of the Otterholt, Renova, and Seaton series have been published in the soil survey for Pierce County, Wisconsin.

The samples tested do not represent the entire range of soil characteristics in Dunn County, or even the entire range of the three series sampled. The data can be used, however, as a general guide in estimating the physical properties of the soils of the county.

In the moisture density, or compaction, test a sample of the soil material is compacted several times with a constant campactive effort, each time at a successively higher moisture content. The moisture content increases until the optimum moisture content is reached. After that, the density decreases with increase in moisture content. The highest density obtained in the compaction test is termed "maximum dry density." Moisture-density data are important in construction, 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.

The results of the mechanical analysis, obtained by combined sieve and hydrometer methods, may be used to determine the relative proportions of the different size particles that make up the soil sample. The percentage of fine-grained material, obtained by the hydrometer method, which generally is used by engineers, should not be used in determining textural classes of soils.

The tests to determine liquid limit and plastic limit measure the effect of water on 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 soil material passes from a plastic to a liquid state. The plasticity index is the numerical difference between liquid limit and plastic limit. It indicates the range in moisture content within which a soil material is in a plastic condition.

Estimated Engineering Properties

In table 10 the soil series and map symbols for each are listed and estimates of properties significant in engineering are given. The estimates are for undisturbed soil. They are based on data shown in table 9, on test

data from similar soils in other counties, on comparison with similar soils that have been tested, and on study of the soils in the field.

The dominant USDA texture, and the Unified and AASHO classifications, are shown in the table for each of the major soil horizons. Also shown are the estimated percentages of material passing through the various sieves.

Estimated depth to seasonal high water table refers to the highest level at which the ground water stands for a significant period of time. Ordinarily, free water stands at this level in spring or during a prolonged wet period. The depth to the water table is related to the natural drainage of the soils, as follows: 0 to 1 foot, poorly drained or very poorly drained; 1 foot to 3 feet, somewhat poorly drained; 3 to 5 feet, moderately well drained; and 5 feet or more, well drained.

The permeability of a soil horizon is the rate at which water moves through the undisturbed soil material when the soil is saturated. The estimates are in inches per hour.

Available water capacity refers to the amount of water that can be stored in the soil for the use of plants. It is expressed as inches of water per inch of soil.

Shrink-swell potential is an indication of the volume change that can be expected with changes in moisture content. It depends largely on the amount and type of clay and on the organic-matter content of the soil.

Engineering Interpretations

Tables 11, 12, and 13 give engineering interpretations for the soils of Dunn County. In table 11 the soils are rated according to their suitability as sources of topsoil, sand and gravel, and road fill. Also listed are soil limitations that affect the use of the soils as foundations for low buildings. The table also rates the soils for corrosion potential for metal conduits. Table 12 lists soil features affecting agricultural drainage, irrigation, terraces and diversions, and farm ponds. Table 13 shows soil limitations that affect highway location, sanitary landfill, septic tank filter fields, and sewage lagoons.

In tables 11 and 13 a rating of *slight* means that a soil has no limitations or has limitations for a given use that are easily overcome. A rating of *moderate* means that the soil has limitiations for a given use that can be overcome by average management and careful design. A rating of *severe* means that the soil has limitations for a given use that are difficult to overcome. A rating of *very severe* means that the soil has limitations that generally preclude its use for a given purpose.

The ratings given the soils in table 11 as sources of topsoil, sand and gravel, and road fill are good, fair, poor, and unsuitable. Topsoil refers to soil material that is used as topdressing for roadbanks, parks, gardens, and lawns. In the column showing suitability as a source of sand and gravel, the ratings are based on the characteristics of the soil material to a depth of 5 feet.

Ratings of the limitations that affect use as subgrade material for roads are determined by the characteristics that enable soils to support base courses, including curbs and gutters, in highway construction.

The limitations of an undisturbed soil for use as support for low buildings depend mainly on bearing capacity and expansion potential. The ratings in table 11 are for the substratum only, because it is assumed that the base of the foundation is below the depth at which the soil is subject to shrink-swell action, root penetration, and frost heaving.

Also shown in the table is the corrosion potential of the soils for metal conduits laid underground. Generally, the characteristics of soils that are most corrosive to metal pipes are poor aeration, a high pH value, a high content of salt, and a high content of moisture.

Table 12 lists soil features that affect selected farm uses. Agricultural drainage is affected mainly by depth to the water table and by soil permeability. In some soils the substratum is unstable, and tile drains are difficult to maintain.

The most important features affecting the use of soils for irrigation are available water capacity, the rate of water intake, natural drainage, and slope. Available water capacity is the total quantity of water that will not drain away but can be taken up by plant roots to a depth of 5 feet or to bedrock, whichever is less. The ratings are very high, more than 12 inches; high, 9 to 12 inches; medium, 6 to 9 inches; low, 3 to 6 inches; and very low, less than 3 inches. The rate of water intake is an evaluation of the combined effects of the initial infiltration rate and the soil permeability.

Also shown in table 12 are features of the soils that determine suitability for terraces and diversions. The main features are slope, soil depth, and soil stability. Depth must be adequate for the excavation of a shallow channel that will carry flowing water. Stability affects the ease or difficulty of maintaining terraces and diversions.

In addition, the table lists soil features that influence the construction of the reservoir area and the embankment of farm ponds. Among the features that affect reservoir areas are soil permeability, depth to bedrock, depth and permeability of the substratum, and depth to the water table. Affecting embankments are compaction characteristics, soil stability, and perviousness of the soil material when compacted. Perviousness refers to water permeability of the soil material. The ratings are very pervious, more than 20 feet per day; pervious, 3 to 20 feet per day; semipervious, 0.003 foot to 3 feet per day; and impervious, less than 0.003 foot per day. The features considered for reservoir areas are for undisturbed soil materials. Those for embankments are for soil materials that have been disturbed.

In table 13 the soils of the county are rated according to their limitations for various nonfarm uses. Highway location is affected by such soil features as presence of organic material, the thickness of organic layers, depth to bedrock, presence of and depth to a high water table (permanent or seasonal), frost heave potential, and plasticity of the soil material. External soil features that affect highway location are stability of slopes, erodibility, hazard of flooding, topography (the need for cuts and fills), and the ease of excavation. Areas that have springs or seepy spots are very unfavorable as highway locations.

Soil texture is important to location of sanitary landfills because of the need to gradually remove, by leaching, toxic or other substances detrimental to health. Other factors that help determine limitations of the soils

for this purpose are internal drainage or soil wetness, depth to the water table, and depth to bedrock. Soil slope, hardness of the bedrock, presence of stones, and the hazard of flooding are also important.

Soil permeability is an important feature in determining the limitations of soils for septic tank filter fields. Effluent is held above soil layers if permeability is moderately slow to very slow and will eventually emerge on the surface of the soil. Rapidly permeable soils (fig. 12) permit effluent to move into the ground water with very little amelioration or very little breakdown of noxious substances through bacterial activity.

The depth to the water table is important because of the hazard of contamination where the soil layer is thin over ground water. Where there is a hazard of flooding, the soils have very severe limitations for filter fields. The systems will not function when flooded, and there is danger of spreading effluent to downstream areas. Where soils are very steep, the effluent is likely to flow laterally and seep out at the surface.

Impervious bedrock or other impervious strata restrict adequate leaching of the effluent. Impervious layers near the surface of the soil will cause unleached effluent to flow laterally and emerge on the surface as seepage.

The hazard of contamination of ground water is always a factor in selection of a site for septic tank filter fields. Where soils are underlain by fractured or creviced bedrock near the surface there is a danger of effluent flowing for long distances and eventually getting into the ground water.

Soil requirements for basin floors of lagoons are imperviousness of the soil to seepage, a smooth surface that is nearly level, and little or no organic matter in the soil. Specifications for lagoons state that the liquid depth should be not less than 2 feet and generally not more than 5 feet, that the floor should be as nearly level as possible, and that the materials for the basin floor should be sufficiently impervious to preclude excessive liquid loss. The impervious soil material should be at least 1 foot thick. This is especially important in the vicinity of shallow wells that may be contaminated.

Formation and Classification of the Soils [6]

In this section the factors that have affected the formation of the soils in Dunn County are discussed. Then, the current system of soil classification is explained, and a table gives the classification of the soil series by higher categories. The soil series in the county and a profile representative of each series are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soil is produced by the interaction of soil-forming processes on material deposited by geologic agents. The characteristics of the soil at any given point are determined by (1) the composition of the parent material;

[6] PAUL CARROLL, soil correlator, helped prepare this section.

Figure 12.—**Urbanization on rapidly permeable Plainfield loamy sand.**

(2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the processes of soil development have been active.

Climate and plant and animal life, especially vegetation, are the active factors of soil formation. They act on the parent material and change it into a natural body with genetically related horizons. All five factors come into play in the formation of every soil, but the relative importance of each factor varies from place to place. In some places one factor is dominant and fixes most of the properties of a soil. Normally, however, the interaction of all five factors determines the kind of soil that develops in any given place.

The soils of Dunn County formed in loess consisting mostly of silt; in material weathered from limestone, shale, and sandstone; in loamy glacial till; and in loamy and sandy material washed downslope, transported by streams, and deposited on stream terraces and bottom lands. Some of the material deposited on bottom lands and terraces was glacial outwash that originated as glacial drift within the county or from other areas. Residuum from bedrock, loess, and glacial till are the more common parent materials, but glacial outwash and alluvium are also important.

The loess, where present, ranges from 1 to 10 feet in thickness throughout the county. It is generally thickest in nearly level areas on uplands in the western part of the county. Seaton soils, which formed in thick deposits of loess, are extensive in these areas. Otterholt and related soils formed in areas where the mantle of loess is underlain by glacial till at depths of about 42 inches. Santiago, Renova, and similar soils formed in moderately thick deposits of loess over till. La Farge and Dubuque soils formed in moderately thick deposits of loess over, respectively, sandstone and limestone. The lower part of the solum of each of these soils formed in residuum from the parent rock. The parent material of the Urne and Elkmound soils and many other soils of the county was derived from residuum from exposed bedrock.

Glacial outwash and alluvium were the parent material of several of the soil series. Soils of the glacial outwash plains were originally deposited as alluvium from adjacent areas of glacial till. Such soils as those of the Tell and Pillot series are representative. Loess now covers some of these areas.

Some outwash plains have no loess covering, and in these areas are sandy soils of the Plainfield, Gotham, and Hubbard series. The dominant areas of alluvial soil material are along the Chippewa, Eau Galle, and Red Cedar Rivers. Soils of the Caryville and Arenzville series and the land type Alluvial land, wet, formed in this recently deposited material. Limited deposits of organic material are along the upper reaches of small streams, such as Mud Creek, Trout Creek, Otter Creek, and the upper tributaries of the Hay River. This material consists mostly of such vegetable matter as sedges and grasses that are sufficiently decomposed to make recognition of the plant parts impossible. Soils of the Markey, Cathro, and Houghton series developed in this material.

Climate affects soil formation through the moisture and heat it contributes to an environment. It influences the formation of soils both directly and indirectly. Its most important direct effect is on the weathering of rocks and the alteration of parent material. Its indirect effects are of equal or even greater importance. For example, the clay content of soils is generally greater where precipitation and temperature are high than where they are relatively low. Climate indirectly provides a suitable environment for living organisms and is of special significance in the accumulation of organic matter and the fertility of the soil. Soils of the Pillot, Dakota, and Dunnville series are representative of fertile soils in this county.

In Dunn County the climate is modified locally by variations in relief. Where slopes are steep, runoff is more rapid and less rainfall soaks into the soil. As a result, plant growth, microbiological activity, and disintegration and weathering of rock are retarded. Elkmound soils are an example of soils that are shallow largely because their slope allows less water to penetrate the soil.

The plant and animal life that influences the formation of soils in this county consists chiefly of vegetation, but bacteria, fungi, earthworms, rodents, and man are also important. Two of the chief functions of plant and animal life are to supply organic matter to the soil and to bring plant nutrients from the lower part of the solum to the upper layers.

Before the county was settled, the vegetation was mostly dense stands of hardwoods and conifers in most of the county. In the central and southern parts, however, grasses were predominant and trees were almost entirely lacking. The soils that formed under forest cover have a gray surface layer, such as that of the Seaton, Norden, Chetek, and Plainfield soils. The soils that formed under grasses have a very dark brown surface layer, such as that of the Dakota and Pillot soils; the color of these soils indicates a relatively high content of organic matter. The difference in the content of organic matter between the dark-colored soils of grassy areas and the light-colored soils of forested areas is partly because soils that formed under forest are generally more acid than soils that formed under grass. The relatively nonacid humus of grasslands is more stable than the acid humus of forests.

Man has changed the soil mainly through long-continued cultivation. These changes include (1) altering the pH value and fertility of acid soils by liming; (2) perpetuating grass by burning over areas that are normally wooded; (3) using cropping practices that cause organic matter to be lost; and (4) accelerating erosion by removing the plant cover on terraces and uplands. Soils of the Arenzville series are an example of soils that formed through erosion and subsequent transportation and deposition of upland or terrace silt over wet, dark-colored recent alluvium.

The effect of relief on formation of the soils of this county has been mainly on the depth of the soils and the texture of the subsoil. Steep soils are generally shallow. The less steep soils are progressively deeper as the slope decreases. For example, the Elkmound and Northfield soils are derived from the same kind of parent material, but the Elkmound soils lack the textural and structural B horizon of the more gently sloping Northfield soils.

Differences in slope are closely related to natural soil drainage, which is generally reflected in the color and

degree and kind of mottling in the soil profile. For example, well-drained, gently sloping Otterholt soils are free of mottling in the A and B horizons. The poorly drained variant of the Almena soils is similar to the Otterholt soils but occurs in depressions and swales and has mottled A and B horizons.

Time is required for the active factors of soil formation to form soils from parent material. Some soils form rapidly; others form slowly. The length of time required for a particular kind of soil to form is dependent on the other factors involved.

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. Examples of immature soils in Dunn County are those of the Arenzville series and the dark variant of the Boaz series. These soils have little or no horizonation, but layering may be evident.

Generally, a soil is considered mature when it has 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.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

The system of classifying soils currently used by the National Cooperative Soil Survey was adopted in 1965 (*13*). It is under continual study (*11*).

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 14 shows the classification of each soil series of Dunn County by family, subgroup, and order, according to the current system. The classes of this system are briefly defined in the following paragraphs.

Order.—Ten soil orders are recognized in the current system: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Ovisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, the Entisols and Histosols, occur in many different kinds of climate. The five orders represented in Dunn County are Alfisols, Entisols, Histosols, Inceptisols, and Mollisols.

Alfisols formed mostly under trees, but some formed under grass. They are light colored and have a base saturation of more than 35 percent. The base saturation increases as depth increases.

Entisols are mineral soils that show only slight modification from the geologic material in which they formed.

Histosols are highly organic soils that are saturated with water at some season of the year unless they have been artificially drained. The Histosols order has not been completely defined.

Inceptisols are mineral soils in which horizons have definitely begun to develop. They generally are on young, but not recent, land surfaces.

Mollisols formed mostly under grass. They have a thick, friable, dark-colored surface layer. Base saturation is more than 50 percent.

Suborder.—Each order is divided into suborders, primarily on the basis of characteristics that seem to produce classes having genetic similarity. Mainly, these are characteristics that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. The climatic range is narrower than that of the orders.

Great group.—Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major horizons and other features. The horizons used as a basis for distinguishing between great groups are those in which clay, iron, or humus have accumulated and those that have pans that interfere with the growth of roots or the movement of water. The other features commonly used to distinguish great groups are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly the bases calcium, magnesium, sodium, and potassium), or the dark-red or dark-brown colors associated with soils that formed in material weathered from basic rocks. The great group is not shown separately in table 14, because it is the last word in the name of the subgroup.

Subgroup.—Each great group is divided into subgroups. One of these represents the central, or typic, seg-

TABLE 14.—*Classification of soil series by higher categories*

Series	Family [1]	Subgroup	Order
Almena	Fine-silty, mixed, frigid	Aeric Glossaqualfs	Alfisols.
Almena, wet variant	Fine-silty, mixed, frigid	Typic Glossaqualfs	Alfisols.
Amery	Coarse-loamy, mixed	Glossic Eutroboralfs	Alfisols.
Arenzville	Coarse-silty, mixed, nonacid, mesic	Typic Udifluvents	Entisols.
Arland	Fine-loamy over sandy or sandy-skeletal, mixed	Eutric Glossoboralfs	Alfisols.
Billett	Coarse-loamy, mixed, mesic	Mollic Hapludalfs	Alfisols.

See footnotes at end of table.

TABLE 14.—*Classification of soil series by higher categories*—Continued

Series	Family [1]	Subgroup	Order
Billett, mottled subsoil variant	Coarse-loamy, mixed	Aquic Eutroboralfs	Alfisols.
Boaz	Fine-silty, mixed, nonacid, mesic	Aeric Haplaquepts	Inceptisols.
Boaz, dark variant	Fine-silty, mixed, frigid (fluventic)	Typic Haplaquolls	Mollisols.
Brems [2]	Mixed, mesic	Aquic Udipsamments	Entisols.
Burkhardt	Sandy, mixed, mesic	Typic Hapludolls	Mollisols.
Campia [2]	Fine-silty, mixed	Typic Glossoboralfs	Alfisols.
Caryville	Sandy, mixed	Fluventic Haploborolls	Mollisols.
Cathro	Loamy, mixed, euic	Terric Borosaprists	Histosols.
Chetek	Coarse-loamy, mixed	Eutric Glossoboralfs	Alfisols.
Dakota	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Argiudolls	Mollisols.
Dickinson [2]	Coarse-loamy, mixed, mesic	Typic Hapludolls	Mollisols.
Dubuque [2]	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Dunbarton	Clayey, montmorillonitic, mesic	Lithic Hapludalfs	Alfisols.
Dunnville	Coarse-loamy, mixed	Udic Haploborolls	Mollisols.
Dunnville, silty subsoil variant	Coarse-silty, mixed	Typic Haploborolls	Mollisols.
Eleva	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Elkmound	Loamy, mixed, mesic (siliceous)	Lithic Dystrochrepts	Inceptisols.
Gotham	Sandy, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Hixton	Fine-loamy over sandy or sandy-skeletal, mixed, mesic (coarse-loamy).	Typic Hapludalfs	Alfisols.
Hixton, mottled subsoil variant	Fine-loamy over sandy or sandy-skeletal, mixed	Aquic Glossoboralfs	Alfisols.
Houghton	Euic, mesic	Typic Medisaprists	Histosols.
Hubbard	Sandy, mixed	Udic Haploborolls	Mollisols.
Kickapoo	Coarse-loamy, mixed, nonacid, mesic	Typic Udifluvents	Entisols.
La Farge	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Lows	Fine-loamy over sandy or sandy-skeletal, mixed, nonacid, frigid.	Mollic Haplaquepts	Inceptisols.
Markey	Sandy or sandy-skeletal, mixed, euic	Terric Borosaprists	Histosols.
Marshan [2]	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Haplaquolls	Mollisols.
Meridian	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Mollic Hapludalfs	Alfisols.
Morocco	Mixed, mesic	Aquic Udipsamments	Entisols.
Morocco, loamy subsoil variant	Sandy over loamy, mixed, nonacid, frigid	Aquic Udorthents	Entisols.
Newton	Sandy, mixed, mesic	Typic Humaquepts	Inceptisols.
Norden	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Northfield	Loamy, mixed, mesic	Lithic Hapludalfs	Alfisols.
Otterholt	Fine-silty, mixed	Typic Glossoboralfs	Alfisols.
Palsgrove	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Pillot [2]	Fine-silty over sandy or sandy-skeletal, mixed, mesic.	Typic Argiudolls	Mollisols.
Plainbo	Mixed, frigid	Typic Udipsamments	Entisols.
Plainfield	Mixed, mesic	Typic Udipsamments	Entisols.
Poskin	Fine-silty over sandy or sandy-skeletal, mixed	Aquic Glossoboralfs	Alfisols.
Renova [2]	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Rib	Fine-silty over sandy or sandy-skeletal, mixed, nonacid, frigid (mesic).	Mollic Haplaquepts	Inceptisols.
Rib, moderately shallow variant	Fine-silty, mixed, frigid (fine loamy)	Typic Haplaquolls	Mollisols.
Santiago	Fine-loamy, mixed	Typic Glossoboralfs	Alfisols.
Seaton	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Shiffer	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Aquollic Hapludalfs	Alfisols.
Stronghurst	Fine-silty, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Tell [2]	Fine-silty over sandy or sandy-skeletal, mixed, mesic.	Typic Hapludalfs	Alfisols.
Terril	Fine-loamy, mixed, mesic	Cumulic Hapludolls	Mollisols.
Urne	Coarse-loamy, mixed, mesic	Dystric Eutrochrepts	Inceptisols.
Wallkill [2]	Fine-loamy, mixed, nonacid, mesic	Thapto Histic Fluvaquents	Entisols.

[1] All series listed in the mesic temperature class are cooler than is normal for the series. All series listed as frigid are warmer than is normal. This is because the dividing line between temperature zones runs approximately through the center of Dunn County, where the mean annual soil temperature is 47° F.

[2] These soils are taxadjuncts. The reasons for excluding them from the series with which they are here identified are as follows:

Brems.—Lack mottles that have chroma of 2 or less within the control section (depths between 10 and 40 inches).

Campia.—Content of fine sand and coarser sand is more than 15 percent.

Dickinson.—More pebbles within a depth of 40 inches than is defined as the range for the series.

Dubuque.—In some areas, 6 inches or more of clay is above the limestone.

Marshan.—Lower temperature and lack of gravel in the underlying material.

Pillot.—Lacks silty clay loam texture in the B horizon.

Renova.—Solum is less than 40 inches thick.

Tell.—Darker colored surface layer than is defined as the range for the series.

Wallkill.—Less sand in the control section.

ment of the group. Other subgroups, called intergrades, have properties of one great group and also one or more properties of another great group, suborder, or order. Subgroups may also be established for soils having properties that intergrade outside the range of any other great group, subgroup, or order.

Family.—Families are established within a subgroup primarily on the basis of properties that affect the growth of plants or the behavior of soils when used for engineering. Among the properties are texture, clay composition, reaction, soil temperatures, permeability, thickness of horizons, and consistence.

Series.—The series consists of a group of soils that formed in a particular kind of parent material and that have genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile. Among these characteristics are color, structure, reaction, consistence, and mineral and chemical composition.

General Nature of the County

This section gives general information about the county. It discusses climate, early settlement, and farming.

Climate [7]

Dunn County has a continental climate, characterized by marked changes in weather. This kind of climate is common in areas in the interior of large land masses of the middle latitudes.

Winters are cold and snowy. Snowfall has ranged from 92 inches in 1950 to 11 inches in 1958. The average date of the first snowfall of 1 inch or more is November 19. The chance that 1 inch of snow will fall by October 24 is 1 year in 10, and the chance that this amount will fall by December 16 is 9 years in 10.

Summers are warm and usually include periods that are hot and humid. Spring and fall are transitional periods between summer and winter and are sometimes short. Changes in the weather can be expected every few days in winter and spring.

Table 15 shows the probability of the last low temperature in spring and the first in fall. Table 16 gives temperature and precipitation data. The data in these tables are based on records at Menomonie and are fairly representative of the county as a whole. The minimum temperatures throughout the county may vary considerably, however, on calm, clear nights because temperature is affected by topography and soil type. Usually, the temperature in the valleys is several degrees cooler than at the higher elevations.

The average date of the last temperature of 32° F. in spring is May 10, and the first in fall is September 29. The growing season, defined as the number of days between the latest date in spring when the temperature reaches freezing and the first in fall, averages 142 days.

The average number of days in a year when the temperature reaches 90° F. or higher is 20, but the number has ranged from 34 in 1964 to 4 in 1951 and 1967. The average number of days when the temperature falls to zero or below is 30, but the number has ranged from 49 days in 1955 to 19 in 1944 and 1954. The highest temperature recorded at Menomonie since 1938 was 101°, and the lowest was -40°. At neighboring weather stations, a high temperature of 107° was recorded in May 1934 and a temperature of 111° was recorded in July 1936.

About 65 percent of the annual precipitation falls in the period May through September in an average year. The probability that 1 inch or more of rain will fall in a 7-day period in summer is greatest during the last 3 weeks of June, when the probability is more than 4 years in 10. The probability that no measurable amount of rain will fall in a 7-day period in summer is greatest in mid-August, when the probability is about 2 years in 10. Heavy rainfall of about 1.25 inches in 1 hour, 1.95 inches in 6 hours, and 2.60 inches in 24 hours can be expected about once in 2 years.

Thunderstorms occur on an average of 41 days a year, but the number ranges from 59 days to 22. Hailstorms

[7] By Hans E. Rosendal, climatologist for Wisconsin, National Weather Service, U.S. Department of Commerce.

TABLE 15.—*Probabilities of last low temperatures in spring and first in fall*

[All data from Menomonie]

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:					
1 year in 10 later than	April 13	April 21	May 1	May 13	May 25
2 years in 10 later than	April 8	April 15	April 26	May 7	May 20
5 years in 10 later than	March 28	April 5	April 16	April 27	May 10
Fall:					
1 year in 10 earlier than	October 29	October 22	October 8	September 23	September 13
2 years in 10 earlier than	November 4	October 27	October 14	September 29	September 19
5 years in 10 earlier than	November 15	November 7	October 25	October 10	September 29

TABLE 16.—*Temperature and precipitation data*

[All data from Menomonie]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Average maximum	Average minimum	Average precipitation	One year in 10 will have—		Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover
						Less than—	More than—		
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January	24	5	39	−25	0.7	0.3	1.7	24	8
February	28	8	47	−17	.9	.2	1.9	22	10
March	40	19	61	−6	1.8	.8	3.0	18	8
April	58	34	79	18	2.8	1.5	4.0	5	3
May	71	45	87	29	4.1	1.9	6.1	(1)	2
June	80	56	92	39	4.8	2.7	6.2	0	0
July	84	60	94	46	4.1	1.7	5.5	0	0
August	83	58	92	42	3.7	2.1	5.5	0	0
September	73	49	87	30	3.3	1.2	6.6	0	0
October	62	39	80	21	1.8	.6	3.7	(1)	1
November	41	25	60	3	1.5	.7	3.1	7	2
December	29	13	47	−13	1.2	.3	1.9	19	5
Year	56	34	[2] 95	[3] −27	30.7	23.0	40.0	96	7

[1] Less than half a day. [2] Average annual maximum. [3] Average annual minimum.

occur on an average of 2 days a year, but the number ranges from 7 days to none. Violent windstorms associated with thunderstorms or small squall lines occasionally pass over the county. Tornadoes are infrequent; in the 50-year period since 1916, seven tornadoes have touched down.

The prevailing winds are from the northwest from November through April and from the southeast the rest of the year. April is the windiest month, when windspeed averages 13 miles per hour. July and August are the least windy; in these months windspeed averages 9 miles per hour. The average windspeed for the year is less than 4 miles per hour about 10 percent of the time, 4 to 12 miles per hour about 55 percent of the time, 13 to 31 miles per hour about 35 percent of the time, and more than 31 miles per hour less than 1 percent of the time. The highest windspeeds usually occur when winds are from the northwest, west, or southwest.

The length of the daylight hours ranges from approximately 15½ hours late in June to 9 hours late in December. The percentage of the daylight hours when the sun is visible averages between 60 and 70 percent from June through September. The sun shines nearly 40 percent of the daylight hours in November and December, and between 50 and 60 percent of the daylight hours in the remaining months.

Early Settlement

Lumbering was important in the early development of Dunn County. A lumber company, established in Menomonie in 1846 as a mill with a daily capacity of about 5,000 board feet, soon developed into one of the largest lumber concerns in the country. The operations of this company expanded to include many kinds of businesses, but as timber resources declined the operations of the company also declined.

Railroad construction progressed rapidly between 1860 and 1890, and a large volume of lumber was transported by rail. During this period, also, lumber and logs were rafted down the Red Cedar River to the Mississippi.

Early settlers were attracted to the area by the work available in the lumber camps. Farmers began permanent settlement in 1846 at Wilsons Creek. Farm enterprises were sponsored by the lumber companies, and many farms were established between 1860 and 1890. In these years the number of farms increased from 103 to 2,714, and farm acreage increased from about 5 percent of the county to about 65 percent. After 1890, establishment of farms and expansion of farm acreage progressed more slowly, but since 1920 more than 90 percent of the acreage of the county has been farmed.

Farming

Dunn County is mainly agricultural, and dairying is the main source of income. In the relatively short span of years the land has been farmed, much of the original topsoil has been lost through water erosion and soil blowing. Such losses can be reduced by use of such practices as stripcropping, terracing, sodded waterways, and adequate cropping systems.

Renovation of permanent pastures would improve the available water capacity of the soils and increase the feed value of the forage. Minimum tillage practices, such as wheel-track planting of corn and the control of weeds, are important in maintaining soil tilth and conserving soil and moisture in sloping areas.

In 1960 a conservation needs study showed that 65 percent of the land area is suited to crops. At present, 45 percent of this acreage is used for crops, but the acreage in crops is decreasing. If this downward trend continues, the acreage in cultivation will decrease to 42 percent by 1975 Some of the acreage suitable for crops will remain

in woods and pasture and in uses other than farming. About 7 percent of the land area of the county is not suited to cultivation, because of wetness, stoniness, or susceptibility to flooding. These areas are suited to grass, trees, and wildlife habitat. About 19 percent is unsuitable for cultivation but is suited to timber production and food and cover for wildlife.

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Glossary

Acidity. See Reaction.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

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.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour or 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, or diversion terrace. A ridge of earth, generally a terace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Dolomite. A calcium-magnesium carbonate mineral. Limestone that contains magnesium carbonate is commonly called dolomitic limestone.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Friability. Term for the ease with which soil crumbles. A friable soil is one that crumbles easily.

Glacial drift (geology). Rock material transported by glacial ice and then deposited; also includes the assorted and unassorted materials deposited by streams flowing from glaciers.

Glacial outwash (geology). Cross-bedded gravel, sand, and silt deposited by melt-water as it flowed from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes.

These are the major horizons :

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Lacustrine deposit (geology). Material deposited in lake water and exposed by lowering of the water level or elevation of the land.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited 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.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Muck. An organic soil consisting of fairly well decomposed organic material that is relatively high in mineral content, finely divided, and dark in color.

Peat. Unconsolidated soil material, largely undecomposed organic matter, that has accumulated where there has been excess moisture.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

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 on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stone line. A concentration of coarse rock fragments in soils that generally represents an old weathering surface. In a cross section, the line may be one stone or more thick. The line generally overlies material that weathered in place, and it is ordinarily overlain by sediment of variable thickness.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

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. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

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. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs. In referring to a capability unit, a woodland group, or any other group, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, page 6.
Predicted yields, table 2, page 57.
Wood crops, table 3, page 60.
Trees suitable for planting, table 4, page 64.
Shrub and vine planting guide, table 5, page 66.
Recreation, table 6, page 70.
Engineering, tables 9, 10, 11, 12, and 13, pages 76 to 107.

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Tree and shrub group	Wildlife group	Recreation group
			Symbol	Page	Symbol	Number	Number	Number
Ad	Alluvial land, loamy	6	IIIw-12	53	3w5	3	7	8
Ae	Alluvial land, sandy	6	VIIs-9	56	6s1	---	7	8
Af	Alluvial land, wet	7	Vw-14	55	4w5	3	5b	7
AmB	Almena silt loam, 2 to 6 percent slopes	8	IIw-2	52	2w5	3	5a	5
An	Almena silt loam, wet variant	8	IIw-2	52	2w5	3	5a	5
AsB	Amery loam, 2 to 6 percent slopes	9	IIe-1	51	2o1	1	1	1
AsC2	Amery loam, 6 to 12 percent slopes, eroded	9	IIIe-1	53	2o1	1	1	1
AsD2	Amery loam, 12 to 20 percent slopes, eroded	9	IVe-1	54	2r2	1	1	1
At	Arenzville silt loam	10	IIw-11	53	2o1	1	7	8
AuC2	Arland sandy loam, 6 to 12 percent slopes, eroded	10	IVe-4	54	2o1	1	1	2
AuD2	Arland sandy loam, 12 to 20 percent slopes, eroded	10	VIe-2	55	2r2	1	1	2
BlA	Billett sandy loam, 0 to 2 percent slopes	11	IIIs-4	53	3o1	1	1	2
BlB	Billett sandy loam, 2 to 6 percent slopes	11	IIIs-4	53	3o1	1	1	2
BlC2	Billett sandy loam, 6 to 12 percent slopes, eroded	11	IVe-4	54	3o1	1	1	2
Bm	Billett sandy loam, mottled subsoil variant	12	IIIs-4	53	3w5	3	1	2
Bo	Boaz silt loam	12	IIw-13	53	3w5	3	5b	7
Br	Boaz silt loam, dark variant	13	IIw-13	53	3w5	3	5b	7
Bs	Brems loamy sand	13	IVs-3	55	3s1	2	3	4
BuB	Burkhardt sandy loam, 0 to 6 percent slopes	14	IIIe-3	53	3d1	2	3	3
BuC2	Burkhardt sandy loam, 6 to 12 percent slopes, eroded	14	IVe-4	54	3d1	2	3	3
CaA	Campia loam, 0 to 2 percent slopes	15	I-1	51	2o1	1	1	1
Ce	Caryville loam	15	IIIw-12	53	3o1	1	7	8
Ch	Cathro muck	16	IVwc-9	54	5w6	4	6	9
CkA	Chetek sandy loam, 0 to 2 percent slopes	16	IIIs-8	54	3d1	2	3	3
CkB	Chetek sandy loam, 2 to 6 percent slopes	16	IIIe-3	53	3d1	2	3	3
CkD2	Chetek sandy loam, 12 to 20 percent slopes, eroded	17	VIe-3	55	3d2	2	3	3
CkE2	Chetek sandy loam, 20 to 30 percent slopes, eroded	17	VIIe-4	56	3d2	2	3	3

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Tree and shrub group	Wildlife group	Recreation group
			Symbol	Page	Symbol	Number	Number	Number
DaA	Dakota sandy loam, 0 to 2 percent slopes	18	IIIs-4	53	4o1	1	4	1
DaB	Dakota sandy loam, 2 to 6 percent slopes	18	IIIs-4	53	4o1	1	4	1
DbA	Dakota loam, 0 to 2 percent slopes	18	IIs-1	53	4o1	1	4	1
DbB	Dakota loam, 2 to 6 percent slopes	18	IIe-2	52	4o1	1	4	1
DdA	Dickinson sandy loam, 0 to 2 percent slopes	19	IIIs-4	53	3o1	1	4	2
DdB	Dickinson sandy loam, 2 to 6 percent slopes	19	IIIs-4	53	3o1	1	4	2
DfB	Dubuque silt loam, 2 to 6 percent slopes	19	IIe-2	52	2o1	1	1	1
DfC2	Dubuque silt loam, 6 to 12 percent slopes, eroded	20	IIIe-2	53	2o1	1	1	1
DfD2	Dubuque silt loam, 12 to 20 percent slopes, eroded	20	IVe-2	54	2r2	1	1	1
DfE2	Dubuque silt loam, 20 to 30 percent slopes, eroded	20	VIe-2	55	2r2	1	1	1
DnB2	Dunbarton silt loam, 2 to 6 percent slopes, eroded	20	IIIe-3	53	3d1	2	3	3
DnC2	Dunbarton silt loam, 6 to 12 percent slopes, eroded	21	IVe-3	54	3d1	2	3	3
DnD2	Dunbarton silt loam, 12 to 20 percent slopes, eroded	21	VIe-3	55	3d2	2	3	3
DnE	Dunbarton silt loam, 20 to 30 percent slopes	21	VIIe-2	56	3d2	2	3	3
Du	Dunnville loam	21	IIs-1	53	3o1	1	1	1
Dv	Dunnville silt loam, silty subsoil variant	22	I-1	51	3o1	1	1	1
ElB	Eleva sandy loam, 2 to 6 percent slopes	22	IIIs-4	53	3o1	1	1	2
ElC2	Eleva sandy loam, 6 to 12 percent slopes, eroded	22	IVe-4	54	3o1	1	1	2
EmA	Elkmound loam, 0 to 2 percent slopes	23	IIIs-8	54	3d1	2	3	3
EmB	Elkmound loam, 2 to 6 percent slopes	23	IIIe-3	53	3d1	2	3	3
EmC2	Elkmound loam, 6 to 12 percent slopes, eroded	23	IVe-3	54	3d1	2	3	3
GoA	Gotham loamy fine sand, 0 to 2 percent slopes	24	IVs-3	55	3s1	2	3	4
GoB	Gotham loamy fine sand, 2 to 6 percent slopes	24	IVs-3	55	3s1	2	3	4
GoC2	Gotham loamy fine sand, 6 to 12 percent slopes, eroded	24	IVs-3	55	3s1	2	3	4
GsA	Gotham loamy fine sand, loamy substratum, 0 to 2 percent slopes	24	IVs-3	55	3o1	1	3	4
GsB	Gotham loamy fine sand, loamy substratum, 2 to 6 percent slopes	24	IVs-3	55	3o1	1	3	4
GsC2	Gotham loamy fine sand, loamy substratum, 6 to 12 percent slopes, eroded	24	IVs-3	55	3o1	1	3	4
HfB	Hixton loam, 2 to 6 percent slopes	25	IIe-2	52	2o1	1	1	1

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Tree and shrub group	Wildlife group	Recreation group
			Symbol	Page	Symbol	Number	Number	Number
HfC2	Hixton loam, 6 to 12 percent slopes, eroded	25	IIIe-2	53	2o1	1	1	1
HfD2	Hixton loam, 12 to 20 percent slopes, eroded	25	IVe-2	54	2r2	1	1	1
HmB	Hixton loam, mottled subsoil variant, 2 to 6 percent slopes	26	IIw-5	52	3w5	3	5a	5
Ho	Houghton peaty muck	26	IVwc-9	54	5w6	4	6	9
HuA	Hubbard loamy sand, 0 to 2 percent slopes	27	IVs-3	55	3s1	2	3	4
HuB	Hubbard loamy sand, 2 to 6 percent slopes	27	IVs-3	55	3s1	2	3	4
HuC2	Hubbard loamy sand, 6 to 12 percent slopes, eroded	27	IVs-3	55	3s1	2	3	4
Hv	Hubbard loamy sand, loamy substratum	28	IVs-3	55	3o1	1	3	4
HwC	Hubbard sand, hummocky	28	VIIs-3	56	4s1	2	8	4
Kc	Kickapoo fine sandy loam	28	IIIw-12	53	3o1	1	7	8
LfB	La Farge silt loam, 2 to 6 percent slopes	29	IIe-2	52	2o1	1	1	1
LfC2	La Farge silt loam, 6 to 12 percent slopes, eroded	29	IIIe-2	53	2o1	1	1	1
LfC3	La Farge silt loam, 6 to 12 percent slopes, severely eroded	29	IVe-2	54	2o1	1	1	1
LfD2	La Farge silt loam, 12 to 20 percent slopes, eroded	29	IVe-2	54	2r2	1	1	1
LfD3	La Farge silt loam, 12 to 20 percent slopes, severely eroded	29	VIe-2	55	2r2	1	1	1
LfE2	La Farge silt loam, 20 to 30 percent slopes, eroded	29	VIe-2	55	2r2	1	1	1
Lo	Lows loam	30	IIw-5	52	3w5	3	5b	6
Ma	Markey muck	31	Vw-7	55	5w6	4	6	9
Mc	Marshan silt loam	31	IIw-5	52	4w5	3	5b	6
MeA	Meridian loam, 0 to 2 percent slopes	32	IIs-1	53	2o1	1	1	1
MeB	Meridian loam, 2 to 6 percent slopes	32	IIe-2	52	2o1	1	1	1
MeC2	Meridian loam, 6 to 12 percent slopes, eroded	32	IIIe-2	53	2o1	1	1	1
Mo	Morocco loamy sand	32	IVw-5	54	3w4	3	5a	5
Mr	Morocco sandy loam, loamy subsoil variant	33	IVw-5	54	3w4	3	5a	5
Ne	Newton loamy sand	33	IVw-5	54	4w4	3	5b	6
NrB	Norden silt loam, 2 to 6 percent slopes	34	IIe-2	52	2o1	1	1	1
NrC2	Norden silt loam, 6 to 12 percent slopes, eroded	34	IIIe-2	53	2o1	1	1	1
NrD2	Norden silt loam, 12 to 20 percent slopes, eroded	34	IVe-2	54	2r2	1	1	1
NrE2	Norden silt loam, 20 to 30 percent slopes, eroded	34	VIe-2	55	2r2	1	1	1
NtA	Northfield silt loam, 0 to 2 percent slopes	35	IIIs-8	54	3d1	2	3	3
NtB	Northfield silt loam, 2 to 6 percent slopes	35	IIIe-3	53	3d1	2	3	3
NtC2	Northfield silt loam, 6 to 12 percent slopes, eroded	36	IVe-3	54	3d1	2	3	3
OsB	Otterholt silt loam, 2 to 6 percent slopes	37	IIe-1	51	2o1	1	1	1

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Tree and shrub group	Wildlife group	Recreation group
			Symbol	Page	Symbol	Number	Number	Number
OsC2	Otterholt silt loam, 6 to 12 percent slopes, eroded	37	IIIe-1	53	2o1	1	1	1
PaB	Palsgrove silt loam, deep, 2 to 6 percent slopes	38	IIe-1	51	2o1	1	1	1
PaC2	Palsgrove silt loam, deep, 6 to 12 percent slopes, eroded	38	IIIe-2	53	2o1	1	1	1
PaD2	Palsgrove silt loam, deep, 12 to 20 percent slopes, eroded	38	IVe-1	54	2r2	1	1	1
Pc	Pillot silt loam	38	IIs-1	53	4o1	1	1	1
PdB	Plainbo loamy sand, 2 to 6 percent slopes	39	IVs-3	55	3s1	2	3	4
PdC2	Plainbo loamy sand, 6 to 12 percent slopes, eroded	39	VIs-3	55	3s1	2	3	4
PdF	Plainbo loamy sand, 12 to 40 percent slopes	40	VIIs-3	56	3s2	2	3	4
PfA	Plainfield loamy sand, 0 to 2 percent slopes	41	IVs-3	55	3s1	2	3	4
PfB	Plainfield loamy sand, 2 to 6 percent slopes	41	IVs-3	55	3s1	2	3	4
PfC2	Plainfield loamy sand, 6 to 12 percent slopes, eroded	41	VIs-3	55	3s1	2	3	4
Po	Poskin silt loam	41	IIw-5	52	2w5	3	5a	5
RaB	Renova silt loam, 2 to 6 percent slopes	42	IIe-1	51	2o1	1	1	1
RaC2	Renova silt loam, 6 to 12 percent slopes, eroded	42	IIIe-1	53	2o1	1	1	1
RaD2	Renova silt loam, 12 to 20 percent slopes, eroded	42	IVe-1	54	2r2	1	1	1
Rb	Rib silt loam	43	IIw-5	52	3w5	3	5b	6
Rc	Rib silt loam, moderately shallow variant	43	IIw-5	52	3w5	3	5b	6
Re	Riverwash	43	VIIIs-9	56	6s1	---	8	7
SaB	Santiago silt loam, 2 to 6 percent slopes	44	IIe-1	51	2o1	1	1	1
SaC2	Santiago silt loam, 6 to 12 percent slopes, eroded	44	IIIe-1	53	2o1	1	1	1
SeB	Seaton silt loam, 2 to 6 percent slopes	45	IIe-1	51	1o1	1	1	1
SeC2	Seaton silt loam, 6 to 12 percent slopes, eroded	45	IIIe-1	53	1o1	1	1	1
SeD2	Seaton silt loam, 12 to 20 percent slopes, eroded	45	IVe-1	54	1r2	1	1	1
SeE2	Seaton silt loam, 20 to 30 percent slopes, eroded	45	VIe-1	55	1r2	1	1	1
SfA	Seaton silt loam, benches, 0 to 2 percent slopes	46	I-1	51	1o1	1	1	1
SfB	Seaton silt loam, benches, 2 to 6 percent slopes	46	IIe-1	51	1o1	1	1	1
Sh	Shiffer loam	46	IIw-5	52	3w5	3	5a	5
StF	Steep stony rock land	46	VIIe-4	56	4d2	2	8	10
Su	Stronghurst silt loam	47	IIw-2	52	2w5	3	5a	5
TeA	Tell silt loam, 0 to 2 percent slopes	48	IIs-1	53	2o1	1	1	1
TeB	Tell silt loam, 2 to 6 percent slopes	48	IIe-2	52	2o1	1	1	1
TeC2	Tell silt loam, 6 to 12 percent slopes, eroded	48	IIIe-2	53	2o1	1	1	1
Tn	Terrace escarpments, sandy	48	VIIs-3	56	4s1	2	8	10

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Tree and shrub group	Wildlife group	Recreation group
			Symbol	Page	Symbol	Number	Number	Number
To	Terrace escarpments, loamy---------	48	VIIe-4	56	4d2	2	8	10
Tr	Terril loam----------	49	IIIw-12	53	3o1	1	7	8
UeD2	Urne-Elkmound loams, 12 to 20 percent slopes, eroded----------	49	VIe-3	55	3r2	1	3	3
UeF	Urne-Elkmound loams, 20 to 40 percent slopes----------	49	VIIe-2	56	3r2	1	3	3
UnB	Urne-Norden loams, 2 to 6 percent slopes----------	49	IIe-2	52	3o1	1	1	1
UnC2	Urne-Norden loams, 6 to 12 percent slopes, eroded----------	50	IIIe-2	53	3o1	1	1	1
UnD2	Urne-Norden loams, 12 to 20 percent slopes, eroded----------	50	IVe-2	54	3r2	1	1	1
UnE2	Urne-Norden loams, 20 to 30 percent slopes, eroded----------	50	VIe-2	55	3r2	1	1	1
UnF	Urne-Norden loams, 30 to 45 percent slopes----------	50	VIIe-2	56	3r3	1	1	1
Wa	Wallkill silt loam----------	50	IIw-13	53	4w5	3	5b	7

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