SOIL SURVEY OF

Sheboygan County, Wisconsin

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

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1967–73. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the Sheboygan County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

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 Sheboygan 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 alphabetical order by map symbol and gives the page where each is described. It also shows the capability unit, woodland group, wildlife group, recreation group, and tree and shrub 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 discussions of capability units and woodland groups.

Foresters and others can refer to the section "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 "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation areas in the sections "Engineering interpretations" and "Recreation."

Engineers and builders can find, under "Engineering," 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 Soils."

Newcomers in Sheboygan 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 information about the county given in the section "Environmental Factors Affecting Soil Use."

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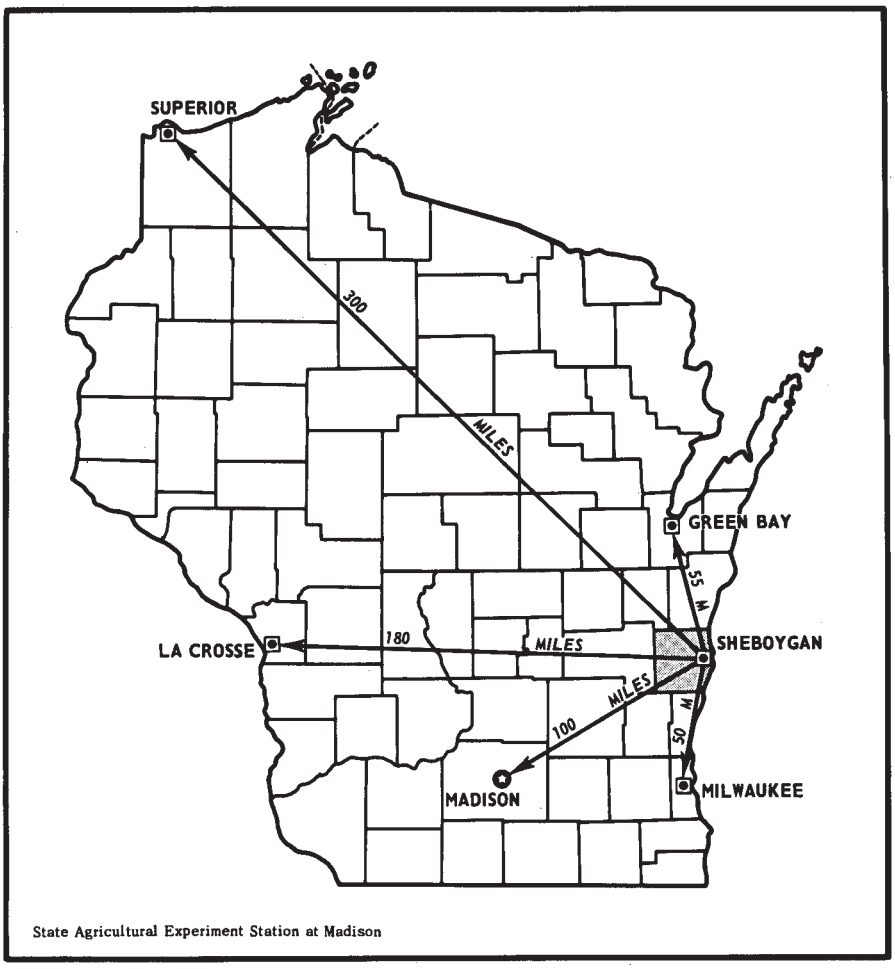

Location of Sheboygan County in Wisconsin.

SOIL SURVEY OF SHEBOYGAN COUNTY, WISCONSIN

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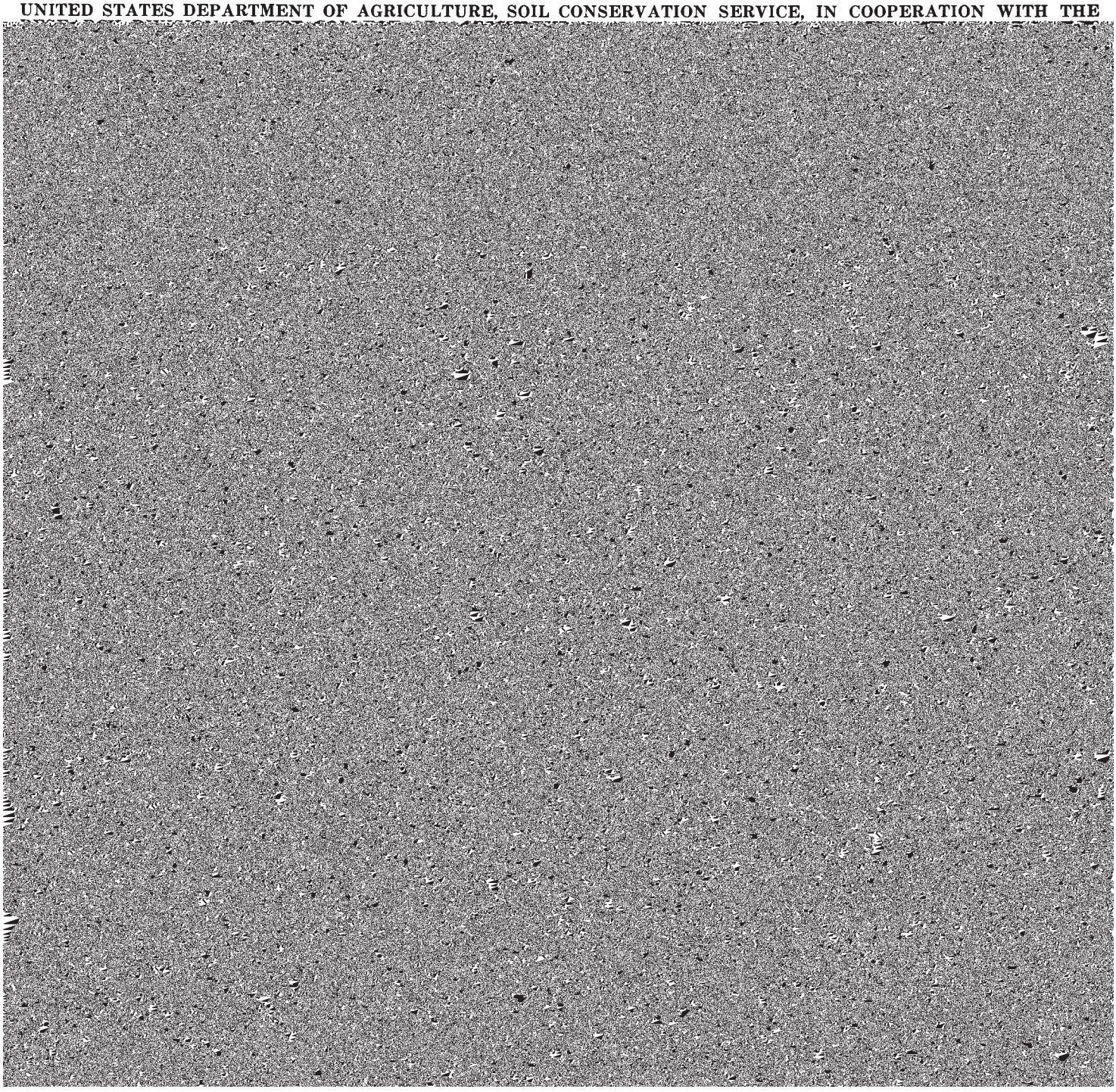
UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE



ferent series, or of different phases within one series. One such kind of mapping unit that is shown on the soil map of Sheboygan County is a soil complex.

A soil complex consists of areas of two or more soils so intricately mixed 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. Generally, the name of a soil complex consists of the names of the dominant soils joined by a hyphen. Casco-Rodman complex, 6 to 12 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been 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 and Dune land are examples of two land types in Sheboygan County.

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

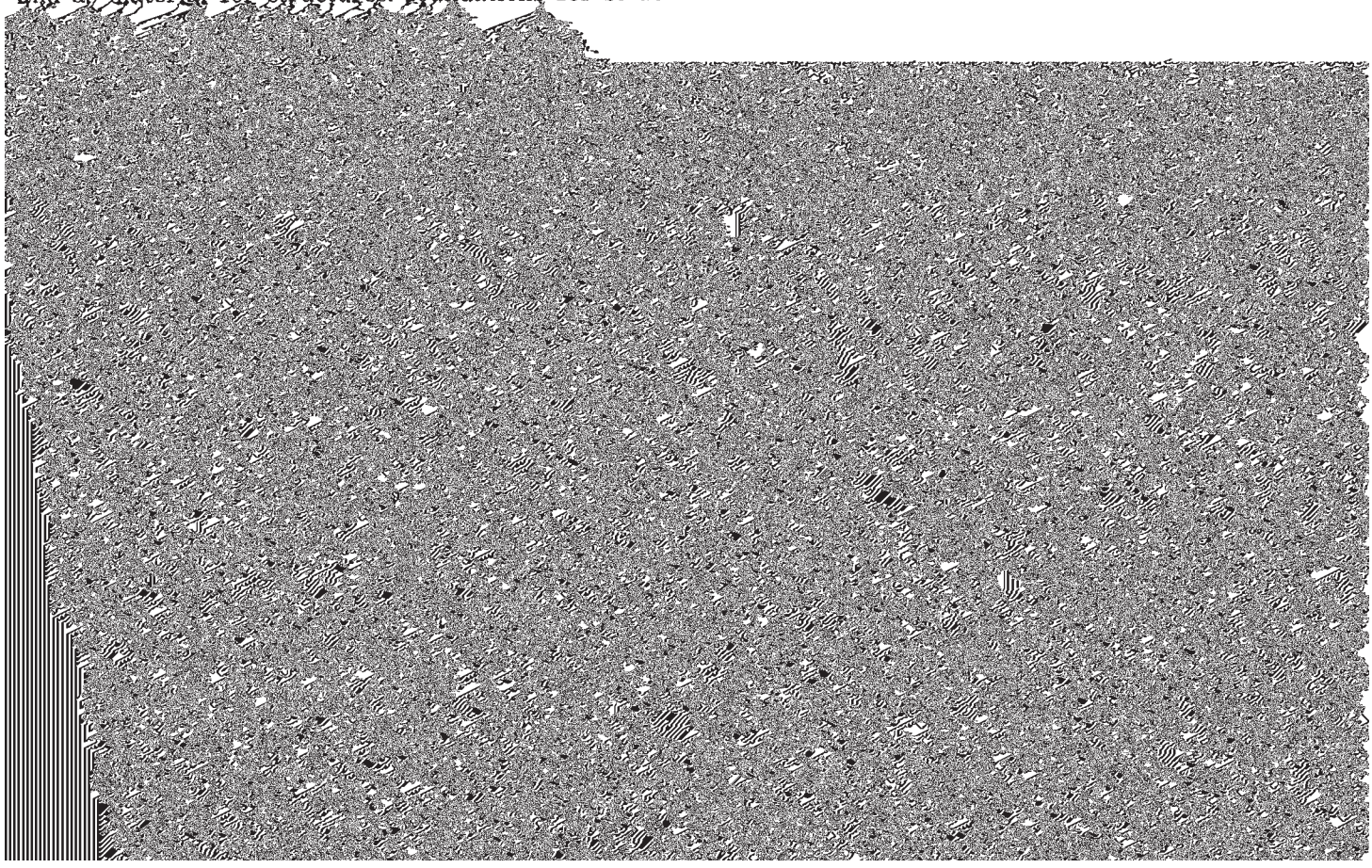
Soil scientists observe how soils behave when used as a growing medium for native and cultivated plants and as material for structures. foundations for struc-

A map showing soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that area, or who want to locate large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide for broad planning of a watershed, a wooded tract, or a wildlife area or for broad planning of recreational facilities, community developments, and such engineering works as transportation corridors. It is not a suitable map for detailed planning for management of a farm or field or for selecting the exact location of a road or building or other structure because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

Soil associations and delineations on the general soil map do not fully agree with those of the general soil map in adjacent counties published at a different date. Differences in the maps are the result of improvement in the classification of soils, particularly in the modifications or refinements in soil series concepts. In addition, more precise and detailed maps are needed because the use of the general soil maps has expanded in recent years. The more modern maps meet this need. Still another difference is the pattern of occurrence of the major soils or the range in slope that is permitted within associations in different surveys.

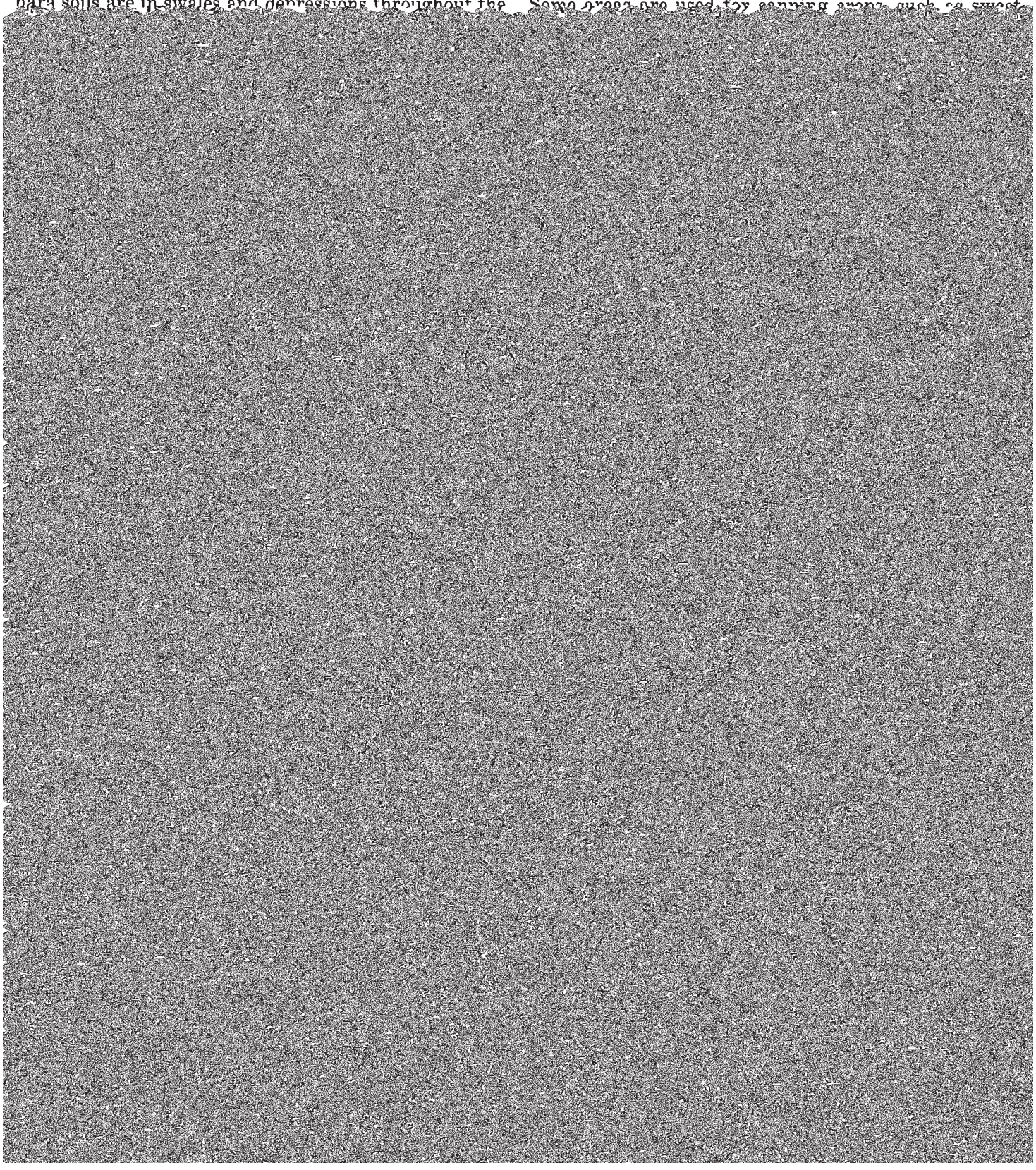
The five soil associations in this survey area are described on the following pages.

1. Mosel-Oakville-Hebron association



the Hebron variant. Sisson soils and the Hebron variant are intermingled with other Hebron soils and with Oakville soils. Colwood, Kibbie, Navan, and Yahara soils are in swales and depressions throughout the

all crops commonly grown in the county. Most of it is used for corn, small grain, and legumes. A large acreage is also used for dairy farming and beef cattle. Some areas are used for canning crops, such as sweet



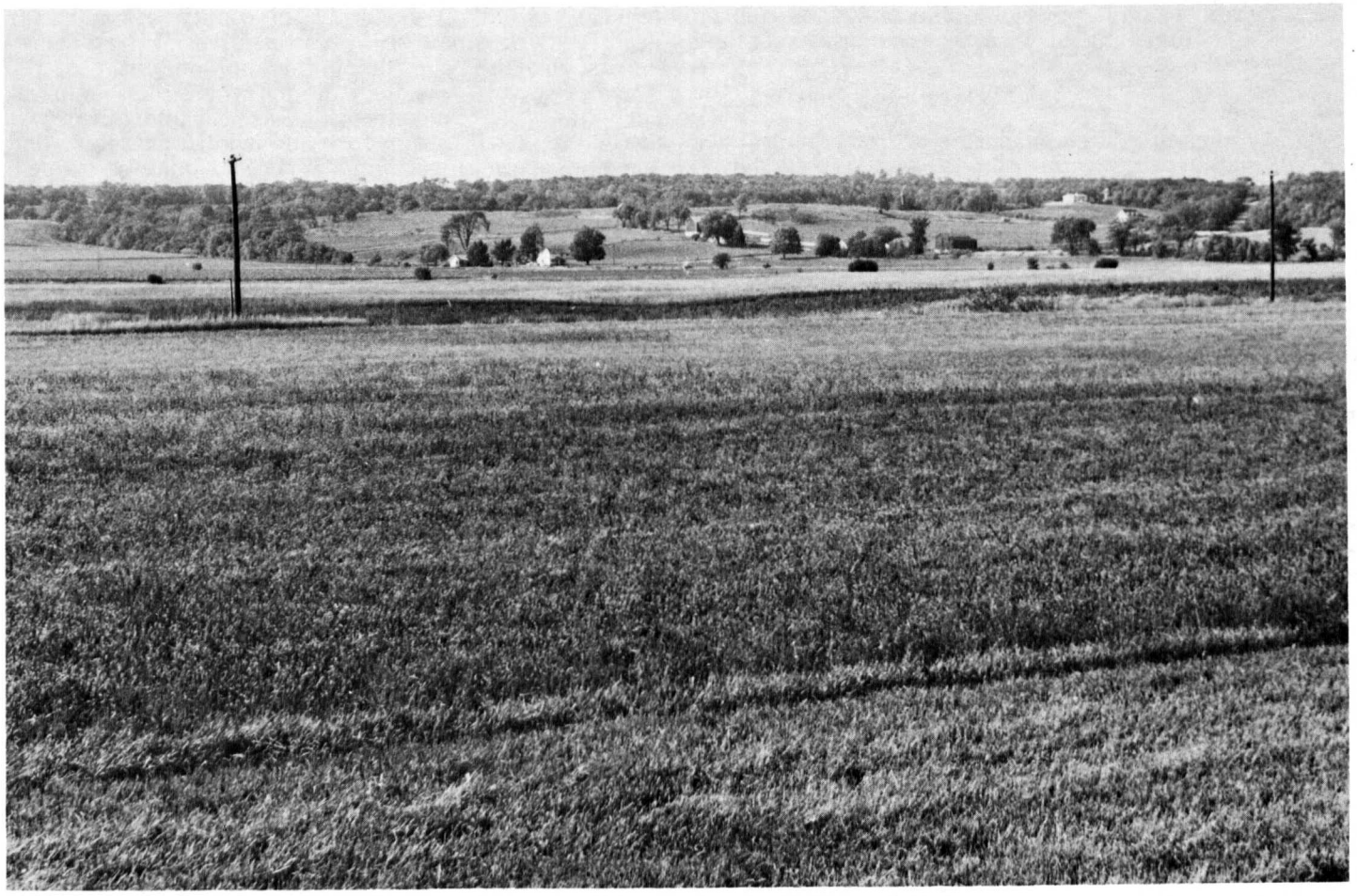


Figure 1.—**Landscape of Casco and Fox soils in association 4.**

Where slopes are less than 6 percent, the major soils of this association have slight limitations for septic tank absorption fields and dwellings with basements and moderate limitations for sewage lagoons. Where slopes are less than 12 percent, they have slight limitations for trench type sanitary landfill. The limitations for local roads and streets are moderate or severe.

4. *Casco-Fox-Rodman association*

Well drained to excessively drained soils that have a subsoil of mainly silty clay loam to sandy clay loam or gravelly sandy loam and are underlain by stratified gravel and sand outwash

This association makes up about 17 percent of the county. It is about 54 percent Casco soils, 28 percent Fox soils, 5 percent Rodman soils, and 13 percent minor soils (fig. 1).

in the upper part and clay loam in the lower part. The substratum to a depth of 60 inches is stratified gravel and sand.

Rodman soils are on outwash plains, kames, and eskers. They are sloping to very steep and are excessively drained. The surface layer and subsoil are gravelly sandy loam. The substratum to a depth of 60 inches is stratified gravel and sand.

Among the minor soils in this association are the Boyer, Fabius, Matherton, St. Charles, and Sebewa soils. Boyer soils are intermingled with Casco, Fox, and Rodman soils. St. Charles and Matherton soils are in areas where the silty mantle is thick. Fabius and Sebewa soils are in swales and wet drainageways throughout the association.

Where slopes are no more than 12 percent, this association is suited to poorly suited to all the general

all general farm crops commonly grown in the county. Small woodlots are common. Some areas are used as a source of sand and gravel.

Controlling erosion and maintaining organic-matter content, tilth, available water capacity, and fertility are the main concerns in managing the dominant soils for cultivation.

Where slopes are less than 6 percent, the major soils of this association have only slight limitations for septic tank filter fields and dwellings with basements. They have severe limitations for sewage lagoons and

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 is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit or they are dif-

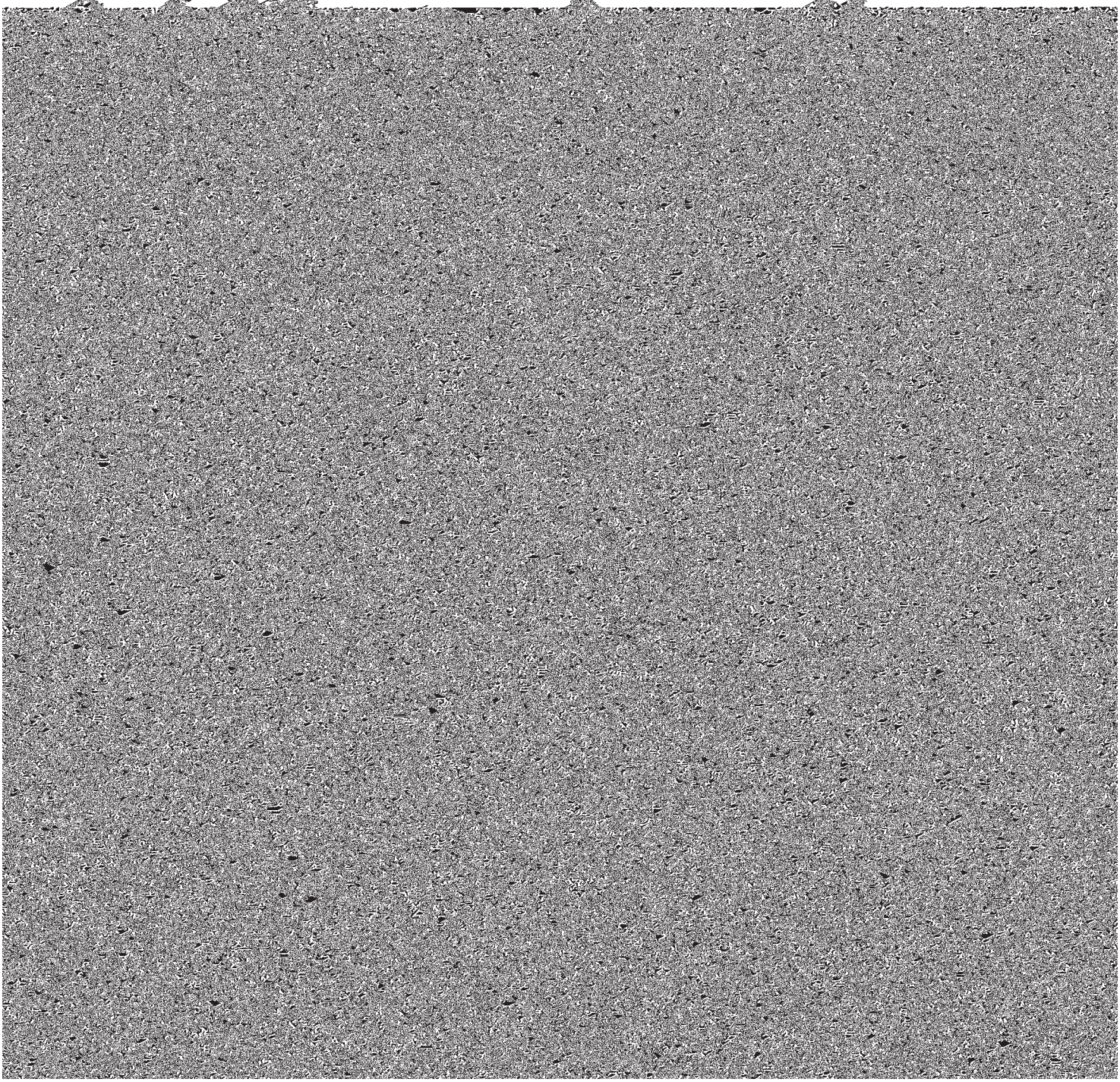
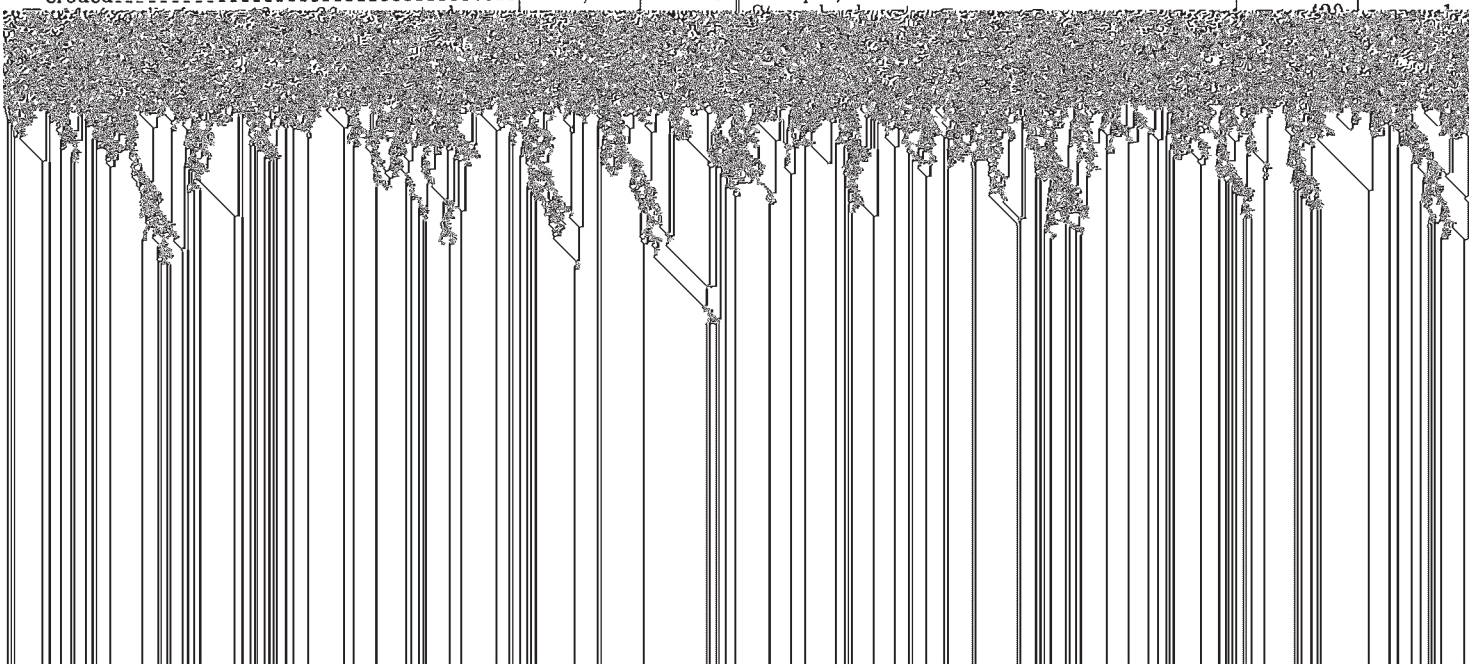


TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Mapping unit	Acres	Percent
Adrian muck	960	0.3
Adrian-Granby-Oakville complex	635	.2
Alluvial land	600	.2
Alluvial land, wet	3,300	1.0
Barry silt loam	2,700	.8
Beaches, sandy	225	(1)
Bellevue silt loam	950	.3
Bellevue fine sandy loam, sandy subsoil variant	1,700	.5
Boots muck	7,000	2.2
Boyer loamy sand, 2 to 6 percent slopes	2,720	.8
Boyer loamy sand, 6 to 12 percent slopes, eroded	1,040	.3
Casco loam, 0 to 2 percent slopes	700	.2
Casco loam, 2 to 6 percent slopes	6,100	1.9
Casco loam, 6 to 12 percent slopes, eroded	8,200	2.5
Casco-Rodman complex, 6 to 12 percent slopes	2,100	6
Casco-Rodman complex, 12 to 20 percent slopes, eroded	10,300	3.2
Casco-Rodman complex, 20 to 30 percent slopes	8,800	2.7
Casco-Rodman complex, 30 to 45 percent slopes	3,000	.9
Colwood silt loam	2,150	.7
Cut and fill land, sandy and gravelly	440	.1
Cut and fill land, loamy	1,150	.4
Cut and fill land, clayey	460	.1
Dune land	390	.1
Edwards muck	275	(1)
Elvers silt loam	225	(1)
Fabius loam, 0 to 3 percent slopes	1,250	.4
Fox silt loam, 0 to 2 percent slopes	5,600	1.7
Fox silt loam, 2 to 6 percent slopes	9,950	3.1
Fox silt loam, 6 to 12 percent slopes, eroded	1,130	.4
Granby loam fine sand	800	.2
Granby silt loam, gravelly variant	990	.3
Gravel pit	530	.2
Hebron loam, 0 to 2 percent slopes	990	.3
Hebron loam, 2 to 6 percent slopes	1,650	.5
Hebron sandy loam, sandy subsoil variant, 0 to 2 percent slopes	710	.2
Hebron sandy loam, sandy subsoil variant, 2 to 6 percent slopes	1,200	.4
Hochheim silt loam, 2 to 6 percent slopes eroded	19,600	6.2
Hochheim silt loam, 6 to 12 percent slopes, eroded	15,300	4.8
Kewaunee silty clay loam, 2 to 6 percent slopes, eroded	14,500	4.5
Kewaunee silty clay loam, 6 to 12 percent slopes, eroded	7,900	2.4
Kewaunee silty clay loam, 12 to 20 percent slopes, eroded	800	.2
Kewaunee silty clay, 6 to 12 percent slopes, severely eroded	500	.2
Kewaunee silty clay, 12 to 20 percent slopes, severely eroded	700	.2
Kibbie silt loam, 0 to 3 percent slopes	1,900	.6
Lamartine silt loam, 0 to 3 percent slopes	3,150	1.0
Loamy land, seeped	610	.2
Made land	380	.1
Manawa silt loam, 0 to 3 percent slopes	16,950	5.3
Marsh	2,300	.7
Martinton silt loam, 0 to 3 percent slopes	800	.2
Matherton silt loam, 0 to 3 percent slopes	2,400	.7
Montgomery silty clay loam	800	.2
Mosel loam, 0 to 3 percent slopes	4,100	1.3
Muskego muck	880	.3
Navan loam	1,750	.5
Nenno silt loam, 0 to 2 percent slopes	540	.2
Nenno silt loam, 2 to 6 percent slopes	2,850	.9
Oakville loamy fine sand, 0 to 6 percent slopes	2,400	.7
Oakville loamy fine sand, 6 to 12 percent slopes	580	.2
Otter silt loam	1,250	.4
Palms muck	4,500	1.4
Pella silt loam	3,800	1.2
Poygan silty clay loam	9,500	2.9
Rough broken land	1,400	.4
St. Charles silt loam, 0 to 2 percent slopes	1,100	.3
St. Charles silt loam, 2 to 6 percent slopes	1,300	.4
Saylesville silt loam, 0 to 2 percent slopes	490	.2
Saylesville silt loam, 2 to 6 percent slopes	620	.2
Saylesville silty clay loam, 6 to 12 percent slopes, eroded	215	(1)
Sebewa silt loam	3,300	1.0
Sisson very fine sandy loam, 0 to 2 percent slopes	1,400	.4
Sisson very fine sandy loam, 2 to 6 percent slopes	2,250	.7
Sisson very fine sandy loam, 6 to 12 percent slopes, eroded	680	.2



The thickness of the organic material ranges from 16 to 50 inches. The organic material is 1 to 50 percent fiber, but is less than 5 percent after rubbing. In places the organic layers contain some woody fragments. The organic material is slightly acid to mildly alkaline. The substratum is mildly alkaline or moderately alkaline.

Adrian soils are near Granby, Houghton, and Palms soils. They formed in thinner organic remains than Houghton soils. They contain more sand in the substratum than Palms soils. Adrian soils have an organic layer more than 16

tion. The land is well drained and moderately well drained. Slopes are 0 to 2 percent.

Included with this land in mapping are small areas of Alluvial land, wet; the Bellevue variant; and other Bellevue and Juneau soils. Also included are small somewhat poorly drained areas.

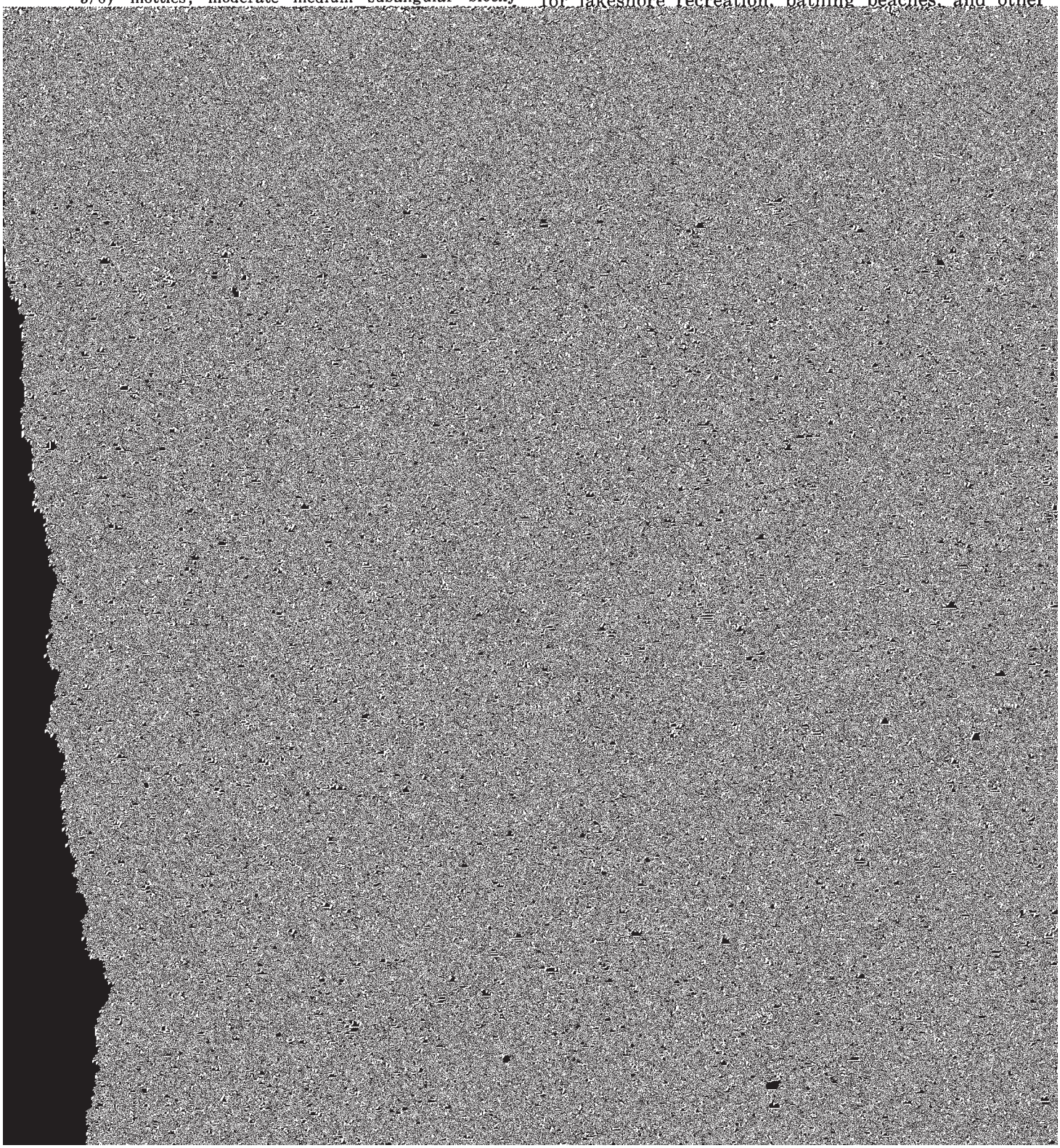
Alluvial land ranges widely in permeability and available water capacity. It is subject to flooding.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam; weak medium subangular blocky structure parting to moderate fine granular; friable; mildly alkaline; abrupt smooth boundary.

B21tg—10 to 16 inches; grayish brown (2.5Y 5/2) heavy silt loam; few fine prominent light olive brown (2.5Y 5/6) mottles; moderate medium subangular blocky

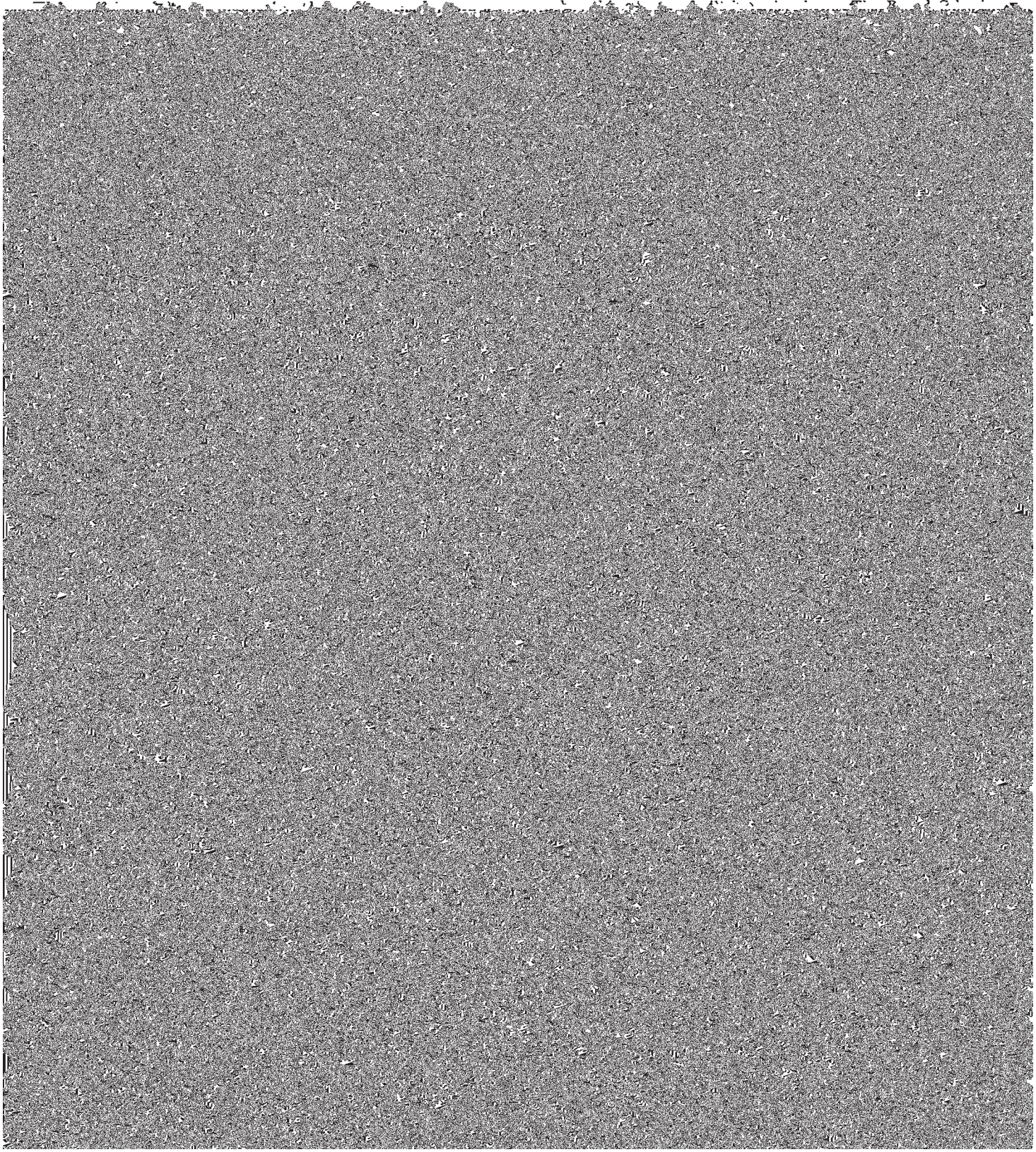
and natural fertility is low. The root zone is limited by the sand. The water table varies in depth with the water level of Lake Michigan.

This mapping unit is not suited to commercial crop production, woodland, or wildlife habitat. It is used for lakeshore recreation, bathing beaches, and other



Included with this soil in mapping are small areas of Alluvial land; Alluvial land, wet; the Bellevue variant; and Sisson soils. Also included are some small areas that are somewhat poorly drained.

A horizon is 7 to 10 inches thick. It is very dark grayish brown or dark brown. It is generally fine sandy loam, but in places is silt loam. The B horizon is 12 to 28 inches thick and has thin layers of silt loam or loam in places. The C horizon is sandy loam, loamy fine sand, or sand and



The depth of the organic material ranges from 51 to about 84 inches. The surface layer ranges from 5 to 20 inches in thickness and is black sapric material. It is 5 to 15 percent fiber, but is less than 5 percent when rubbed. The next layer ranges from 20 to 45 inches in thickness. It is hemic material that is 35 to 90 percent fiber but is 20 to 40 percent when rubbed. The lower layer is sapric material that is 20 to 35 percent fiber but is 5 to 15 percent when rubbed. Marl is at a depth of 51 to 84 inches in some areas. The organic material ranges from slightly acid to mildly alkaline.

Boots soils are near Edwards and Palms soils. They have more fiber than Edwards and Palms soils. They lack the marl within a depth of 51 inches that is typical of Edwards soils and the mineral material within a depth of 51 inches that is typical of Palms soils.

Bk—Boots muck. This nearly level soil is in old lake basins. Areas are irregularly shaped and range in size up to 6,000 acres. This soil is mostly in one large area. Slopes are 0 to 2 percent.

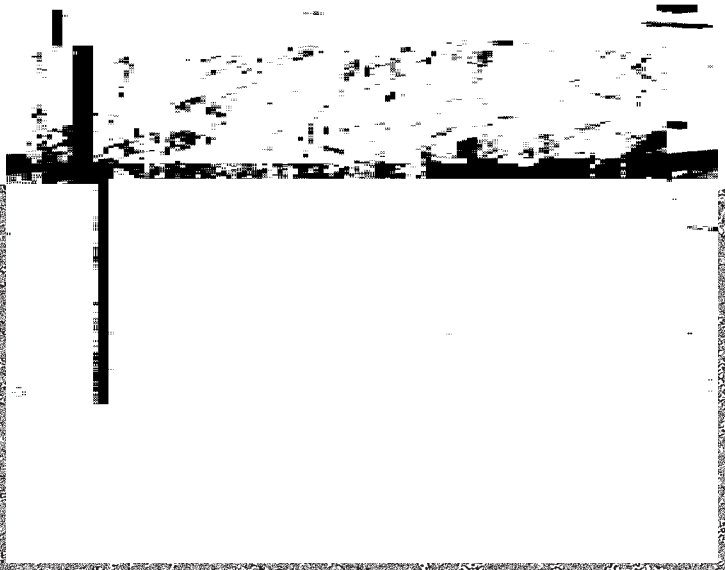
Included with this soil in mapping are small areas of Edwards soils, Marsh, and Palms soils. Also included are some areas of Boots soils containing woody fragments in the organic layers.

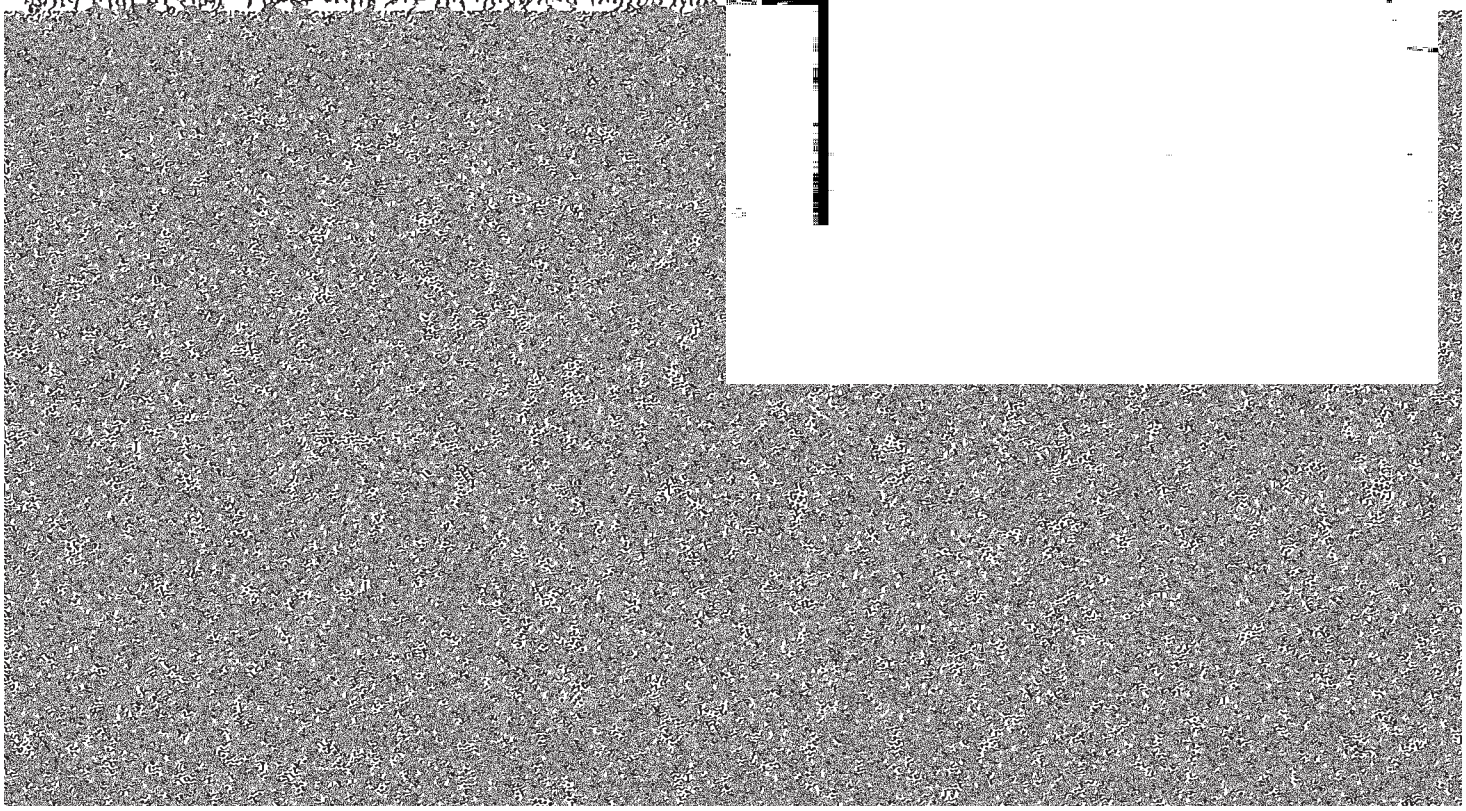
Wetness is the major limitation of this soil. If drained, however, the soil is subject to subsidence, soil blowing, and burning.

If adequately drained, this soil is moderately well suited to the crops commonly grown in the county. Most areas are used for woodland, wildlife habitat, and recreation. Capability unit IIIw–9; woodland group 3w3; wildlife group 8.

Boyer Series

The Boyer series consists of gently sloping and sloping, well drained soils that are underlain by stratified sand and gravel. These soils are on outwash plains and





The solum ranges from 24 to 40 inches in thickness. The Ap horizon is 4 to 10 inches thick. It is dark brown or dark grayish brown. It is generally loamy sand, but in places is sandy loam. In undisturbed areas and areas where the Ap horizon is thin, the A2 horizon is up to 5 inches thick. It is yellowish brown or brown loamy sand or sandy loam. In some areas the A2 horizon does not occur. The B horizon is 15 to 30 inches thick. It is sandy loam and sandy clay loam, but includes transitional horizons of loamy sand. The average clay content of the Bt horizon is less than 18 percent. The C horizon is stratified sand and gravel or stratified medium and coarse sand. The B horizon ranges from slightly acid to mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Boyer soils are near Casco, Fox, Hebron, and Wasepi soils. They lack the mottles in the B horizon typical of Wasepi soils and are better drained than those soils. They have less clay in the B horizon than Casco, Hebron, and Fox soils and less silt and clay in the C horizon than Hebron soils.

BmB—Boyer loamy sand, 2 to 6 percent slopes. This gently sloping soil is on outwash plains along major streams. Areas are irregularly shaped and generally less than 40 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Fox, Hebron, and Wasepi soils. Also included are areas where the sand and gravel substratum is underlain by silt and fine sand or silt and clay below a depth of 4 feet, small areas of nearly level and sloping soils, areas of moderately well drained soils, and areas where the surface layer is sandy loam.

The soil blowing hazard is moderate, and the erosion hazard is slight. The soil is slightly droughty. Management that conserves moisture, reduces runoff, improves tilth, helps control erosion and soil blowing, and increases the available water capacity is beneficial where the soil is used for crops.

This soil is suited to all crops commonly grown in the county. It is also suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIIs–4; woodland group 3o1; wildlife group 3.

BmC2—Boyer loamy sand, 6 to 12 percent slopes, eroded. This sloping soil is on outwash plains along major streams. Areas are irregularly shaped and are generally less than 30 acres in size. This soil differs from the soil described as representative of the series in having some of the subsurface layer and subsoil mixed with the surface layer.

Included with this soil in mapping are small areas of Casco, Fox, and Hebron soils. Also included are areas where the sand and gravel substratum is underlain by silt and fine sand or silt and clay below a depth of 4 feet, small areas of gently sloping and moderately steep soil, areas where more sand is in the subsoil than is typical, areas where the surface layer is sandy loam, and somewhat poorly drained areas.

The hazards of soil blowing and erosion are moderate. The soil is slightly droughty. Controlling runoff, conserving moisture, improving tilth, and reducing the risk of erosion and soil blowing are beneficial where this soil is used for crops.

If well managed, this soil is suited to all crops commonly grown in the county. It is also suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIIe–7; woodland group 3o1; wildlife group 3.

Casco Series

The Casco series consists of nearly level to very steep, well drained soils that are underlain by stratified sand and gravel outwash. These soils are on outwash plains, stream terraces, and convex side slopes of glacial moraines. Many areas have complex slopes. The native vegetation was a deciduous forest of mainly oak and hickory.

In a representative profile the surface layer is dark grayish brown loam about 8 inches thick (fig. 3). The subsoil is about 9 inches thick and is dark brown. It is firm clay loam in the upper part and firm sandy clay loam with some gravel in the lower part. The sub-

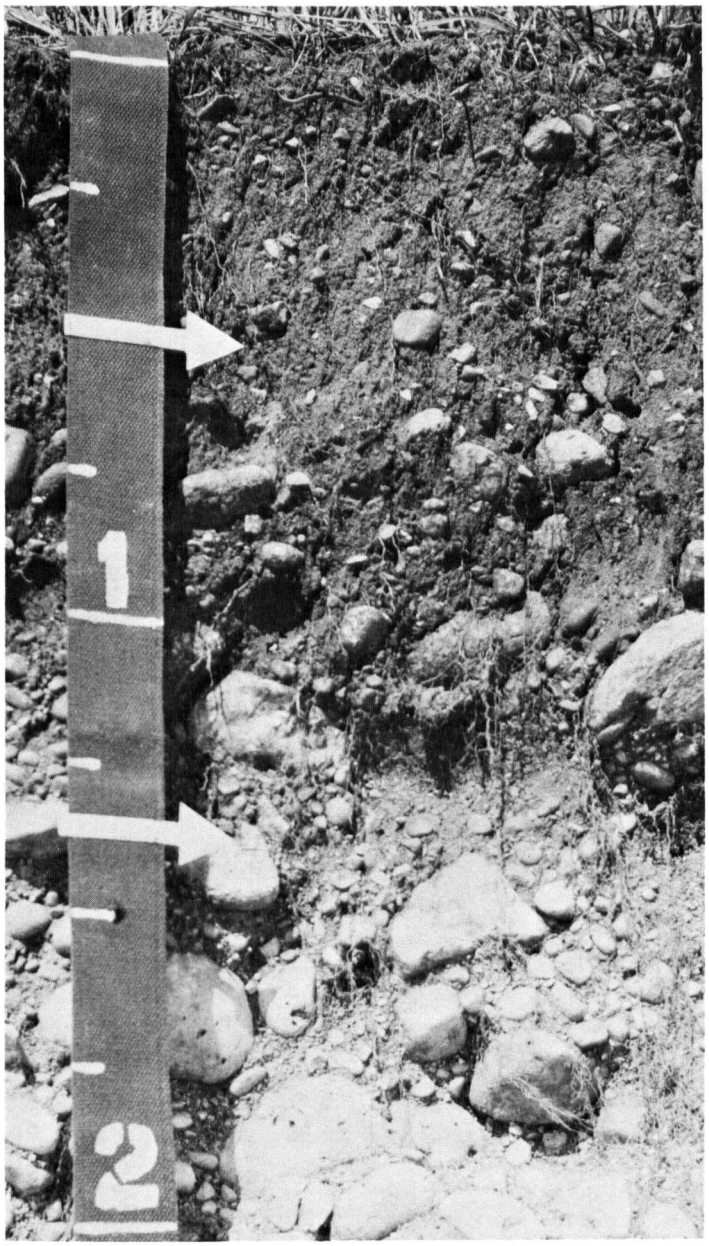


Figure 3.—**Profile of Casco loam underlain by gravel and sand at a depth of about 17 inches.**

stratum to a depth of 60 inches is brown, loose stratified gravel and sand.

Permeability is moderate to a depth of about 17 inches and very rapid below. Available water capacity is low. Organic-matter content is moderately low, and natural fertility is low. The root zone is limited by the underlying sand and gravel.

Most areas where slopes are less than 12 percent are used for corn, small grain, legumes, and other crops commonly grown in the county. Some of the less sloping areas and most areas where slopes are more than 12 percent are used for woodland, pasture, wildlife habitat, and recreation.

Representative profile of Casco loam, 2 to 6 percent slopes, in a cultivated area, 100 feet north and 2,440 feet west of the southeast corner of sec. 6, T. 14 N., R. 20 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; weak medium subangular blocky structure parting to moderate medium granular; friable; slightly acid; abrupt smooth boundary.

B21t—8 to 13 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thick continuous clay films on faces of peds; slightly acid; clear wavy boundary.

B22t—13 to 17 inches; dark brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; thick patchy clay films on faces of peds; estimated 9 percent gravel by volume in the lower part; neutral; abrupt wavy boundary.

IIC—17 to 60 inches; brown (10YR 5/3) stratified gravel and sand; single grained; loose; estimated 60 percent gravel by volume; strong effervescence; moderately alkaline.

The solum ranges from 11 to 24 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is dark grayish brown or dark brown. It is generally loam, but in places is silt loam. In uncultivated areas the A1 horizon is 3 to 5 inches thick and is very dark grayish brown. The A2 horizon if

sloping soil is on outwash plains. Areas are irregularly shaped and range in size from 4 to more than 100 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Boyer, Fabius, Fox, and Hochheim soils. Also included are small nearly level areas and small areas where the surface layer is sandy loam. Spot symbols have been used in some places on the soil map to identify areas where slopes are more than 6 percent. Spot symbols also identify areas where the surface is gravelly.

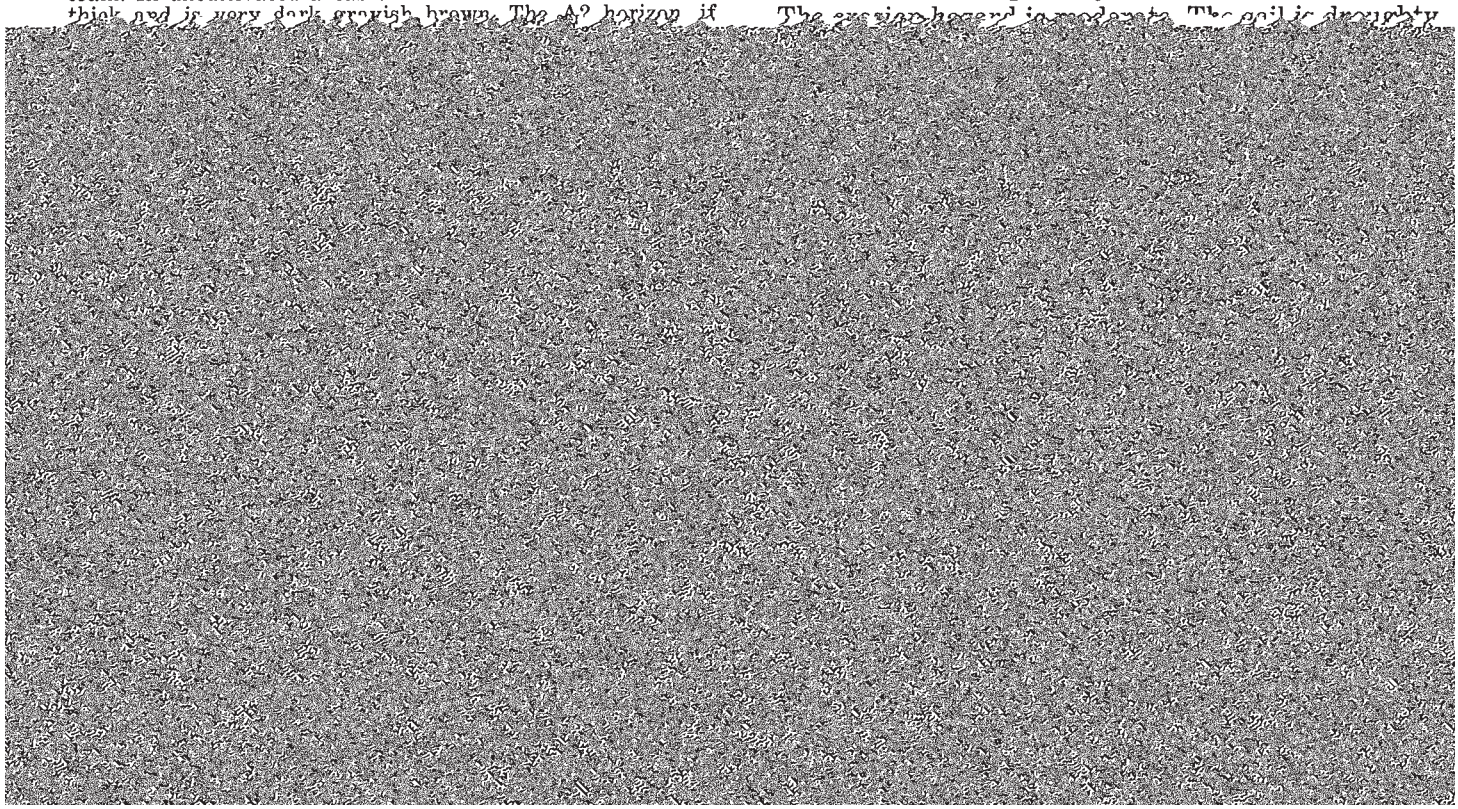
The erosion hazard is slight. The soil is droughty. Conserving moisture, reducing runoff, and maintaining tilth help to control erosion and maintain available water capacity.

This soil is suited to all crops commonly grown in the county and is well suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIIe–3; woodland group 3d1; wildlife group 4.

CeC2—Casco loam, 6 to 12 percent slopes, eroded. This sloping soil is on outwash plains. Areas are irregularly shaped and range in size from 4 to more than 150 acres. Many of the larger areas have complex slopes. This soil differs from the soil described as representative of the series in having some dark brown subsoil material mixed with the surface layer.

Included with this soil in mapping are small areas of Boyer, Fox, Hochheim, and Rodman soils. Also included are small areas of Casco soils that are severely eroded. Spot symbols have been used in some places on the soil map to identify areas where slopes are greater than 12 percent. Spot symbols also identify many areas where the surface is gravelly.

The erosion hazard is moderate. The soil is droughty



where cultivated, they are thinner and have a lighter colored, more sandy and gravelly surface layer.

than is representative for the Casco series. In unplowed areas they have a thinner, darker colored sur-

in having a light colored subsurface layer. The Rodman soils have the profile described as representative of the Rodman series. Both soils are droughty. The hazard of erosion is very severe.

These soils are not suited to commercial crop production and are poorly suited to pasture. They are suited to woodland. Most of the acreage is in woodland, but some areas have been cleared and farmed or pastured. Most areas that have been farmed are eroded and are planted to pine trees. Capability unit VIIe–3; woodland group 3d2; wildlife group 4.

CrF—Casco-Rodman complex, 30 to 45 percent slopes. These very steep soils are on outwash plains, eskers, and kames. Areas are long and range in size from 4 to more than 300 acres.

This complex is made up of areas of Casco and Rodman soils that are so small and so closely intermingled that they cannot be shown separately on the soil map. It is about 45 percent Casco soils, 35 percent Rodman soils, and 20 percent small areas of Boyer, Fox, Hochheim, and St. Charles soils. The deeper soils are generally on concave foot slopes, and the Rodman soils are on the convex side slopes and on ridgetops.

The Casco soils are shallower over sand and gravel and have a thinner, darker colored surface layer than is representative for the Casco series. They also differ in having a light colored subsurface layer. Both soils are droughty. The erosion hazard is very severe.

These soils are not suited to commercial crop production and are poorly suited to pasture. They are suited to woodland. Most areas are in woodland, but small areas have been cleared for pasture. Capability unit VIIe–3; woodland group 3d3; wildlife group 4.

Colwood Series

The Colwood series consists of nearly level, poorly drained soils that are underlain by stratified silt and very fine sand. These soils are in old glacial lake basins. The native vegetation was a deciduous forest of elm, ash, and maple.

In a representative profile the surface layer is silt loam about 11 inches thick. The upper part is very dark brown, and the lower part is very dark gray. The subsoil is about 22 inches thick and is mottled throughout. It is dark gray, firm silt loam in the upper part and gray, friable loam in the lower part. The substratum to a depth of about 60 inches is stratified, friable silt and very fine sand. It is grayish brown in the upper part and yellowish brown in the lower part and is mottled.

Permeability is moderate, and available water capacity is high. Organic-matter content is high, and natural fertility is medium. The root zone is limited by saturated soil during wet periods of the growing season.

Most of the acreage has been cleared and is used for

A12—8 to 11 inches; very dark gray (10 YR 3/1) heavy silt loam; moderate medium prismatic structure parting to moderate thick platy; friable; few black (10YR 2/1) organic stains on vertical faces of peds; mildly alkaline; abrupt wavy boundary.

B2g—11 to 27 inches; dark gray (5Y 4/1) silt loam; weak coarse prismatic structure parting to moderate medium angular blocky; few medium prominent yellowish brown (10YR 5/6) mottles; firm; neutral; clear wavy boundary.

IIB3g—27 to 33 inches; gray (5YR 5/1) loam; common coarse prominent yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; neutral; abrupt wavy boundary.

IIIC1—33 to 40 inches; grayish brown (2.5Y 5/2) stratified coarse silt and very fine sand; fine medium distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; strong effervescence; mildly alkaline; abrupt wavy boundary.

IIIC2—40 to 60 inches; yellowish brown (10 YR 5/4) stratified coarse silt and very fine sand; common medium distinct brownish yellow (10YR 6/6) mottles; massive; friable; strong effervescence; mildly alkaline.

The solum ranges from 24 to 40 inches in thickness. The A horizon is 10 to 15 inches thick. It is very dark grayish brown, very dark gray, very dark brown, or black. The B horizon ranges from 12 to 28 inches in thickness. It is silty clay loam, silt loam, clay loam, loam, or fine sandy loam. In places it is stratified. The C horizon is stratified with layers of silt, silt loam, fine sand, and very fine sand. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Colwood soils are near Kibbie, Sisson, and Yahara soils. They are grayer and more poorly drained than those soils.

Cw—Colwood silt loam. This nearly level soil is in depressions in old glacial lake plains. Areas are irregularly shaped and range in size from 3 to more than 40 acres. Slopes are 0 to 2 percent.

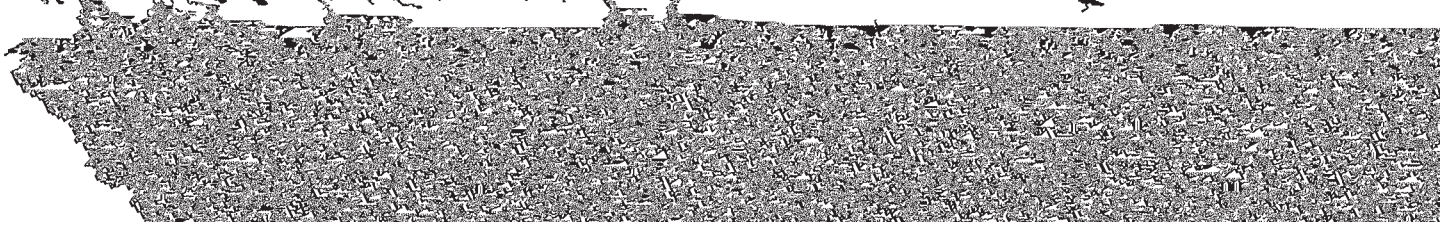
Included with this soil in mapping are small areas of Kibbie, Sebewa, and Yahara soils. Also included are some small sloping areas, some areas where the substratum has layers of clay at a depth of more than 40 inches, and areas where the surface layer is fine sandy loam.

Wetness is the major limitation of this soil. The soil is subject to ponding in spring and after periods of heavy rainfall. It is difficult to drain because the silt and very fine sand in the substratum flow easily and fill tile lines.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and some types of woodland. Most of the acreage is used for pasture or cropland, but a considerable acreage is in woodland. Capability unit IIw–1; woodland group 1w1; wildlife group 7.

Cut and Fill Land, Sandy and Gravelly

Cx—Cut and fill land, sandy and gravelly, is cut and filled sandy and gravelly soil material. Slopes are 0 to 6 percent. The percentage of sand and gravel ranges from almost 100 percent gravel to 100 percent sand.



This land is very difficult to vegetate unless a layer of loamy soil material is placed on the surface. Most of the acreage is used for such urban developments as school grounds, mobile homesites, and resorts. Capability unit VIIIs–10; woodland group 6s1; wildlife group 10.

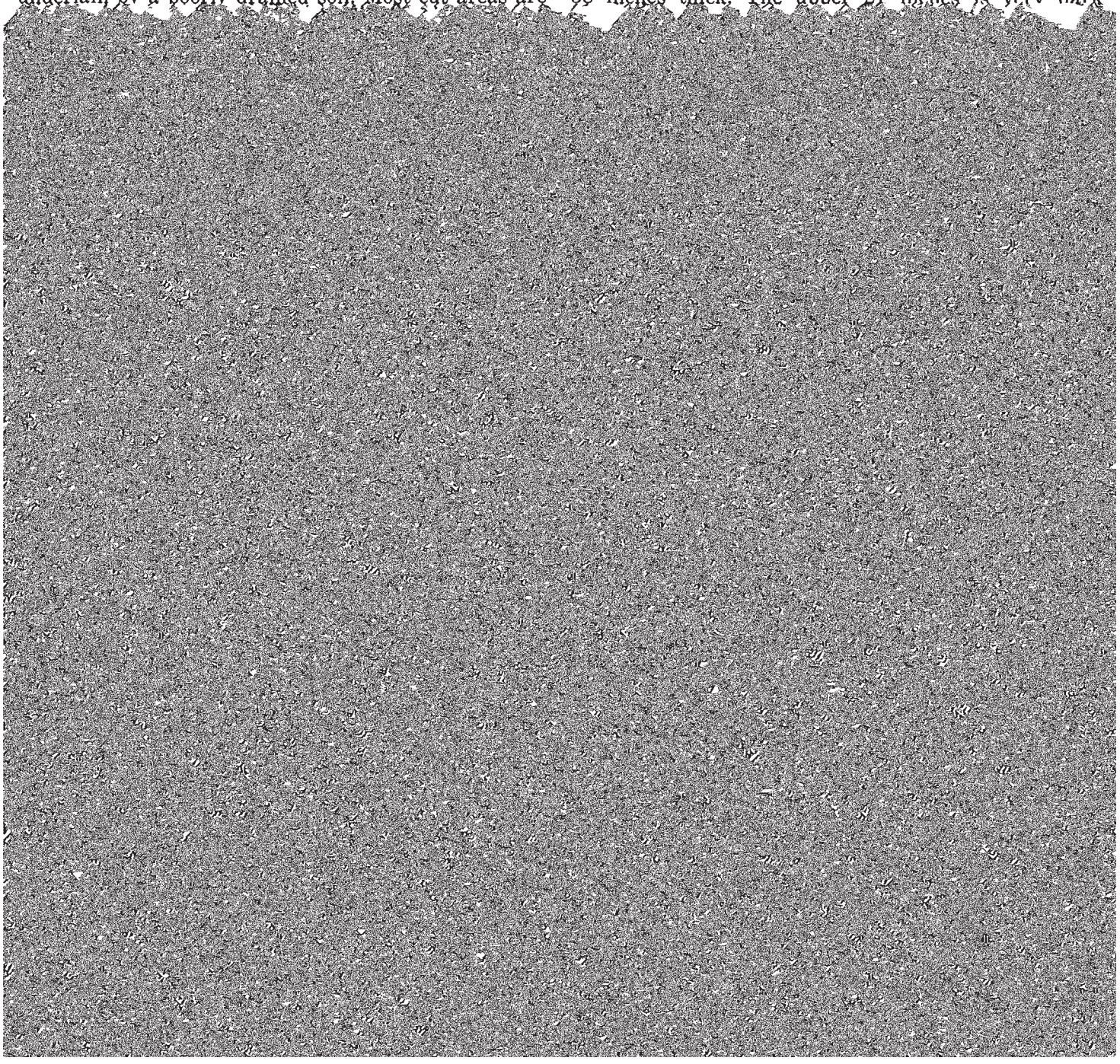
Cut and Fill Land, Loamy

Cy—Cut and fill land, loamy, is cut and filled silt loam, loam, clay loam, sandy loam, or sandy clay loam. Slopes are 0 to 6 percent. Many of the filled areas are underlain by a poorly drained soil. Most cut areas are the acreage is used for recreation. Capability unit VIIIs–10; woodland group 6s1; wildlife group 10.

Edwards Series

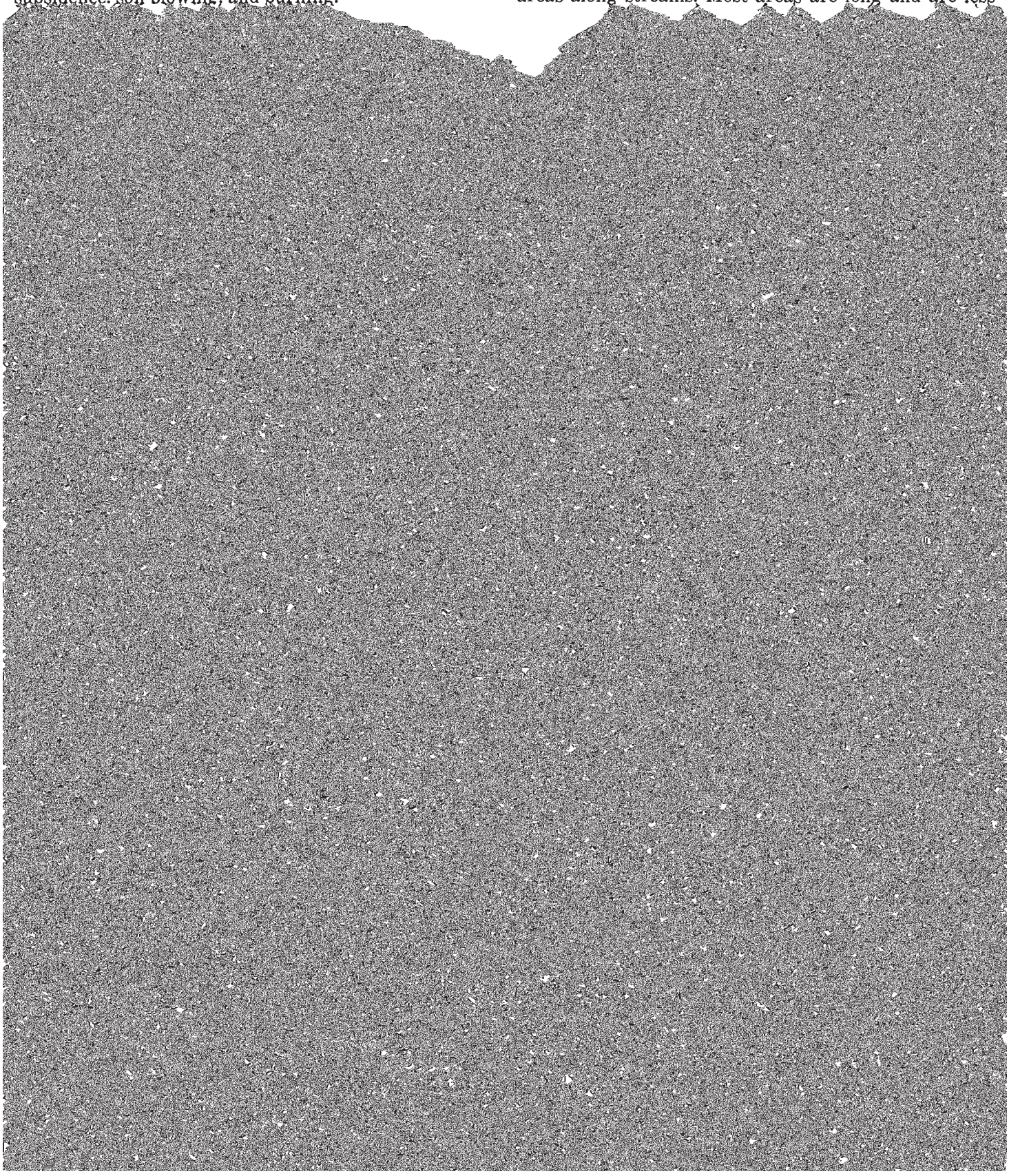
The Edwards series consists of nearly level, very poorly drained soils formed in herbaceous organic material underlain by marl. These soils are in depressional areas in old glacial lake plains. The native vegetation was grasses, sedges, and cattails and some elm, ash, white cedar, and tamarack.

In a representative profile the organic layer is about 38 inches thick. The upper 21 inches is very dark



drained and cultivated, however, the soil is subject to subsidence, soil blowing, and burning.

pressions and around the border of large organic soil areas along streams. Most areas are long and are less



IIC2—43 to 60 inches; pale brown (10YR 6/3) fine sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 12 to 20 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is very dark grayish brown, very dark brown, very dark gray, or black. The B horizon is dominantly clay loam or loam 5 to 12 inches thick. It is brown or dark brown and is mottled. The C horizon is generally sand and gravel, but has strata entirely of sand and also strata of gravel. The B horizon is neutral to mildly alkaline.

Fabius soils are near Casco soils. They are not so well drained as Casco soils. They also differ from these soils in having mottles.

FaA—Fabius loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is on outwash plains and stream terraces. Areas are long and irregularly shaped and range in size from 3 to more than 30 acres.

Included with this soil in mapping are small areas of Casco soils. Also included are areas where the surface layer is sandy loam. In places silt and very fine sand layers are in the substratum at a depth of more than 42 inches.

Wetness is the major limitation of this soil. The soil dries slowly and in some areas is ponded in spring and after periods of heavy rainfall.

If adequately drained and well managed, this soil is moderately well suited to all crops commonly grown in the county. It is suited to woodland and pasture. Most of the acreage is used for crops and pasture. Capability unit IIw–5; woodland group 3o2; wildlife group 6.

Fox Series

The Fox series consists of nearly level to sloping, well drained soils that are underlain by gravelly and sandy outwash. These soils are on outwash plains and stream terraces. Some areas have complex slopes. The native vegetation was a deciduous forest of mainly oak, hickory, and maple.

In a representative profile the surface layer is dark grayish brown silt loam about 9 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is about 14 inches thick. It is brown, firm silty clay loam in the upper part and dark brown, firm clay loam in the lower part. The substratum to a depth of 60 inches is yellowish brown stratified, loose coatings on faces of some peds; neutral; clear wavy boundary.

IIB21t—18 to 22 inches; dark brown (7.5YR 4/4) clay loam; strong medium subangular blocky structure; firm; thick continuous clay films; slightly acid; abrupt wavy boundary.

IIB22t—22 to 27 inches; dark brown (7.5YR 3/2) heavy clay loam; strong medium subangular blocky structure; firm; thick continuous clay films; estimated 10 percent gravel by volume; neutral; abrupt wavy boundary.

IC—27 to 60 inches; yellowish brown (10YR 5/4) stratified gravel and sand; single grained; loose; estimated 55 percent gravel by volume; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is 6 to 9 inches thick. It is dark grayish brown or dark brown. It is generally silt loam, but in places is loam. The A2 horizon is 3 to 6 inches thick. It is grayish brown or brown. In places the A2 horizon does not occur. In uncultivated areas there is an A1 horizon that is 3 to 5 inches thick. It is very dark brown or very dark grayish brown. The B horizon is 13 to 32 inches thick. It is silt loam or silty clay loam in the upper part and clay loam or sandy clay loam in the lower part. The lower part of the B horizon is 5 to 15 percent gravel by volume. The C horizon is generally stratified gravel and sand, but ranges from mostly gravel to mostly sand. The B horizon ranges from slightly acid to mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Fox soils are near Casco, Matherton, and Sebewa soils. Fox soils have a thicker solum than Casco soils. They are better drained than Matherton and Sebewa soils and also differ from those soils in having no mottles. Fox soils have more clay and less sand in the B horizon than Boyer soils.

FsA—Fox silt loam, 0 to 2 percent slopes. This nearly level soil is on outwash plains. Areas are irregularly shaped and range in size from 4 to more than 100 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are some small areas of Boyer, Casco, Matherton, and St. Charles soils. Also included are areas where the surface layer is sandy loam, some small gently sloping areas, and some moderately well drained areas.

This soil is slightly droughty. Conserving moisture and maintaining tilth help to increase available water capacity.

This soil is suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops. Capability unit

land and pasture. Most of the acreage is used for crops. Capability unit IIe–2; woodland group 2o1; wildlife group 1.

FsC2—Fox silt loam, 6 to 12 percent slopes, eroded. This sloping soil is on outwash plains. Areas are irregularly shaped and range in size from 3 to more than 20 acres. This soil differs from the soil described as representative of the series in having all of the subsurface layer and some of the subsoil mixed in the plow layer.

Included with this soil in mapping are small areas of Boyer, Casco, Rodman, St. Charles, and Theresa soils. Also included are areas where the surface layer is sandy loam and some moderately steep areas.

This soil is subject to moderate erosion and is slightly droughty. Conserving moisture, reducing runoff, and maintaining tilth help to control erosion and maintain available water capacity.

If well managed, this soil is suited to all crops

pedons. The C horizon is coarse, medium, or fine sand. Both the B and C horizons are slightly acid or neutral.

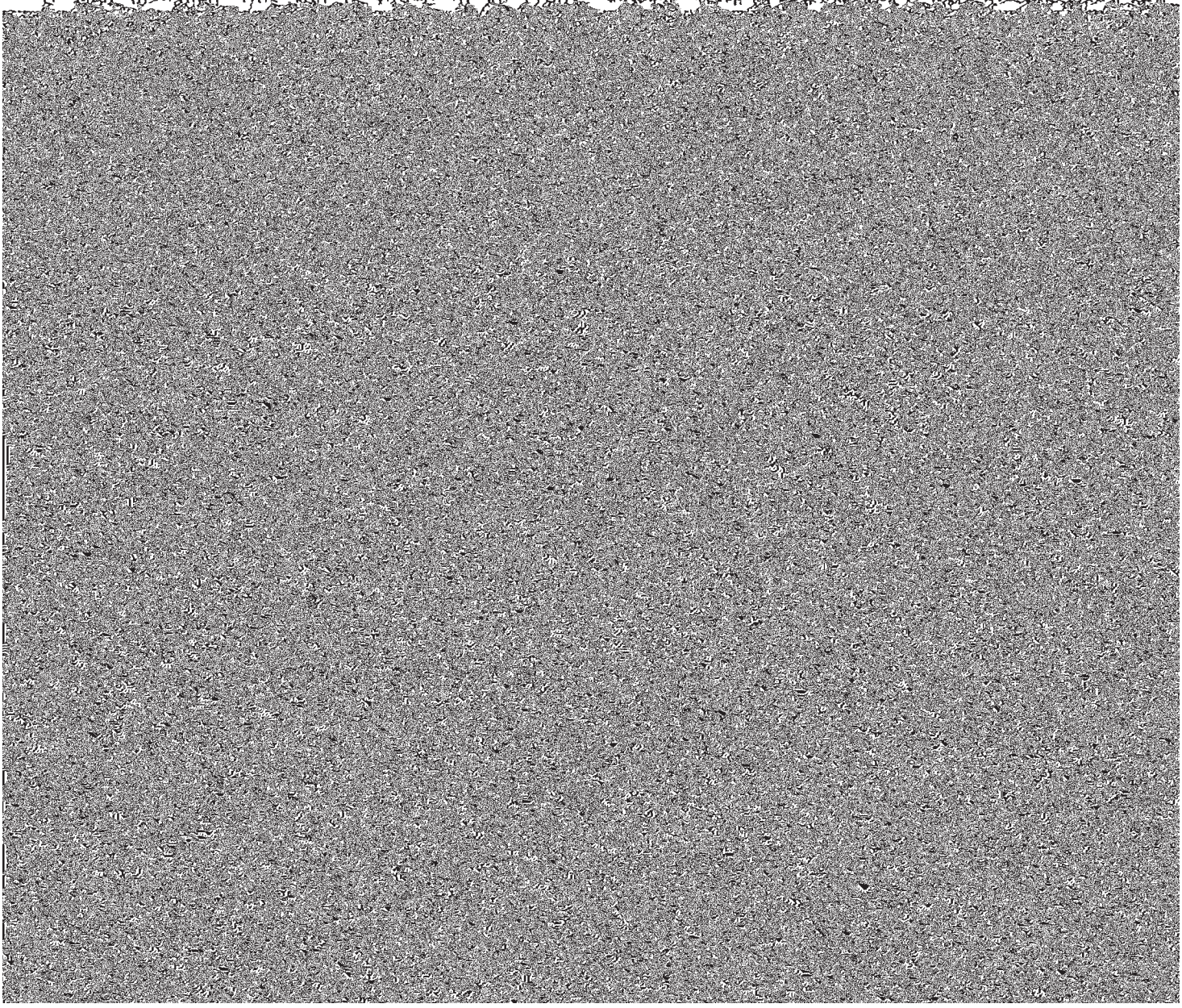
Granby soils are near Adrian and Oakville soils. Granby soils are grayer and more poorly drained than Oakville soils. They lack the organic surface layer typical of the Adrian soils.

Gb—Granby loamy fine sand. This nearly level soil is in depressions and on stream terraces. Areas are irregularly shaped and range in size from 3 to more than 50 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Adrian, Colwood, and Oakville soils. Also included are some areas where the substratum has strata of very fine sand, silt, or clay below a depth of 40 inches.

This soil is too wet for crop production unless it is drained. If drained and cultivated, however, it is droughty and subject to soil blowing.

This soil is poorly suited to crops and pasture, but is suited to some types of woodland and to wildlife



brownish yellow (10YR 6/6) mottles and common medium faint grayish brown (10YR 5/2) mottles; massive; very friable; estimated 45 percent gravel by volume; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—30 to 60 inches; light brownish gray (2.5Y 6/2) gravel and sand; single grained; loose; estimated 60 percent gravel by volume; strong effervescence; moderately alkaline.

The solum ranges from 12 to 20 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is very dark gray, very dark grayish brown, or black. It is generally silt loam, but in places is loam or gravelly loam. The B horizon ranges from 6 to 12 inches in thickness. It is gravelly loam, gravelly sandy loam, or gravelly loamy fine sand. The gravel content ranges from 15 to 50 percent by volume. The C horizon is typically gravel and sand, but contains strata entirely of gravel and also strata of gravelly loamy sand. The B horizon is neutral to moderately alkaline.

The Granby variant is near Fabius and Sebewa soils. It is more poorly drained and has more gravel in the B horizon than Fabius soils. It has a thinner solum and more gravel and less clay in the solum than Sebewa soils.

Gg—Granby silt loam, gravelly variant. This nearly level soil is on outwash plains and low stream terraces. Areas are irregularly shaped and range in size from

is 20 inches thick. The upper 4 inches is brown, friable loam; the next 11 inches is dark reddish brown, firm sandy clay loam and friable sandy loam; and the lower 5 inches is reddish brown, firm silty clay loam. The substratum to a depth of 60 inches is brown, stratified, firm silt, silty clay, and silty clay loam.

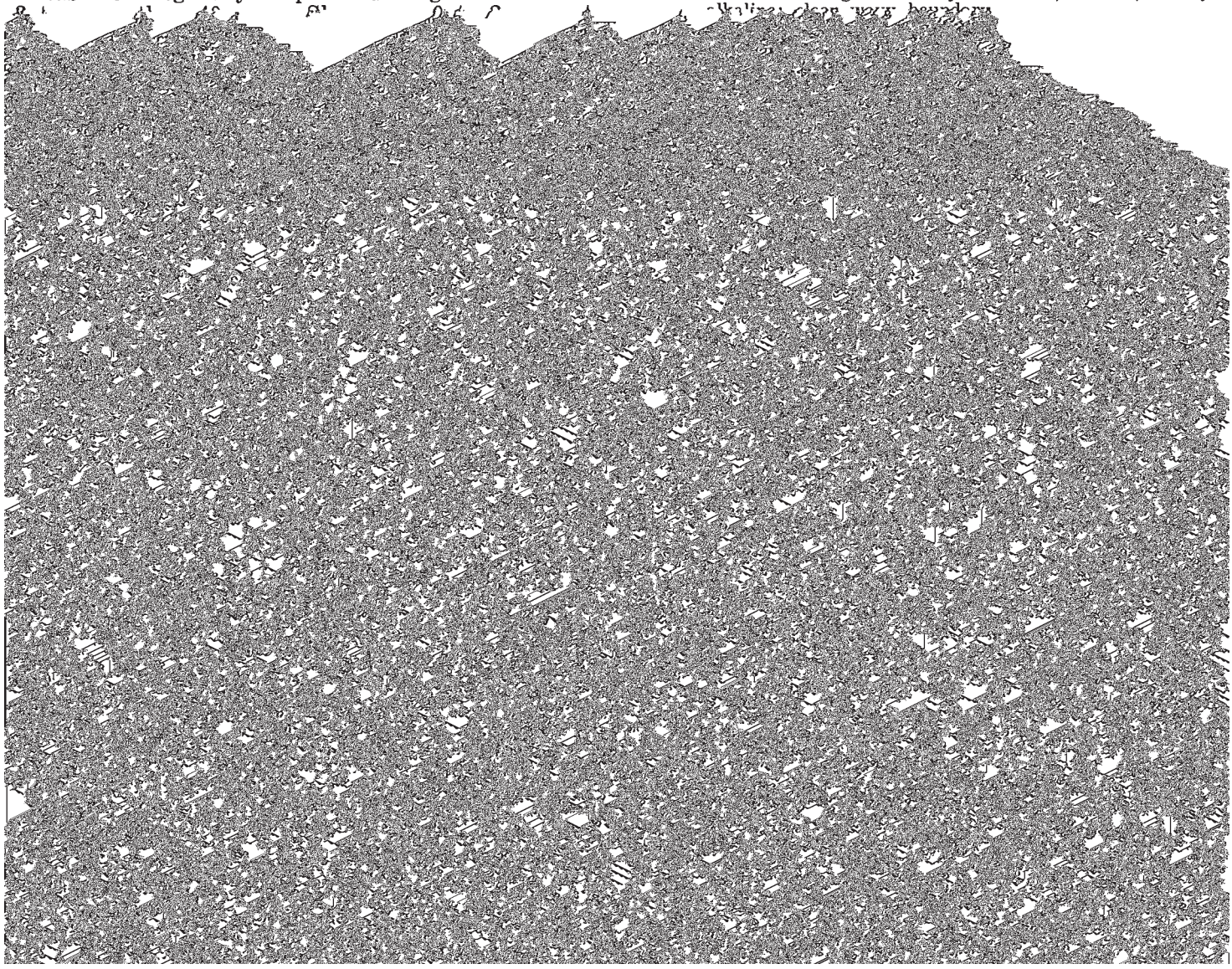
Permeability is moderate to a depth of about 23 inches and moderately slow below. Available water capacity is high. Organic-matter content is moderately low, and natural fertility is medium.

Most of the acreage is used for corn, small grain, legumes, and other crops commonly grown in the county. Some areas are used for pasture and woodland.

Representative profile of Hebron loam, 2 to 6 percent slopes, in a cultivated field, 600 feet north and 2,610 feet west of the southeast corner of sec. 18, T. 15 N., R. 23 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate fine subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.

B1—8 to 12 inches; brown (7.5YR 5/4) loam; moderate medium subangular blocky structure; friable; mildly



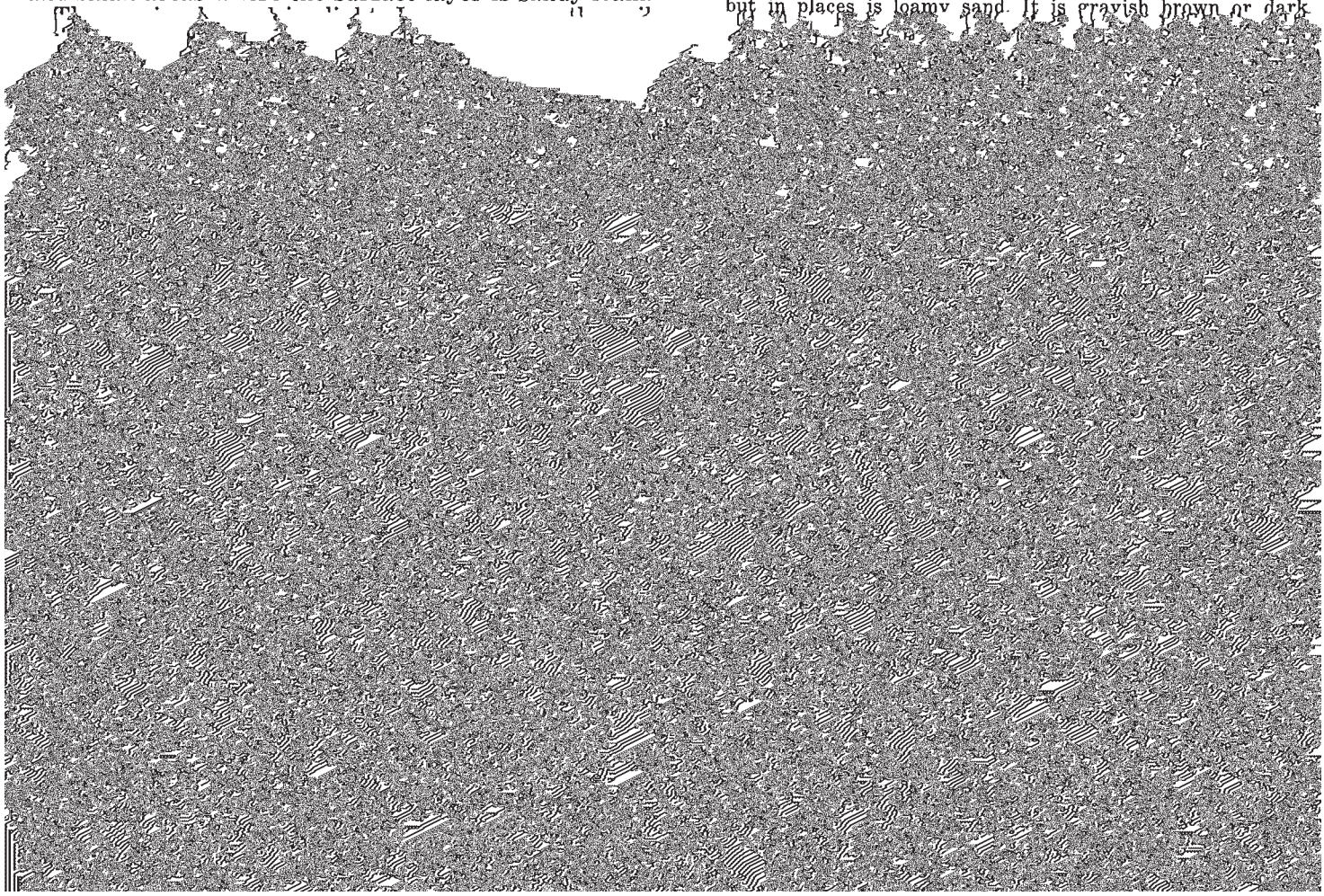
of Fox, Kewaunee, Mosel, and Sisson soils. Also included are areas where a thin layer of sand or sand and gravel is between the loamy upper layer and the silty and clayey substratum, small areas where the surface layer is sandy loam, and small gently sloping areas.

Runoff is slow, and the erosion hazard is slight. Because of the moderately slow permeability in the substratum, water does not readily move through this soil, and the soil dries somewhat slowly in spring and after periods of heavy rainfall. Removing surface water and preventing the entry of runoff from surrounding areas help to reduce ponding.

This soil is suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops, and a small acreage is used for woodland and pasture. Capability unit IIs–7; woodland group 2o1; wildlife group 1.

HeB—Hebron loam, 2 to 6 percent slopes. This gently sloping soil is in old glacial lake basins and on glacial till plains. Areas are irregularly shaped and range in size from 3 to more than 40 acres.

Included with this soil in mapping are small areas of Fox, Mosel, and Sisson soils. Also included are small areas where a thin layer of sand or sand and gravel is between the loamy upper layer and the clayey substratum, small areas of nearly level and sloping soils, and small areas where the surface layer is sandy loam.



and legumes. Some areas are used for woodland and pasture.

Representative profile of Hebron sandy loam, sandy subsoil variant, 0 to 2 percent slopes, in an idle field, 900 feet south and 1,500 feet east of the northwest corner of sec. 3, T. 15 N., R. 23 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam; weak medium granular structure; friable; neutral; abrupt smooth boundary.

A2—8 to 18 inches; grayish brown (10YR 5/2) loamy sand; weak medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.

B2t—18 to 26 inches; dark brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; many thin patchy clay films; neutral; clear smooth boundary.

B31t—26 to 33 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; clay bridging between sand grains; neutral; abrupt wavy boundary.

IIB32t—33 to 38 inches; dark brown (7.5YR 4/4) light silty clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine angular blocky structure; firm; many thin patchy clay films; neutral; clear wavy boundary.

IIC—38 to 60 inches; stratified light yellowish brown (10YR 6/4) silt loam, brown (7.5YR 5/4) silty clay loam, and reddish brown (5YR 4/4) silty clay; firm; pinkish gray (7.5YR 7/2) lime segregations; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is 6 to 9 inches thick. It is generally sandy loam, but in places is loamy sand. It is grayish brown or dark

of Boyer, Mosel, and Sisson soils. Also included are small areas where the surface layer is loam or loamy sand and areas that are nearly level or sloping.

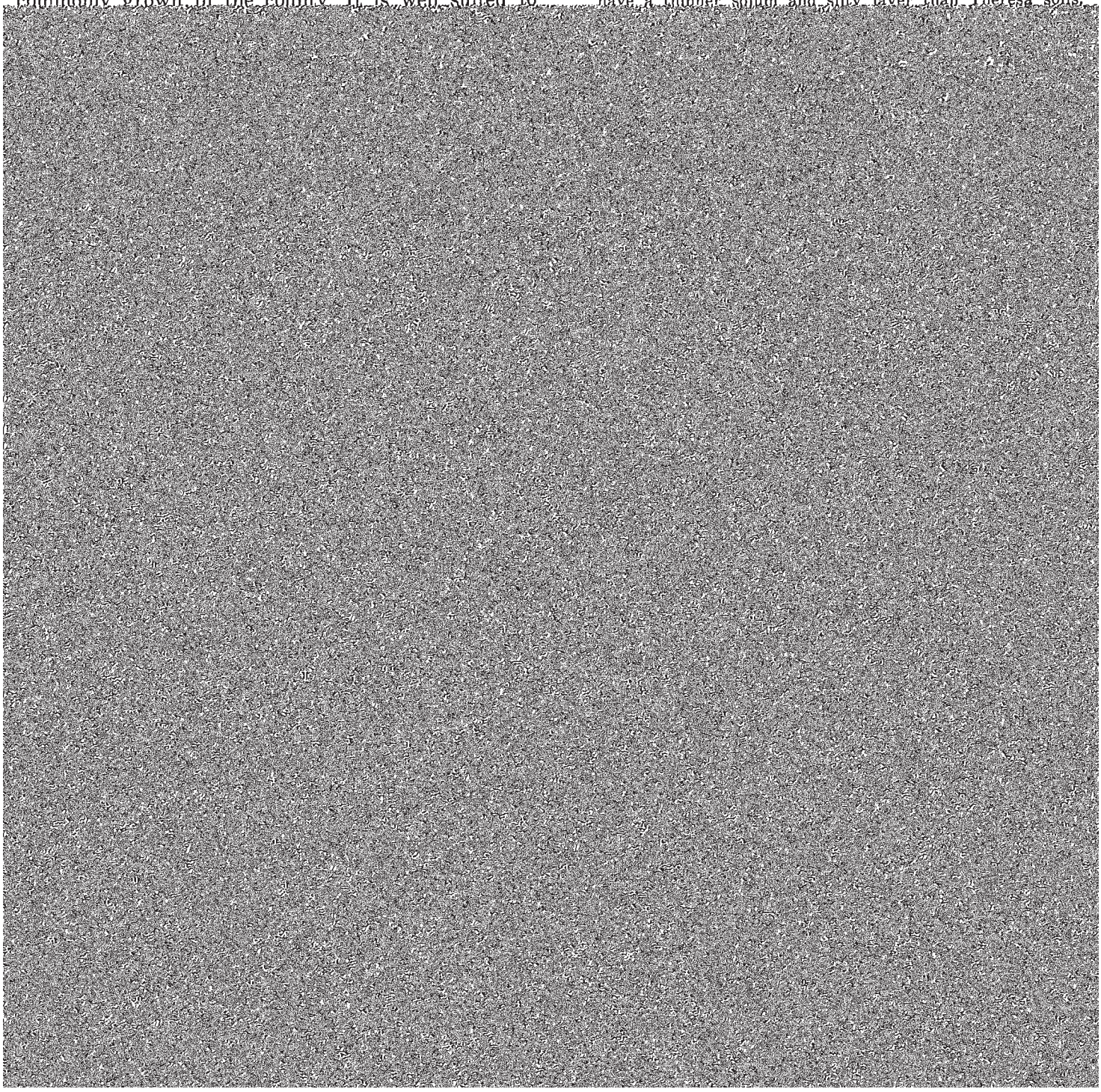
The hazards of erosion and soil blowing are slight. This soil is slightly droughty. In some areas it dries somewhat slowly in spring and after periods of heavy rainfall. Reducing runoff, improving tilth, and conserving moisture are beneficial if the soil is used for crops.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to

loam, but in places the upper part is silt loam, loam, or silty clay loam. In places gravel and stones are in the lower part. The C horizon is loam, sandy loam, gravelly loam, or gravelly sandy loam. It is 5 to 35 percent gravel and as much as 10 percent stones and boulders. The calcium carbonate equivalent of the C horizon is 40 to 60 percent. The B horizon is slightly acid to mildly alkaline.

Hochheim soils in this survey area have a lighter colored surface layer than is defined as the range for the series, but this difference does not alter use or management.

Hochheim soils are near Knowles, Nenno, and Theresa soils. Hochheim soils are better drained than Nenno soils and also differ from those soils in having no mottles. They have a thinner solum and silty layer than Theresa soils.



having the subsurface layer and some of the subsoil mixed with the plow layer.

Included with this soil in mapping are small areas of Casco, Nenno, Sisson, and Theresa soils and areas of Hochheim soils that have a surface layer of clay loam. Also included are some small sloping and steep areas, severely eroded areas, and some stony areas. Many of the stony areas are identified on the soil map by spot symbols.

The hazard of erosion is severe. Controlling runoff and increasing the organic-matter content help to prevent further erosion and improve tilth.

Even if well managed, this soil is poorly suited to most crops commonly grown in the county. It is well suited to woodland and pasture. Most areas are used for cropland, but a considerable acreage is used for pasture or has remained in woodland. Capability unit IVe–1; woodland group 2r1; wildlife group 1.

HmE—Hochheim silt loam, 20 to 30 percent slopes. This steep soil is on the sides of drumlins, on moraines, and along drainageways on till plains. Areas are irregularly shaped and range in size from 3 to more than 40 acres. This soil has a thinner, darker colored surface layer, a thicker subsurface layer, and a thinner subsoil than is representative for the series.

Included with this soil in mapping are small areas of Casco, Rodman, and Theresa soils. Also included are some very steep areas and stony areas.

The hazard of erosion is very severe, and runoff is very rapid. Controlling runoff helps to control erosion.

This soil is generally not suited to crops. It is suited to woodland and pasture. Most of the acreage is used for woodland. Capability unit VIe–1; woodland group 2r1; wildlife group 1.

HsC2—Hochheim-Casco-Sisson complex, 6 to 12 percent slopes, eroded. These sloping soils are on pitted till and outwash plains. Areas are irregularly shaped and range in size from 4 to more than 40 acres.

This complex consists of areas of Hochheim, Casco, and Sisson soils that are so small and closely intermingled that they cannot be shown separately on the soil map. This complex is about 40 percent Hochheim soils, 30 percent Casco soils, 15 percent Sisson soils, and 15 percent Fox, Rodman, St. Charles, Theresa, and Zurich soils.

The Hochheim soils have a browner surface layer and contain more gravel and stones in the substratum than is representative for the Hochheim series. They also differ in having no subsurface layer. The Casco soils have a browner surface layer and more clay in the surface layer than is representative for the Casco series. The Sisson soils are about 5 inches thinner than is representative for the Sisson series.

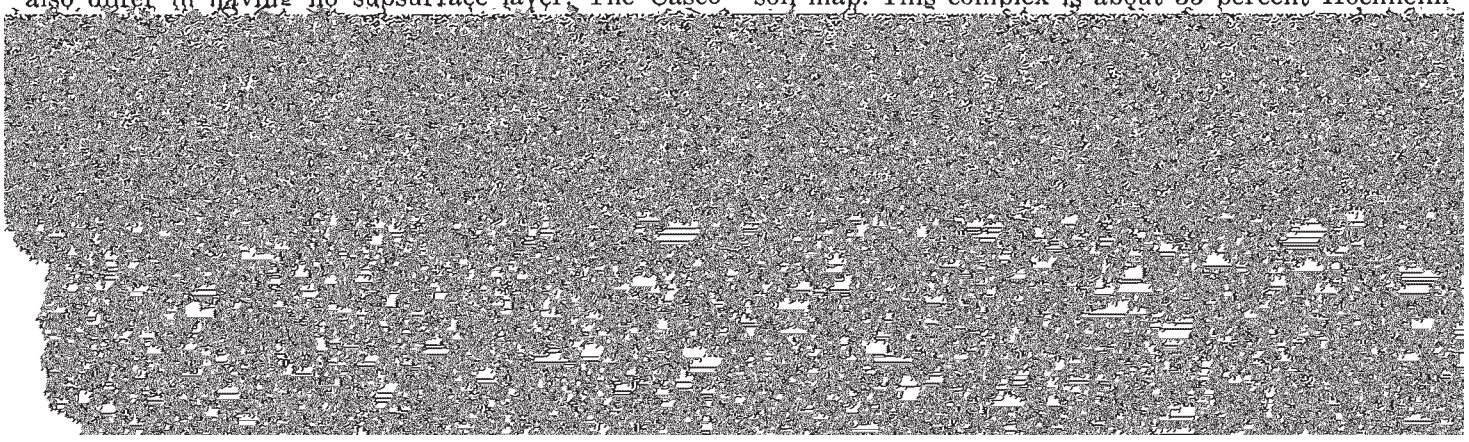
Included with these soils in mapping are some sloping and steep areas. Also included are some stony areas, most of which are identified on the soil map by spot symbols. Some small poorly drained and somewhat poorly drained areas are also identified by spot symbols.

The hazard of erosion is severe. The Casco soils are droughty. Controlling runoff and increasing the organic-matter content help to prevent further erosion, conserve available water, and improve tilth.

Even if well managed, these soils are poorly suited to most crops grown in the county. They are suited to woodland and pasture. About 60 percent of the acreage is used for crops, and about 40 percent is used for woodland and pasture. Capability unit IVe–1; woodland group 2r1; wildlife group 1.

HsE—Hochheim-Casco-Sisson complex, 20 to 30 percent slopes. These steep soils are on pitted till and outwash plains. Areas are irregularly shaped and range in size from 10 to more than 80 acres.

This complex consists of areas of Hochheim, Casco, and Sisson soils that are so small and closely intermingled that they cannot be shown separately on the soil map. This complex is about 35 percent Hochheim



moderately well suited to all crops commonly grown in the county. They are well suited to woodland and pasture. Most of the acreage is used for cropland, but one-third has remained in woodland. Capability unit IIIe–1; woodland group 2o1; wildlife group 1.

HsD2—Hochheim-Casco-Sisson complex, 12 to 20 percent slopes, eroded. These moderately steep soils are on pitted till and outwash plains. Areas are irregularly shaped and range in size from 10 to more than 80 acres.

This complex consists of areas of Hochheim, Casco, and Sisson soils that are so small and closely intermingled that they cannot be shown separately on the soil map. This complex is about 40 percent Hochheim soils, 30 percent Casco soils, 15 percent Sisson soils, and 15 percent Fox, Rodman, St. Charles, Theresa, and Zurich soils.

The Hochheim soils have a browner surface layer and contain more stones and gravel in the substratum than is representative for the Hochheim series. They also differ in having no subsurface layer. The Casco soils have a browner surface layer and more clay in the surface layer than is representative for the Casco series. The Sisson soils are about 5 inches thinner than is representative for the Sisson series.

Included with these soils in mapping are some sloping and steep areas. Also included are some stony areas, most of which are identified on the soil map by spot symbols. Some small poorly drained and somewhat poorly drained areas are also identified by spot symbols.

The hazard of erosion is severe. The Casco soils are droughty. Controlling runoff and increasing the organic-matter content help to prevent further erosion, conserve available water, and improve tilth.

Even if well managed, these soils are poorly suited to most crops grown in the county. They are suited to woodland and pasture. About 60 percent of the acreage is used for crops, and about 40 percent is used for woodland and pasture. Capability unit IVe–1; woodland group 2r1; wildlife group 1.

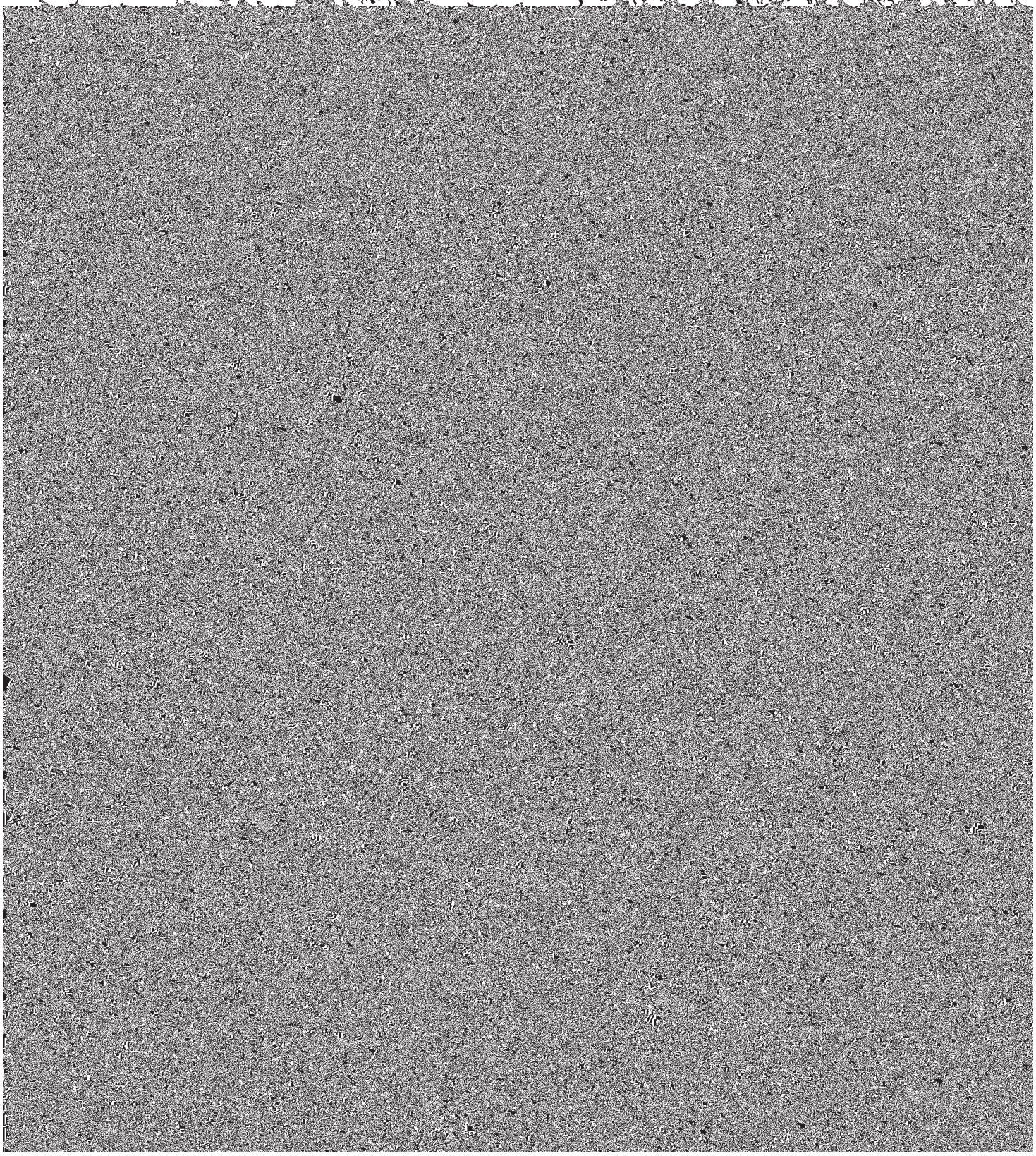
HsE—Hochheim-Casco-Sisson complex, 20 to 30 percent slopes. These steep soils are on pitted till and outwash plains. Areas are irregularly shaped and range in size from 10 to more than 80 acres.

This complex consists of areas of Hochheim, Casco, and Sisson soils that are so small and closely intermingled that they cannot be shown separately on the soil map. This complex is about 35 percent Hochheim

The soils in this complex are generally not suited to crops. They are suited to woodland and pasture. Most of the acreage is used for woodland. Capability unit VIe–1; woodland group 2r1; wildlife group 1.

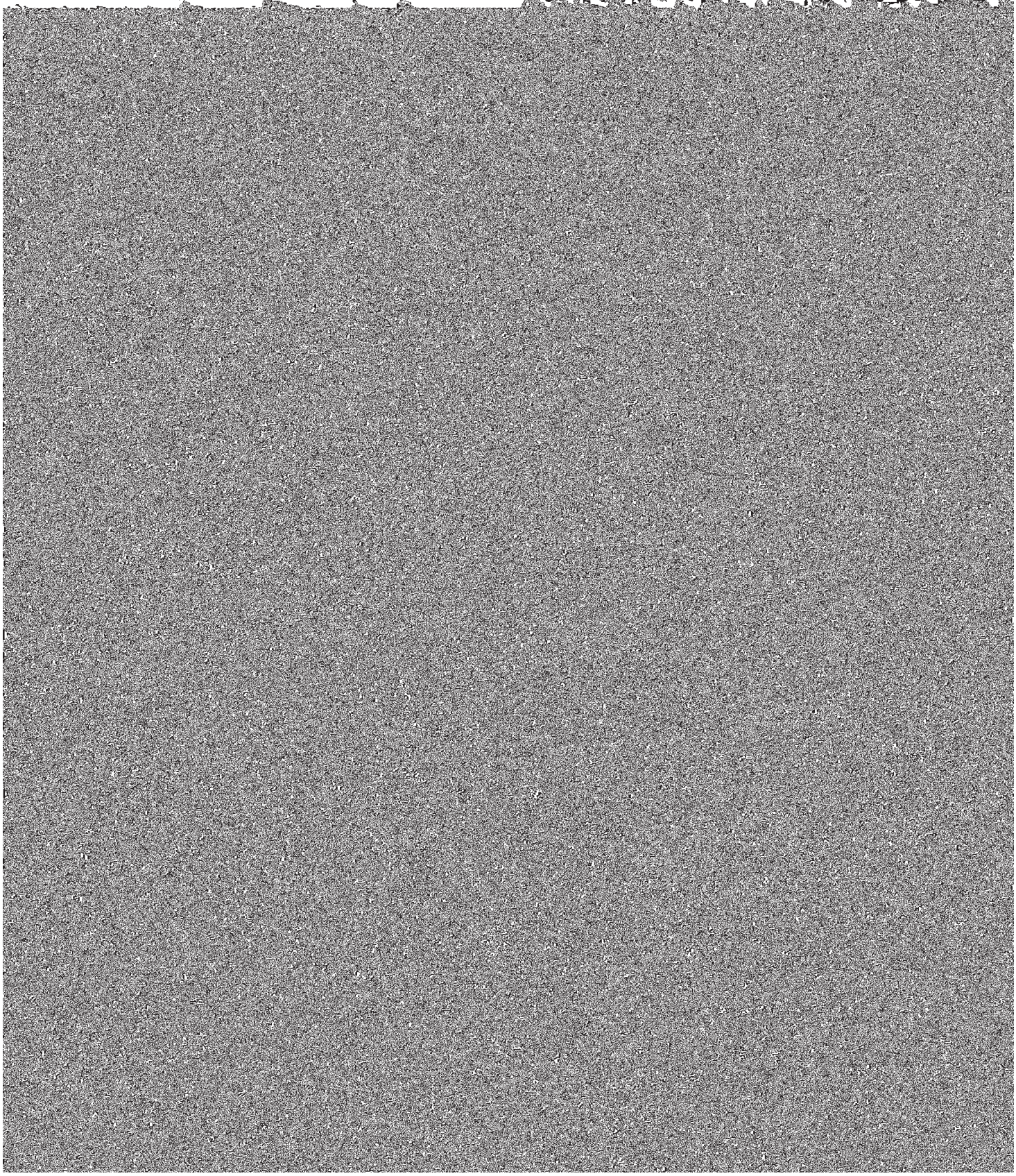
very dark brown (10YR 2/2) on exposure to air; massive; friable; estimated 30 percent fiber, 2 percent rubbed; mildly alkaline; clear smooth boundary.

Oa4—42 to 60 inches; dark yellowish brown (10YR 3/4 broken face and rubbed) sapric material changing to



C1—9 to 14 inches; dark brown (10YR 4/3) silt loam; weak coarse subangular blocky structure parting to moderate

ity is high. Organic-matter content is moderate, and natural fertility is high. The root zone is limited by



suited to all crops commonly grown in the county. It is suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIw–2; woodland group 2o2; wildlife group 6.

Kewaunee Series

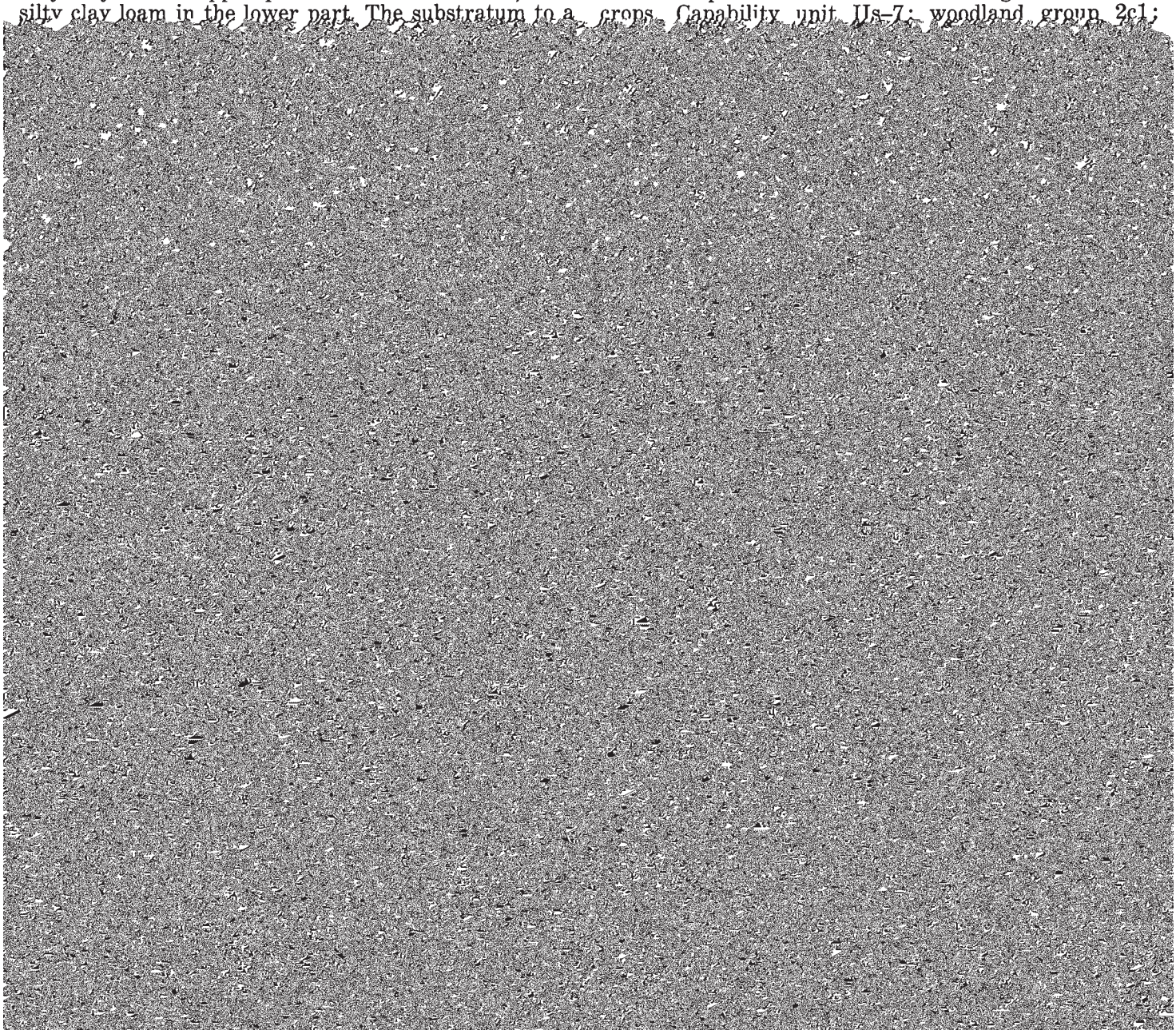
The Kewaunee series consists of nearly level to moderately steep, well drained and moderately well drained soils formed in silty clay loam glacial till. These soils are on till plains. The native vegetation was a forest of mainly oak, maple, beech, basswood, and white pine.

In a representative profile the surface layer is dark reddish gray silt loam about 8 inches thick. The subsoil is about 17 inches thick. It is reddish brown, firm silty clay in the upper part and reddish brown, firm silty clay loam in the lower part. The substratum to a

Included with this soil in mapping are small areas of Hebron, Manawa, Poygan, and Sisson soils. Most areas of the wet Manawa and Poygan soils are along intermittent drainageways or are identified by spot symbols on the soil map. Many areas of the sandy Hebron and Sisson soils are also identified by spot symbols. Also included in mapping are some small gently sloping areas and areas that are underlain by sand and gravel at a depth of less than 60 inches.

Runoff is slow. Because permeability is moderately slow, this soil dries slowly in spring and after periods of heavy rainfall. Removing surface water and preventing the entry of runoff from surrounding areas reduce ponding.

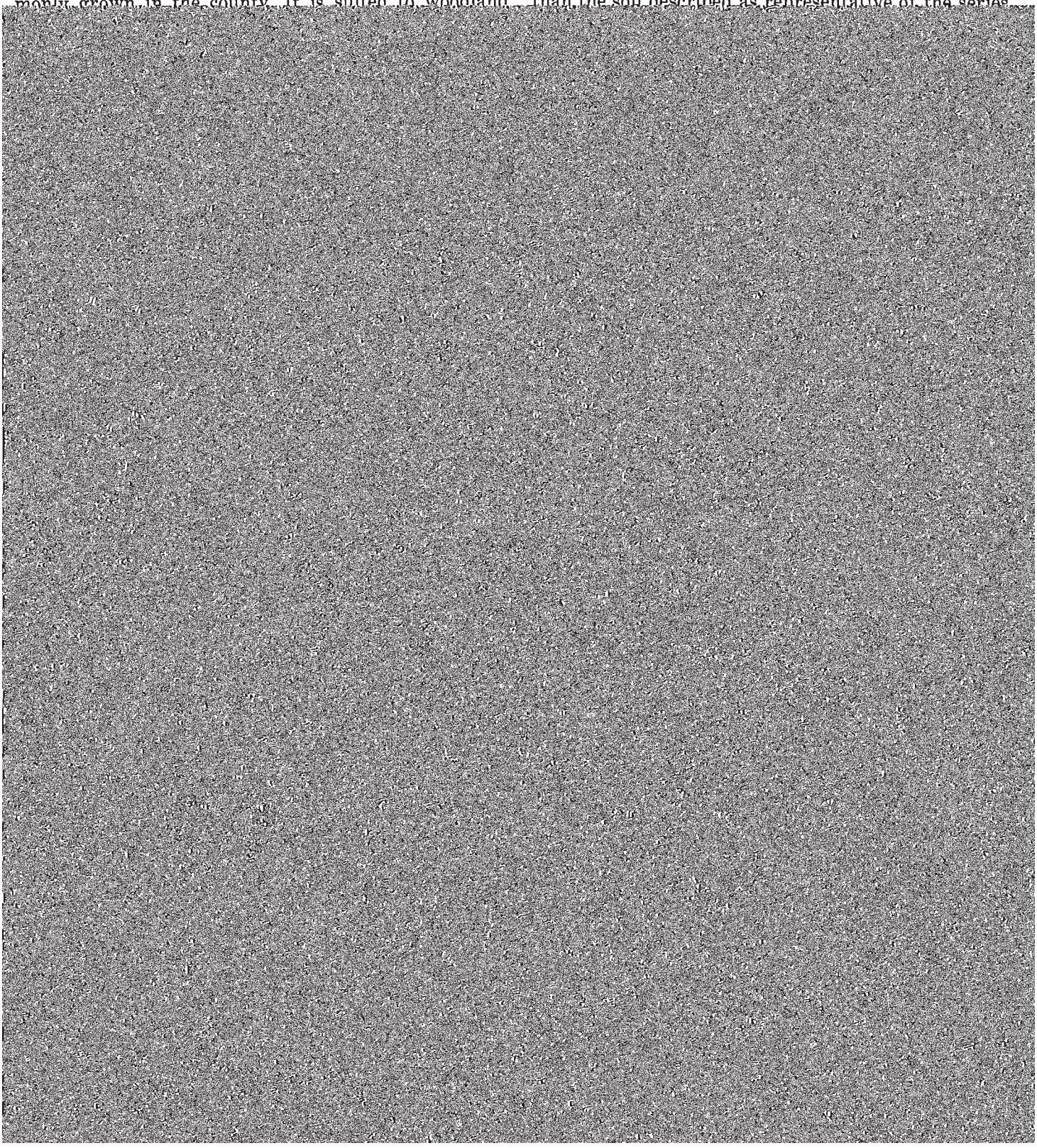
This soil is moderately well suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIs–7; woodland group 2c1;



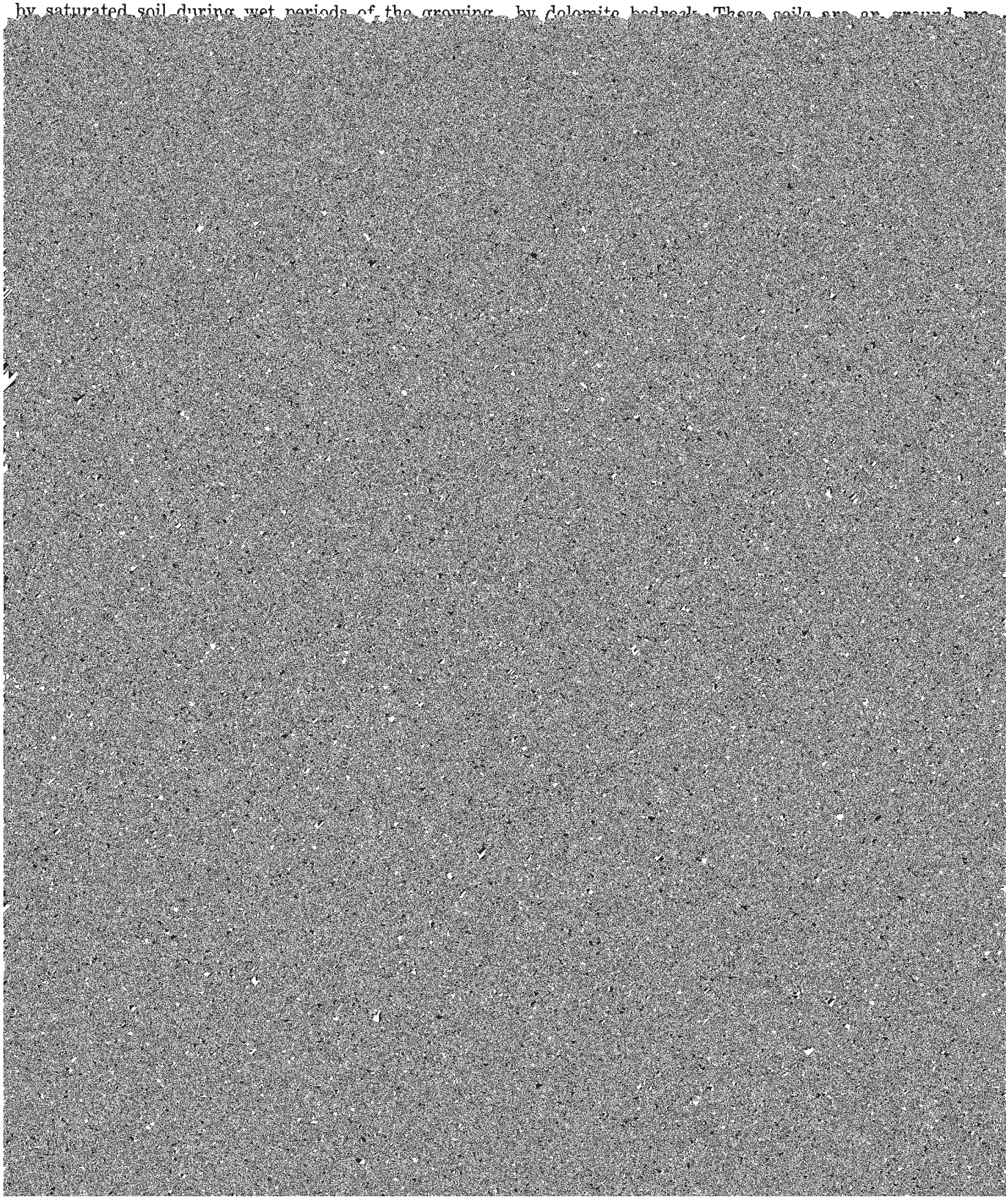
control further erosion and improve tilth. Seedbed preparation and tillage should be done at optimum moisture conditions.

This soil is moderately well suited to all crops commonly grown in the county. It is suited to woodland

severely eroded. This sloping soil is on till plains, on the sides of valleys, and in small depressions. Areas are irregularly shaped and range in size from 3 to 40 acres. This soil contains more clay in the surface layer than the soil described as representative of the series.



by saturated soil during wet periods of the growing by dolomite bedrock. These soils are or ground wa



Permeability is moderate, and available water capacity is high. Organic-matter content is moderate, and natural fertility is medium. The root zone is limited by saturated soil during wet periods of the growing season.

Most areas of these soils are used for crops, but some are used for pasture and woodland.

Representative profile of Lamartine silt loam, 0 to 3 percent slopes, in a cultivated area, 720 feet west and 1,100 feet north of the southeast corner of sec. 15, T. 13 N., R. 21 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; weak medium subangular blocky structure

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to woodland and pasture. Most of the acreage is used for crops. Capability unit IIw–2; woodland group 2o2; wildlife group 6.

Loamy Land, Seeped

Lo—Loamy land, seeped, is on wet foot slopes of drumlins, moraines and escarpments. It is generally adjacent to steeper soils. Slopes are 2 to 20 percent. This land consists of areas of both organic and mineral soils. The mineral soils range from sand and gravel to

Permeability is slow, and available water capacity is moderate. Organic-matter content is also moderate. Natural fertility is medium. The root zone is limited by saturated soil during wet periods.

Most areas of these soils are used for crops, but some are used for pasture and woodland.

Representative profile of Manawa silt loam, 0 to 3 percent slopes, in a cultivated area, 1,570 feet north and 2,240 feet west of the southeast corner of sec. 29, T. 14 N., R. 23 E.

Ap—0 to 8 inches; very dark grayish brown (10 YR 3/2) silt loam; moderate medium granular structure; friable; slightly acid; abrupt smooth boundary.

IIB2t—8 to 18 inches; reddish brown (5YR 5/3) clay; common fine faint reddish gray (5YR 5/2) and few fine prominent yellowish red (5YR 5/6) mottles; weak medium prismatic structure parting to strong fine angular blocky; firm; thin continuous clay films; mildly alkaline; clear wavy boundary.

IIB3—18 to 26 inches; reddish brown (5YR 5/4) heavy silty clay loam; common fine distinct light brownish gray (2.5Y 6/2) and prominent yellowish red (5YR 5/6) mottles; weak medium prismatic structure parting to

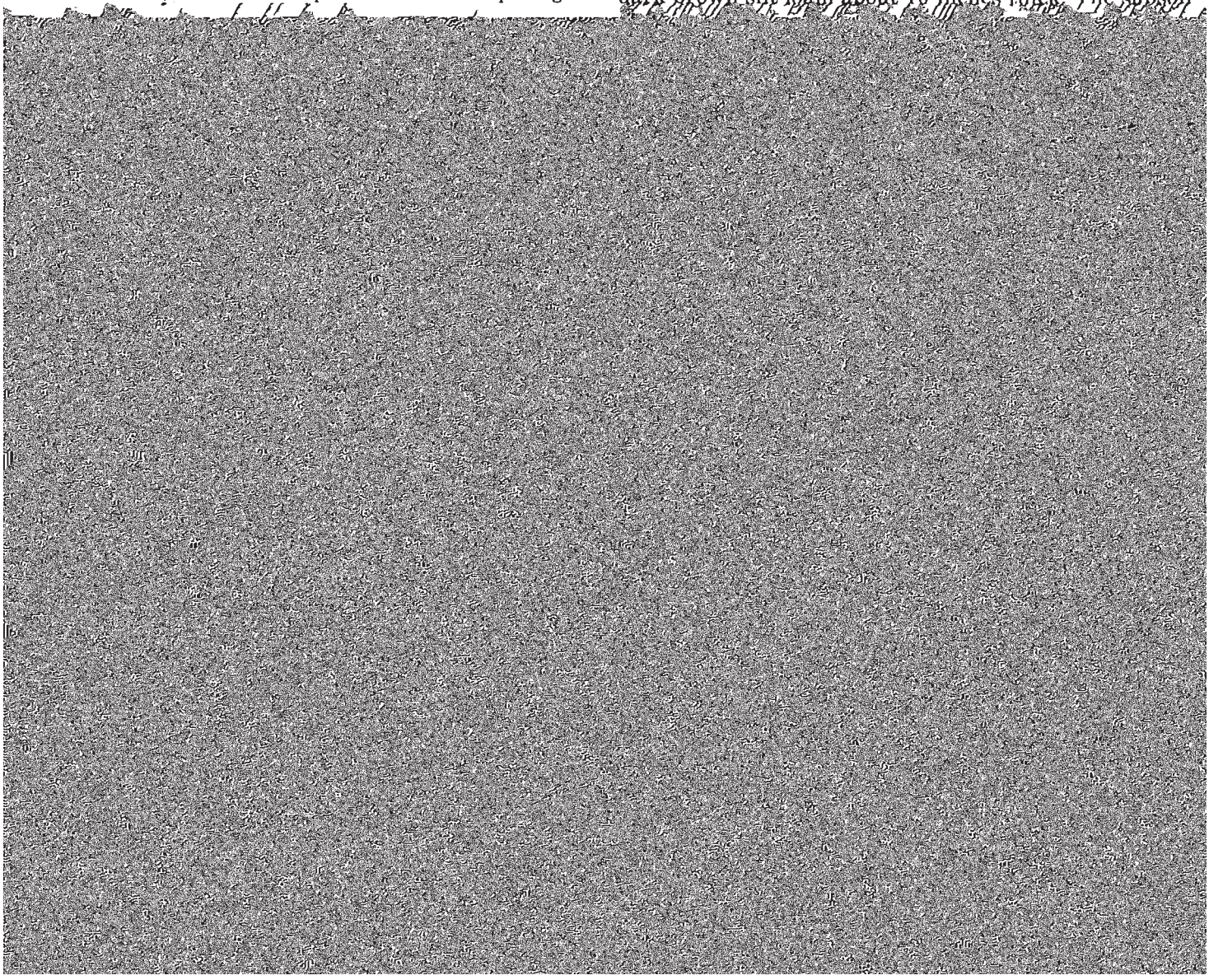
potholes in moraines and outwash plains. The native vegetation is mainly cattails, sedges, reeds, rushes, and other water-tolerant plants. Slopes are 0 to 2 percent. Included in mapping are small areas of open water and Boots and Houghton soils.

Marsh is not suited to commercial crop production, woodland, or pasture. Drainage is not economical or feasible in most areas. Marsh is well suited as wetland wildlife habitat. Capability unit VIIIw–15; woodland group 6wl; wildlife group 7.

Martinton Series

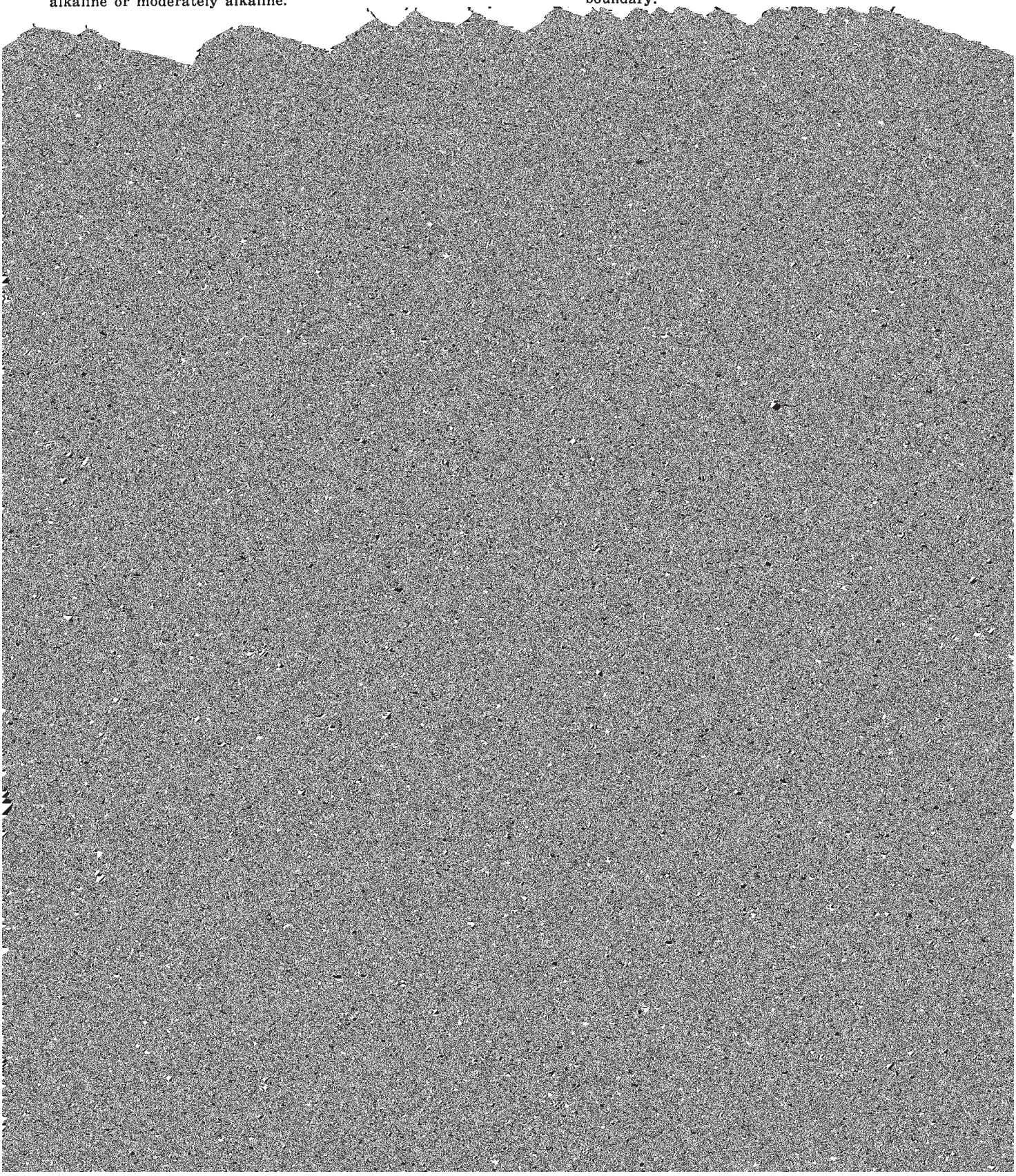
The Martinton series consists of somewhat poorly drained, nearly level and gently sloping soils formed in drainageways and depressions and shallow drainage basins on ground moraines and in old glacial lake basins. The native vegetation was a forest of maple, oak, beech, and ash and an undergrowth of grasses.

In a representative profile the surface layer is very dark brown silt loam about 10 inches thick. The subsoil



horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

(10YR 5/2) worm casts; neutral; abrupt smooth boundary.



Permeability is slow. Available water capacity is high. Organic-matter content is also high. Natural fertility is medium. The root zone is limited by the water table.

Most of the acreage is used for crops, but some areas are used for pasture or woodland.

Representative profile of Montgomery silty clay loam, slopes of 0 to 2 percent, in a cultivated field, 250 feet west and 1,670 feet south of the northeast corner of sec. 12, T. 14 N., R. 22 E.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A12—8 to 12 inches; black (10YR 2/1) silty clay; common fine distinct dark gray (10YR 4/1) mottles; moderate fine subangular blocky structure; firm; neutral; clear smooth boundary.

B2g—12 to 20 inches; dark gray (10YR 4/1) silty clay; few fine prominent strong brown (7.5YR 5/6) mottles; strong fine subangular blocky structure; firm; neutral; clear smooth boundary.

B3—20 to 25 inches; grayish brown (10YR 5/2) silty clay; common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; firm; less than ⅛-inch, light gray (10YR 7/1) strata of silt; strong effervescence; mildly alkaline; clear smooth boundary.

C—25 to 60 inches; brown (10YR 5/3), pale brown (10YR 6/3), and very pale brown (10YR 7/3) stratified silt, clay, and very fine sand; common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium platy structure; firm; strong effervescence; mildly alkaline.

The solum ranges from 24 to 32 inches in thickness. The A horizon is 10 to 15 inches thick. It is black, very dark brown, very dark gray, or very dark grayish brown. The B horizon is 12 to 28 inches thick. It is silty clay or heavy silty clay loam. The C horizon is stratified silt, clay, silty clay loam, or silty clay and has bands of fine and very fine sand in places. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Montgomery soils are near Martinton soils and are similar to Poygan soils. They are grayer and more poorly drained than Martinton soils and are not as red in the C

vegetation was a deciduous forest of maple, oak, beech, and ash.

In a representative profile the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is about 20 inches thick. It is brown, firm light clay loam in the upper part; grayish brown, friable gravelly sandy loam in the next part; and brown, firm silty clay loam in the lower part. The subsoil is mottled. The substratum to a depth of 60 inches is brown, firm silty clay loam. It is mottled.

Permeability is moderate to a depth of about 26 inches and moderately slow below. Available water capacity is high. Organic-matter content is moderate, and natural fertility is medium. The root zone is limited by saturated soil during wet periods of the growing season.

Most of the acreage is used for corn, small grain, vegetables, and other crops commonly grown in the county. Some areas are used for pasture and woodland.

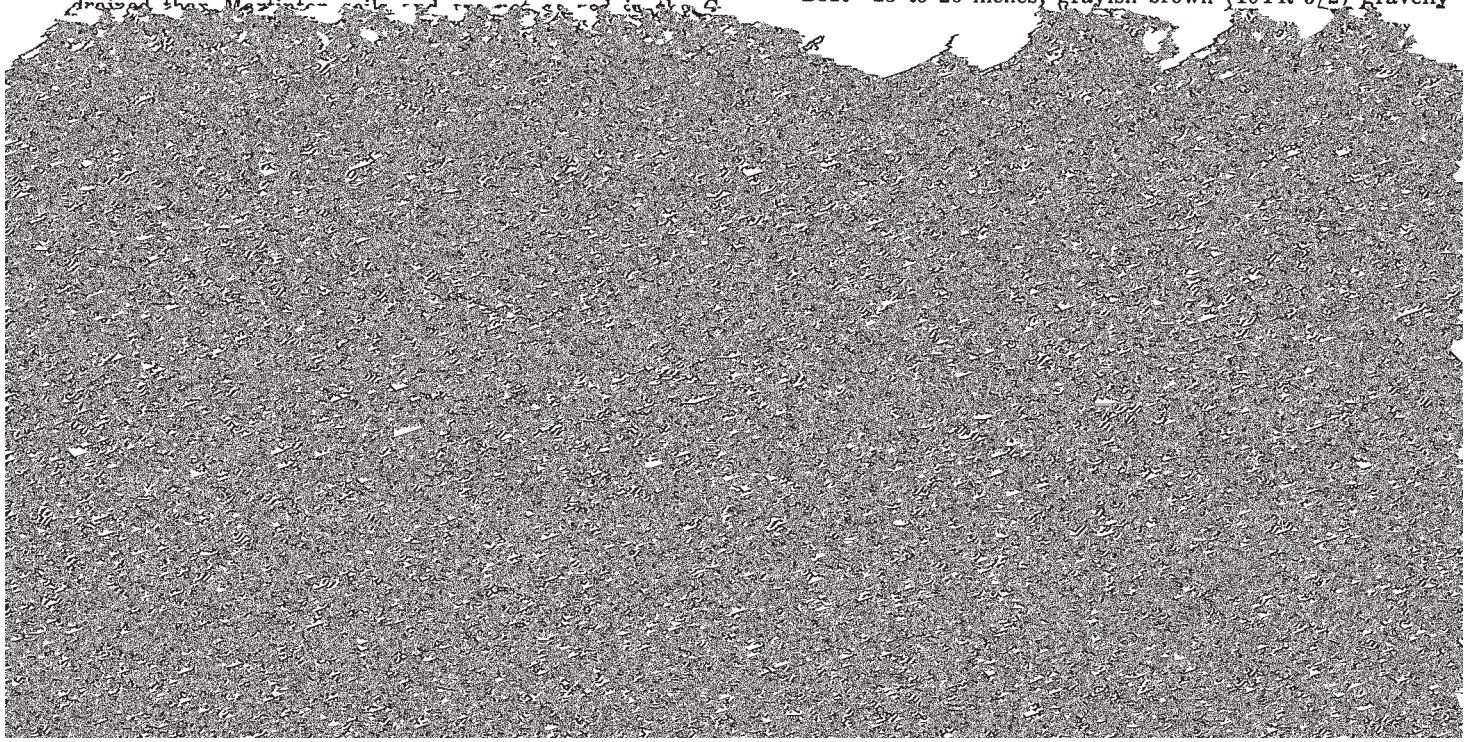
Representative profile of Mosel loam, 0 to 3 percent slopes, in a cultivated area, 200 feet east and 2,300 feet south of the northwest corner of sec. 30, T. 13 N., R. 21 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam; weak medium granular structure; friable; neutral; clear smooth boundary.

B21t—9 to 16 inches; brown (10YR 5/3) light clay loam; few fine faint grayish brown (10YR 5/2) and few fine prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; estimated 10 percent gravel by volume; neutral; clear wavy boundary.

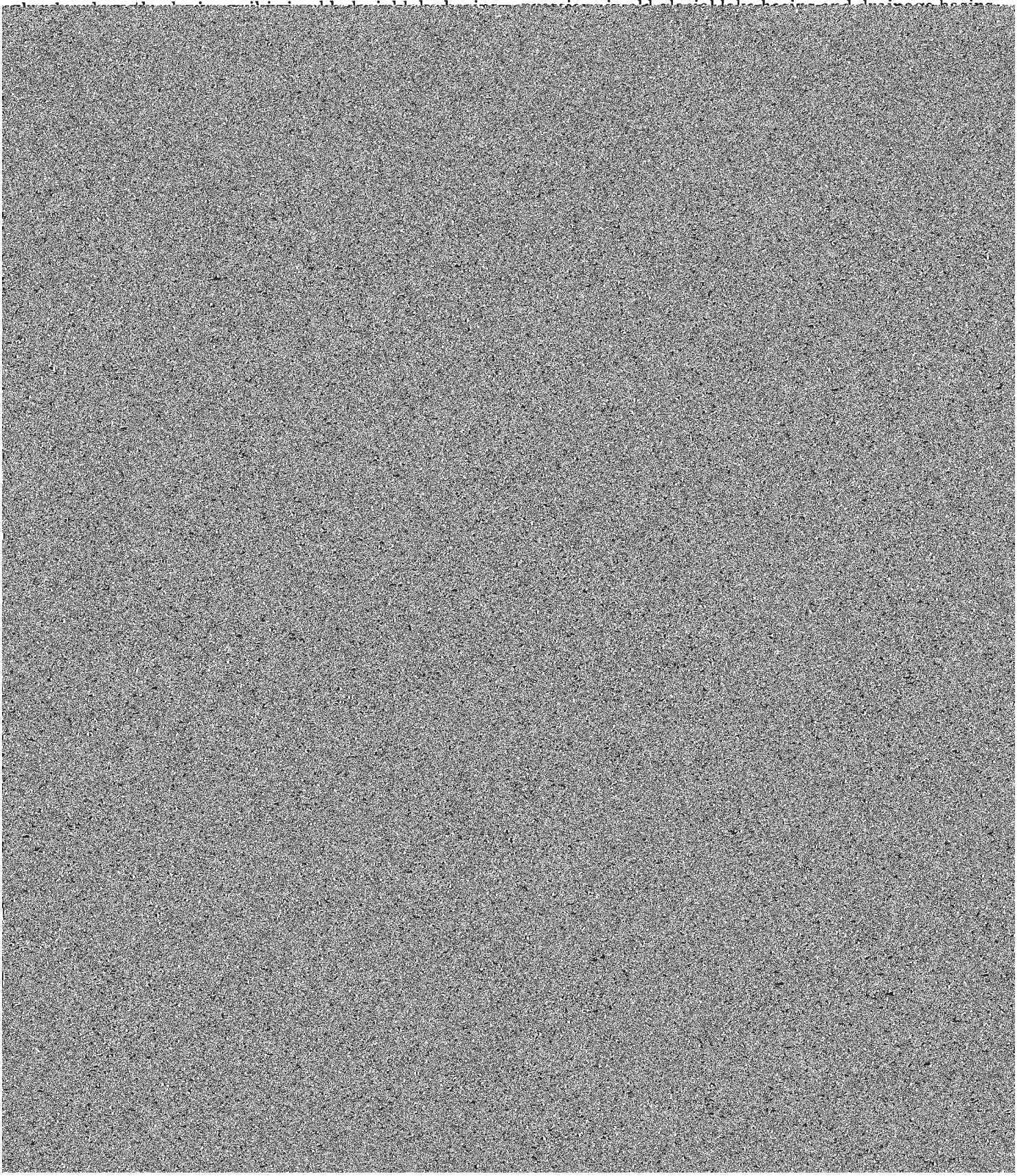
B22t—16 to 23 inches; brown (10YR 4/3) light clay loam; common medium distinct and prominent yellowish brown (10YR 5/6 and 10YR 5/8) and common medium faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thin patchy clay films on faces of peds; mildly alkaline; clear wavy boundary.

B31t—23 to 26 inches; grayish brown (10YR 5/2) gravelly



MsA—Mosel loam, 0 to 3 percent slopes. This nearly

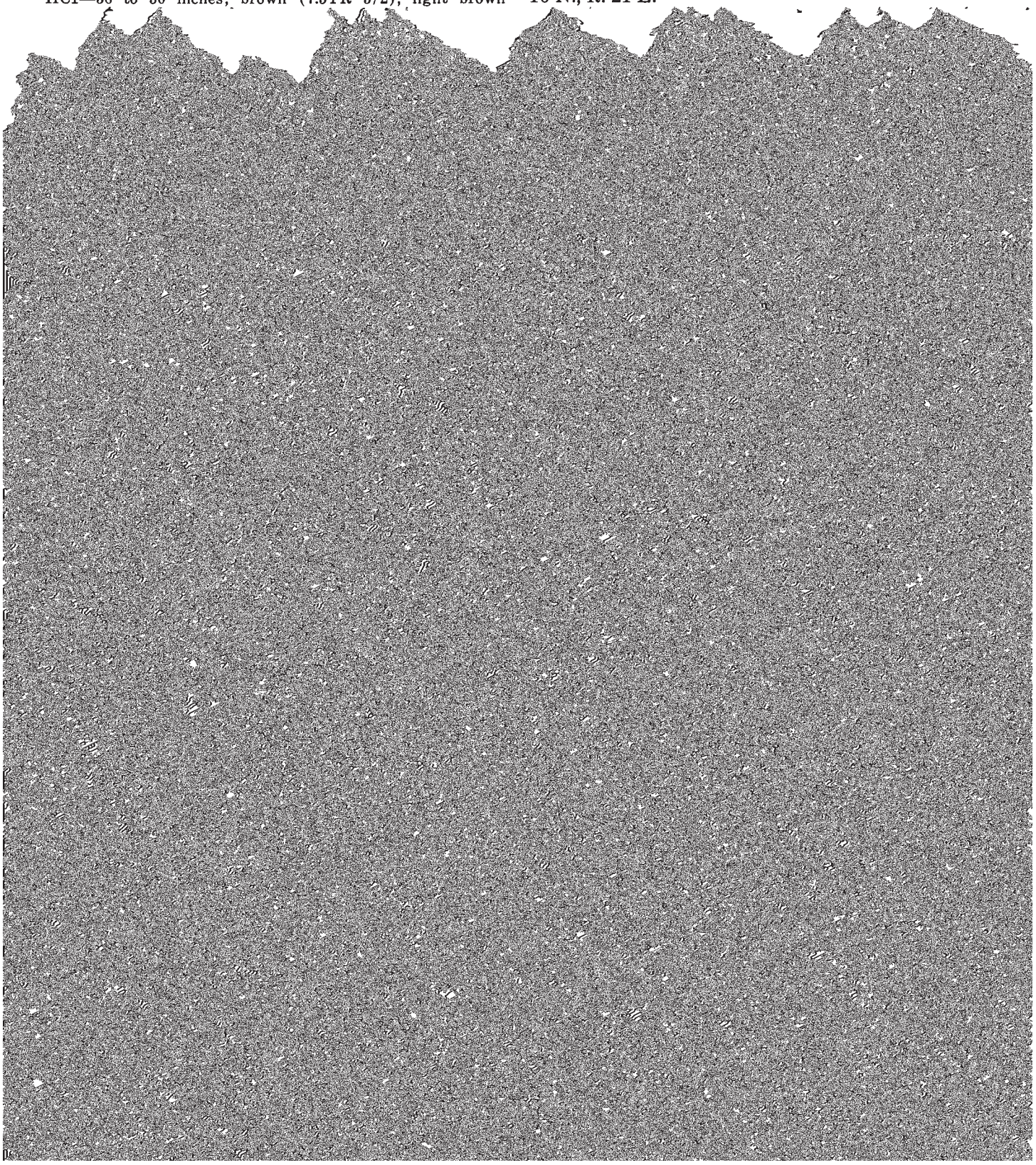
Mz—Muskego muck. This nearly level soil is in de-



6/2) mottles; moderate medium subangular blocky structure; firm; thin discontinuous clay films; strong effervescence; moderately alkaline; clear smooth boundary.

IIC1—36 to 50 inches; brown (7.5YR 5/2), light brown

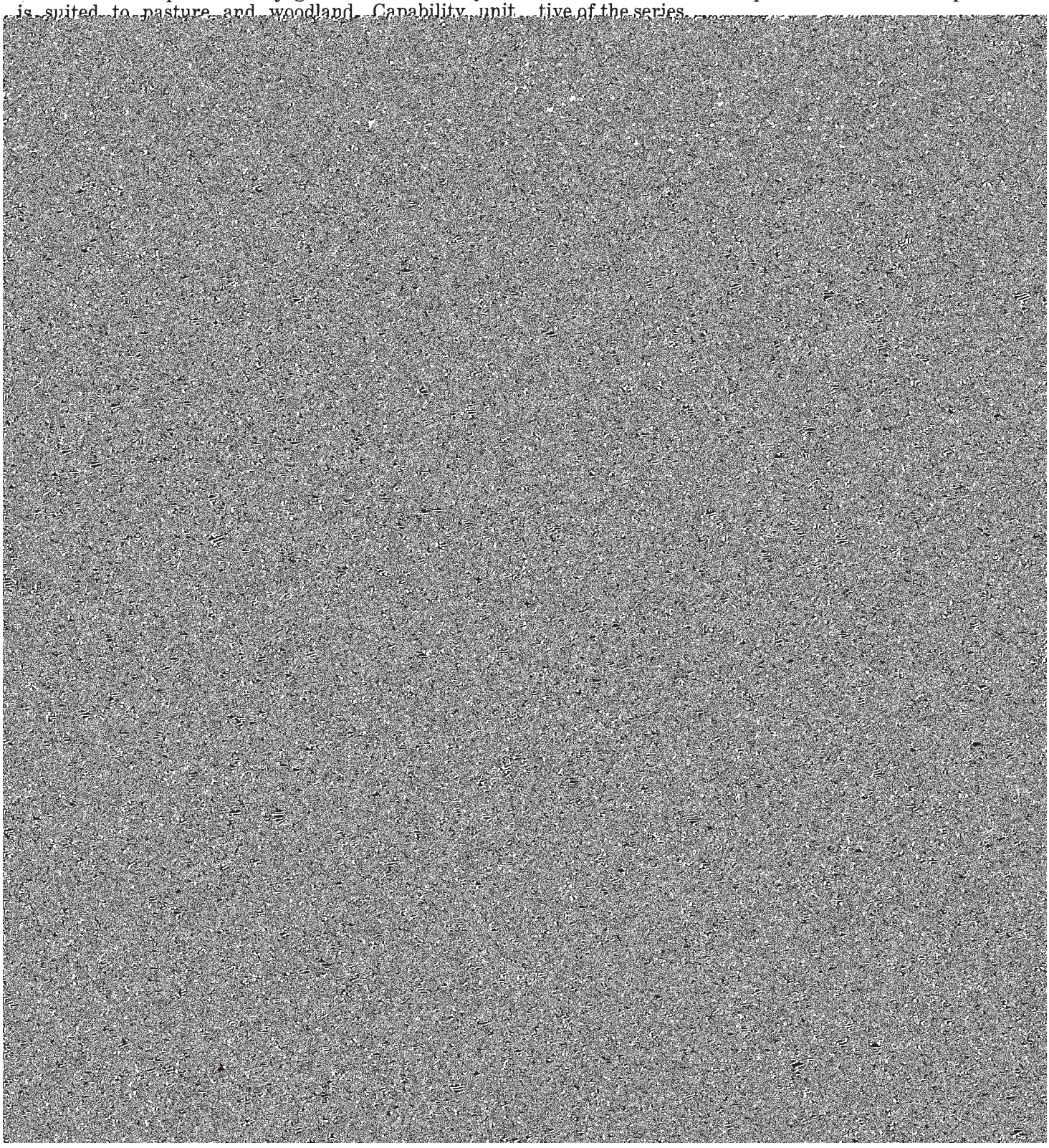
Representative profile of Nenno silt loam, 2 to 6 percent slopes, in a cultivated area, 900 feet east and 2,540 feet south of the northwest corner of sec. 7, T. 16 N., R. 21 E.



This soil dries slowly in spring and after periods of heavy rainfall. In some areas where slopes are long, the erosion hazard is slight.

If adequately drained, this soil is moderately well suited to all crops commonly grown in the county. It is suited to pasture and woodland. Capability unit

OaB—Oakville loamy fine sand, 0 to 6 percent slopes. This nearly level and gently sloping soil is on stabilized sand dunes and beach ridges. Areas are irregularly shaped and range in size from 3 to more than 120 acres. This soil has the profile described as representative of the series.



A13—16 to 24 inches; very dark gray (10YR 3/1) heavy silt loam; common fine prominent dark yellowish brown (10YR 3/4) organic stains; weak fine prismatic structure parting to moderate fine angular blocky; friable; mildly alkaline; clear smooth boundary.

A14—24 to 36 inches; black (10YR 2/1) silty clay loam; common fine prominent dark yellowish brown (10YR 3/4) organic stains; moderate medium angular blocky structure; firm; mildly alkaline; gradual wavy boundary.

C—36 to 60 inches; grayish brown (2.5Y 5/2) heavy silt loam; common fine distinct and prominent yellowish brown (10YR 5/4 and 5/6) mottles along old root channels; massive; firm; mildly alkaline.

The A horizon ranges from 24 to 40 inches in thickness. It is generally silt loam, but in places is mucky silt loam or silty clay loam. It is black, very dark grayish brown, or very dark gray. The C horizon is silt loam, loam, sandy loam, or silty clay loam and is stratified in places. The A and C horizons are neutral or mildly alkaline.

Otter soils are similar to Elvers soils, but are not underlain by sapric material.

Ot—Otter silt loam. This nearly level soil is on flood plains. Areas are irregularly shaped and range in size from 3 to more than 80 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Alluvial land, wet. Also included are some somewhat poorly drained areas.

This soil dries slowly in spring and after periods of heavy rainfall, and flooding and ponding occur in places. The main concern of management is removing excess water to prevent ponding and reduce the risk

material; moderate fine granular structure; friable; estimated 20 percent woody material; mildly alkaline; clear smooth boundary.

Oa2—8 to 18 inches; dark brown (10YR 3/3) sapric material changing to very dark brown (10YR 2/2 broken face and rubbed) on exposure to air; moderate medium subangular blocky structure; friable; estimated 20 percent woody material; mildly alkaline; gradual wavy boundary.

Oa3—18 to 36 inches; very dark grayish brown (10YR 3/2 broken face and rubbed) sapric material; weak medium subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

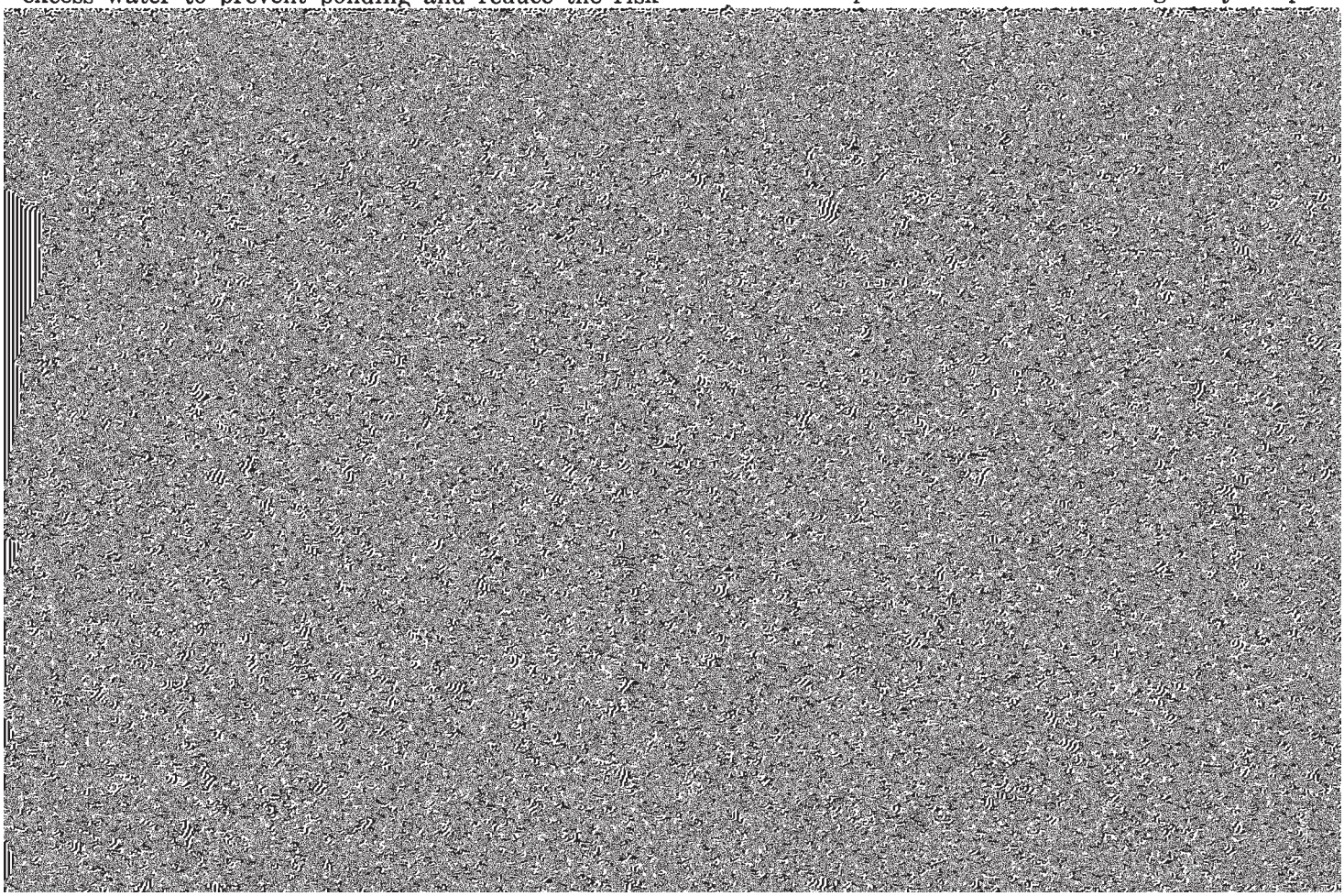
IIC1g—36 to 44 inches; dark gray (5Y 4/1) silt loam; massive; friable; mildly alkaline; gradual smooth boundary.

IIC2—44 to 60 inches; light gray (10YR 7/2) silt loam; few coarse distinct light olive brown (2.5Y 5/6) mottles; massive; friable; slight effervescence; mildly alkaline.

The organic material ranges from 16 to 50 inches in thickness. It is 1 to 50 percent fiber, less than 5 percent after rubbing. Some pedons have thin layers of fibric material less than 5 inches thick. In places the organic layers contain some woody fragments. The IIC horizon is fine sandy loam, sandy loam, silt loam, loam, or clay loam. The organic material is slightly acid to mildly alkaline. The IIC horizon is mildly alkaline or moderately alkaline.

Palms soils are similar to Adrian, Houghton, and Willette soils. They differ from Houghton soils in having loamy mineral material within a depth of 50 inches. They have less sand than Adrian soils and less clay than Willette soils.

Pa—Palms muck. This nearly level soil is in drainage basins and depressions. Areas are irregularly shaped



Most of the acreage is used for crops. Some is used for pasture and woodland.

Representative profile of Pella silt loam, slopes of 0 to 2 percent, 240 feet east and 600 feet south of the northwest corner of sec. 13, T. 13 N., R. 21 E.

Ap—0 to 12 inches; very dark brown (10YR 2/2) silt loam; moderate fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

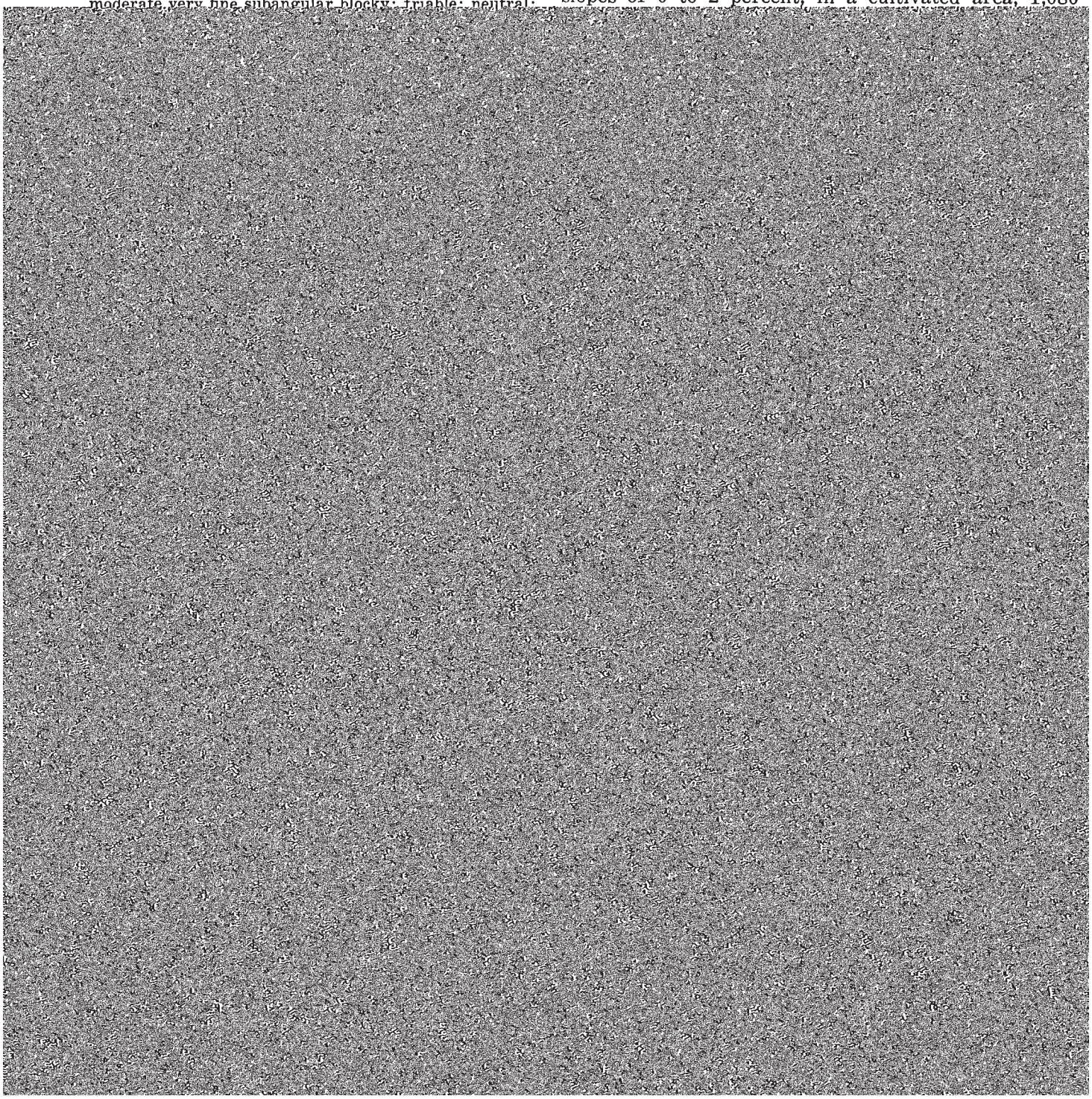
A12—12 to 16 inches; very dark gray (10YR 3/1) heavy silt loam; weak coarse prismatic structure parting to moderate very fine subangular blocky; friable; neutral;

loam. The substratum to a depth of 60 inches is reddish brown, firm silty clay.

Permeability is slow, and available water capacity is moderate. Organic-matter content is high and natural fertility is medium. The root zone is limited by the seasonal high water table.

Most of the acreage is used for crops. Some is used for pasture and woodland.

Representative profile of Poygan silty clay loam, slopes of 0 to 2 percent, in a cultivated area, 1,080

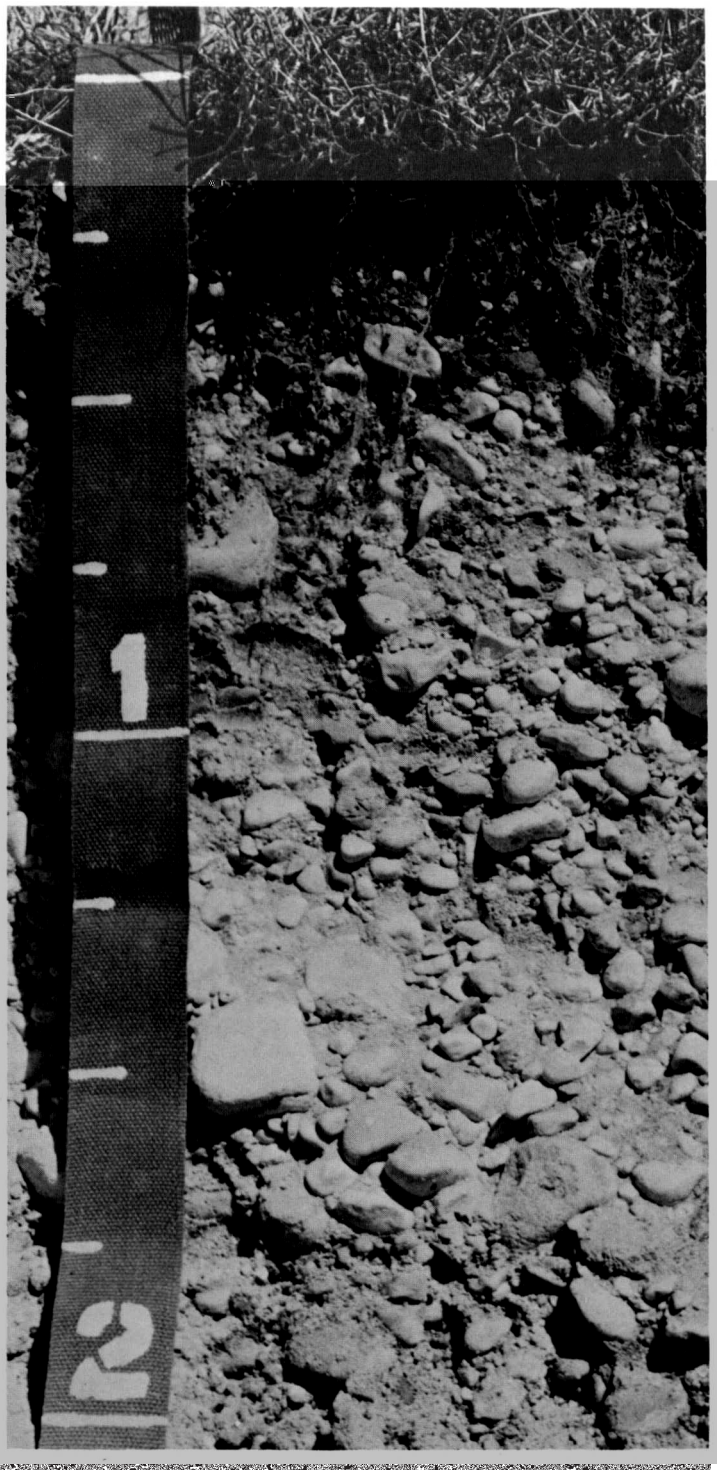


outwash. These soils are on outwash plains, kames, and eskers. The native vegetation was deciduous forest and grasses.

In a representative profile the surface layer is very dark gray gravelly sandy loam about 5 inches thick (fig. 5). The subsoil is dark brown, friable gravelly sandy loam about 4 inches thick. The substratum to a depth of 60 inches is pale brown, stratified, loose gravel and sand.

Permeability is very rapid, and available water capacity is very low. Organic-matter content and natural fertility are low. The root zone is limited by the underlying sand and gravel.

These soils are better suited to woodland and recreation than to crops. Most of the acreage is used for woodland and recreation, but some is used for pasture and crops.



friable silt loam; the next part is dark brown, firm silty clay loam and friable silt loam; and the lower part is pale brown, friable loam. The substratum to a depth of 60 inches is pale brown, stratified silt loam and loam.

Permeability is moderate, and available water capacity is high. Organic-matter content is moderate, and natural fertility is high.

Most areas are used for crops. Some are used for woodland and pasture.

Representative profile of St. Charles silt loam, 0 to 2 percent slopes, 110 feet west and 1,340 feet south of the northeast corner of sec. 29, T. 15 N., R. 21 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

B1—8 to 15 inches; brown (10YR 5/3) silt loam; moderate medium subangular blocky structure; friable; neutral; clear smooth boundary.

B21t—15 to 22 inches; dark brown (10YR 4/3) silty clay loam; moderate medium subangular blocky structure; firm; few patchy clay films on vertical faces of peds; slightly acid; clear smooth boundary.

B22t—22 to 33 inches; dark brown (10YR 4/3) silty clay loam; moderate coarse subangular blocky structure; firm; common thick continuous clay films on faces of peds; firm; medium acid; gradual smooth boundary.

B31—33 to 42 inches; dark brown (10YR 4/3) heavy silt loam; weak medium subangular blocky structure; friable; medium acid; clear smooth boundary.

to more than 20 acres. This soil is 4 to 6 inches thinner than the soil described as representative of the series.

Included with this soil in mapping are small areas of Fox, Kendall, and Theresa soils. Some areas of the wet Kendall soils are identified by spot symbols on the soil map. Also included in mapping are small nearly level or sloping areas.

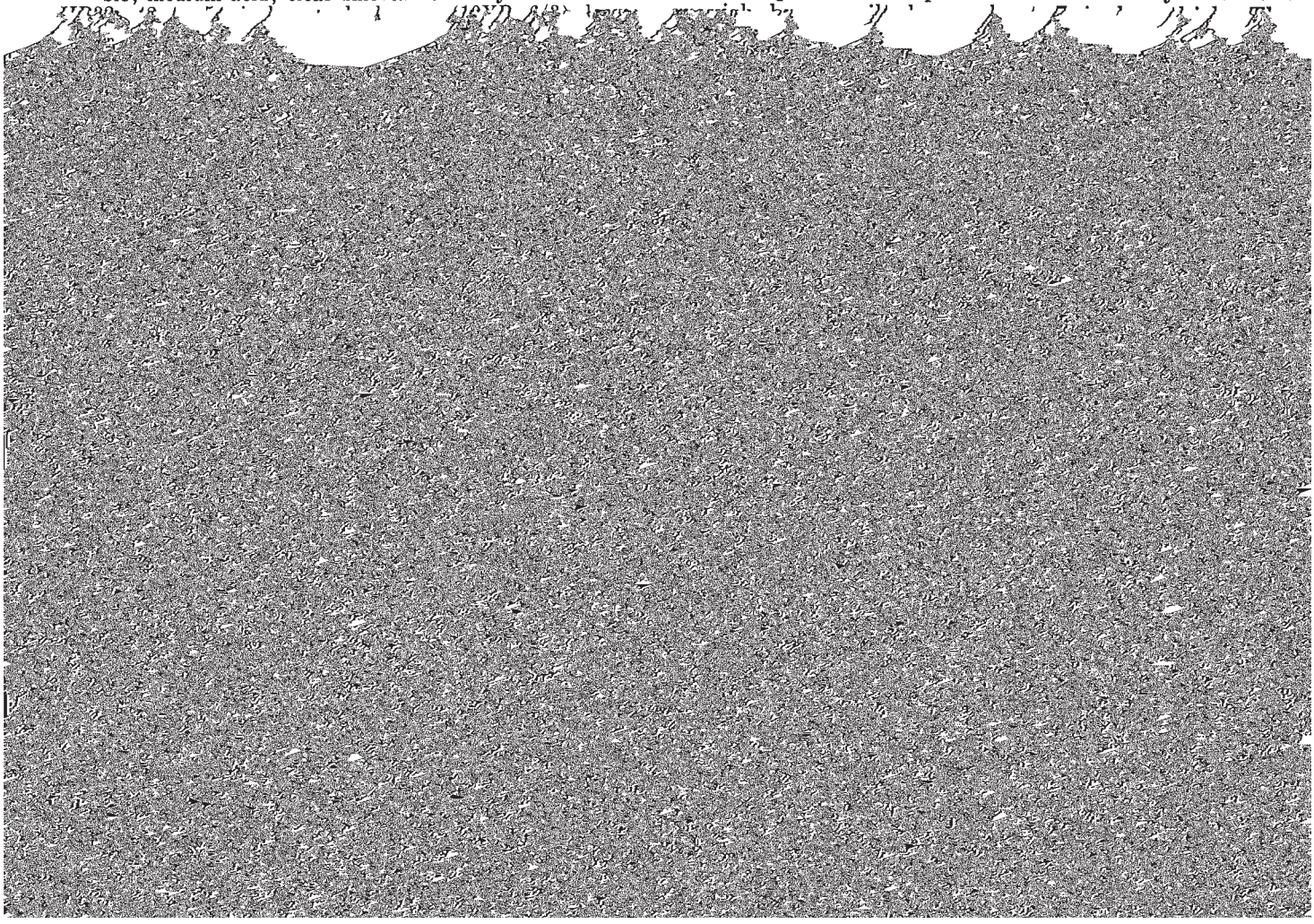
The hazard of erosion is slight. Reducing runoff and increasing the organic-matter content help to control erosion.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIe–1; woodland group 1o1; wildlife group 1.

Saylesville Series

The Saylesville series consists of well drained and moderately well drained, nearly level to sloping soils that are underlain by stratified silt loam and silty clay loam. These soils are in old glacial lake basins and on terraces. The native vegetation was a forest of mainly maple, oak, beech, basswood, and white pine.

In a representative profile the surface layer is dark



fine sandy loam, silty clay, and clay. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Saylesville soils are near Martinton, Montgomery, and Sisson soils. They are better drained and have fewer mottles than Martinton and Montgomery soils. They have more clay in the B and C horizons than Sisson soils.

ShA—Saylesville silt loam, 0 to 2 percent slopes. This nearly level soil is in old glacial lake basins and on terraces. Areas are irregularly shaped and range in size from 3 to more than 20 acres. This soil has a surface layer about 2 inches thicker than that of the soil described as representative of the series.

Included with this soil in mapping are small areas of Martinton, Montgomery, Sisson, and Zurich soils. Some areas of the wet Martinton and Montgomery soils are identified by spot symbols on the soil map. Also included in mapping are some small gently sloping areas.

Runoff is slow. Because this soil has moderately slow permeability in the substratum, water does not readily move through the soil and the soil dries slowly in spring and after periods of heavy rainfall. Removing surface water and preventing the entry of runoff from surrounding areas reduce the time required for the soil to dry.

This soil is moderately well suited to all crops commonly grown in the county. It is well suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIs–7; woodland group 2c1; wildlife group 2.

ShB—Saylesville silt loam, 2 to 6 percent slopes. This gently sloping soil is on the slopes of old glacial lake basins and on terraces. Areas are irregularly shaped and range in size from 3 to more than 80 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas [illegible] are small gently sloping areas and small severely eroded areas.

The hazard of erosion is moderate. Reducing runoff and improving tilth help to control further erosion.

If runoff is reduced, this soil is suited to all crops commonly grown in the county. It is also suited to pasture and woodland. Most of the acreage is used for crops, but some is used for pasture and woodland. Capability unit IIIe–6; woodland group 2c1; wildlife group 2.

Sebewa Series

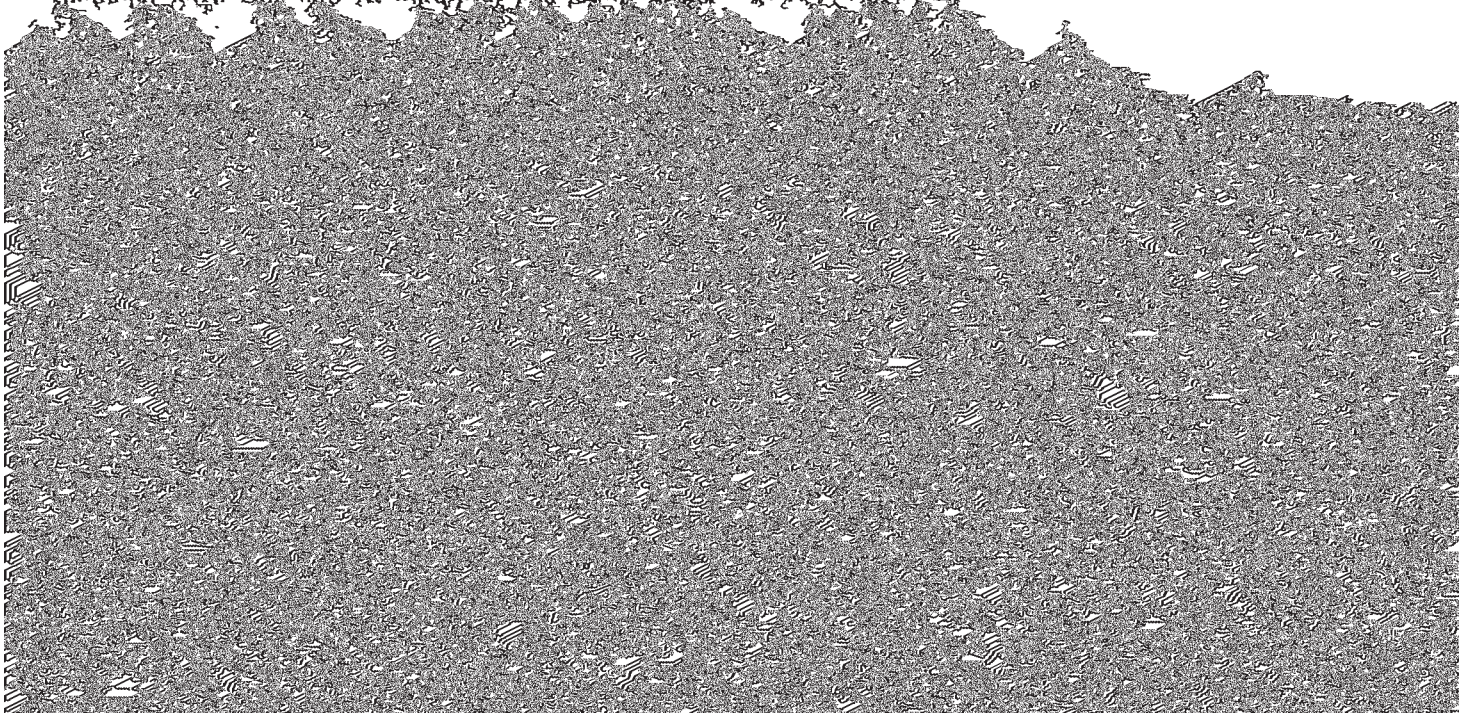
The Sebewa series consists of poorly drained, nearly level soils that are underlain by sand and gravel. These soils are on outwash plains. The native vegetation was deciduous forest and an understory of grasses.

In a representative profile the surface layer is very dark gray silt loam about 10 inches thick. The subsoil is about 23 inches thick and is mottled throughout. The upper 10 inches is grayish brown, firm silty clay loam; the next 9 inches is light gray, firm gravelly clay loam; and the lower 4 inches is grayish brown, friable gravelly sandy loam. The substratum to a depth of 60 inches is light brownish gray, stratified loose sand and gravel.

Permeability is moderate in the subsoil and rapid in the substratum. Available water capacity is moderate. Organic-matter content is high, and natural fertility is medium. The root zone is limited by the water table.

Most of the acreage is used for crops and pasture. Some is used for woodland.

Representative profile of Sebewa silt loam, slopes of 0 to 2 percent, in a cultivated area, 200 feet east and 1,040 feet north of the southwest corner of sec. 18, T. 15 N., R. 20 E.



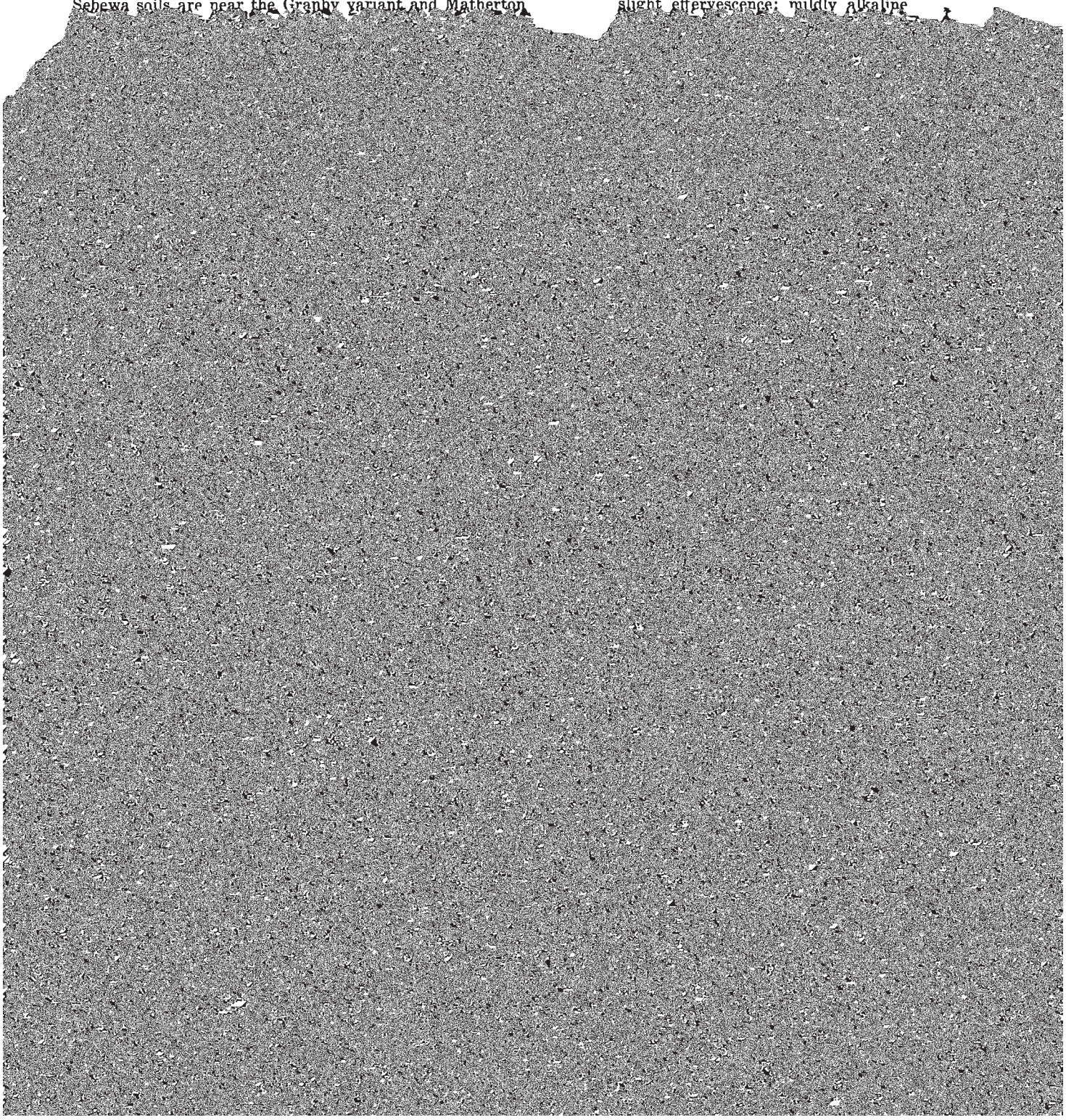
A horizon is black, very dark brown, or very dark gray. It is typically 10 or more inches thick. It is generally silt loam, but in places is loam, clay loam, or sandy loam. The B horizon is 12 to 27 inches thick. It is silty clay loam or clay loam in the upper part and gravelly sandy loam or gravelly clay loam in the lower part. The IIC horizon is stratified sand and gravel. The B horizon is neutral or mildly alkaline. The C horizon is mildly alkaline or moderately alkaline.

Sebewa soils are near the Granby variant and Matherton

B22t—13 to 23 inches; yellowish brown (10YR 5/6) clay loam; moderate medium subangular blocky structure; firm; thin discontinuous clay films on faces of peds; neutral; clear smooth boundary.

B3—23 to 27 inches; light yellowish brown (10YR 6/4) fine sandy loam; weak fine subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

IIC—27 to 60 inches; light yellowish brown (10YR 6/4) stratified silt and very fine sand; massive; friable; slight effervescence; mildly alkaline



Included with this soil in mapping are small areas of Boyer, Hebron, Kibbie, and Zurich soils. Also included are small gently sloping areas, areas where the surface layer is loam, and some areas where clay is below a depth of 5 feet.

This soil is subject to soil blowing in places. The hazard of erosion is moderate. Reducing runoff helps to control soil blowing and erosion.

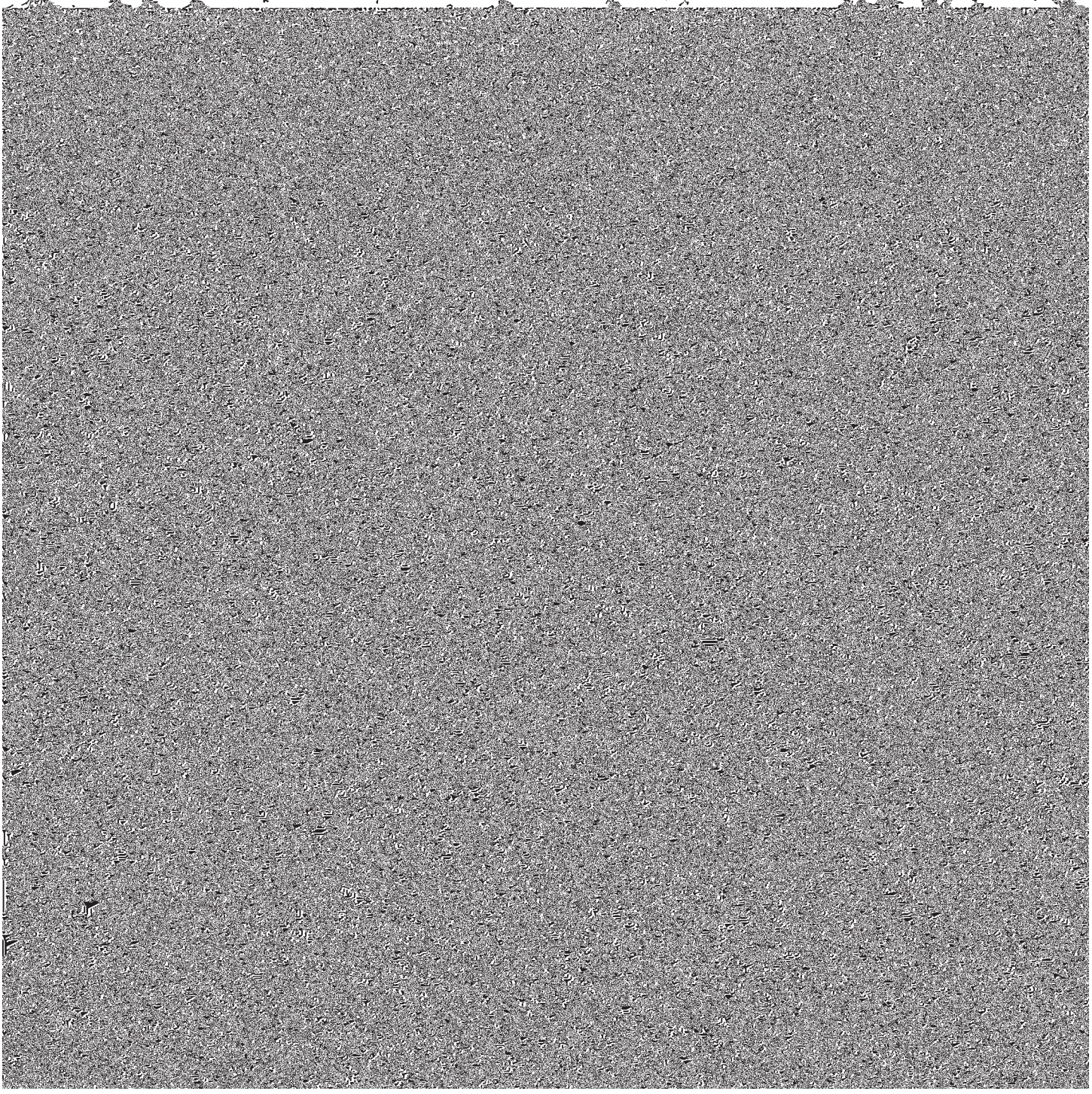
If well managed, this soil is suited to all crops commonly grown in the county. It is also suited to pasture

films on faces of peds; neutral; gradual smooth boundary.

IIB3t—30 to 35 inches; brown (7.5YR 4/4) gravelly clay loam; weak medium subangular blocky structure; firm; estimated 16 percent gravel by volume; thick patchy clay films on faces of peds; slight effervescence; mildly alkaline; gradual wavy boundary.

IIC—35 to 60 inches; very pale brown (10YR 7/3) gravelly sandy loam; massive; friable; estimated 20 percent gravel by volume; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The



sentative of the series, but 3 or 4 inches of the surface layer has been removed by erosion.

Included with this soil in mapping are small areas of Lamartine soils. Also included are small gently sloping areas.

The hazard of erosion is moderate. Controlling runoff and increasing the organic-matter content help to control further erosion and improve tilth.

If well managed, this soil is suited to all crops commonly grown in the county. It is well suited to woodland and pasture. Most of the acreage is used for crops, but some is used for woodland and pasture. Capability unit IIIe-1; woodland group 1o1; wildlife group 1.

sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. The Ap horizon is 6 to 10 inches thick. It is generally sandy loam, but includes loamy sand or loam. It is very dark grayish brown or very dark brown. The B horizon ranges from 14 to 30 inches in thickness. It is gravelly in places. The IIC horizon is sand or stratified sand and gravel. The B horizon ranges from medium acid to mildly alkaline.

Wasepi soils are near Boyer, Granby, and Matherton soils. They are more gray than Boyer soils and are not so well drained as those soils. They are less gray than Granby soils and are not so poorly drained as those soils. They have less clay in the subsoil than Matherton soils.

Wa Wasepi sandy loam. This nearly level soil is

5/6) between 42 and 48 inches; estimated 5 percent gravel by volume; strong effervescence; moderately alkaline.

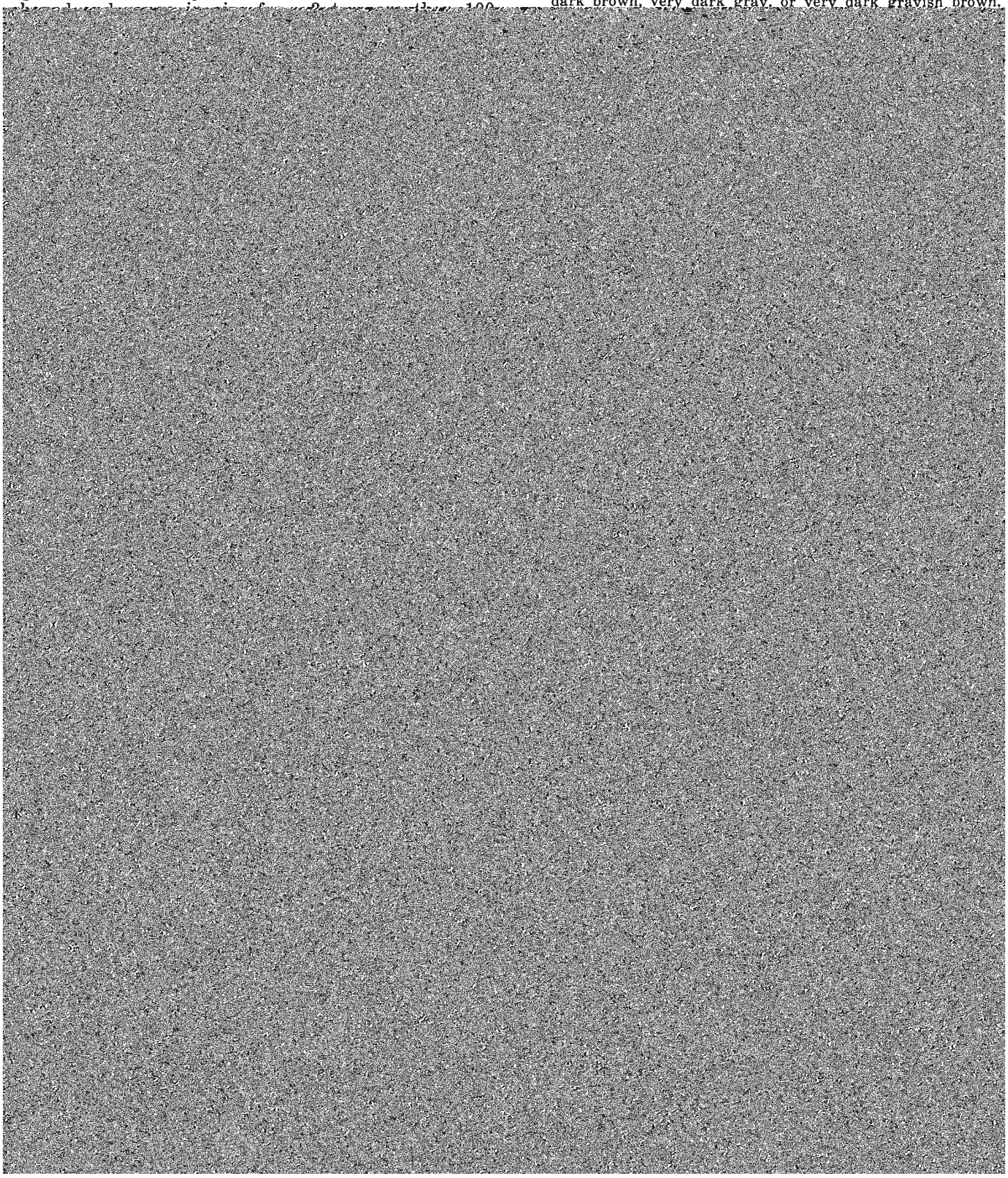
The solum is 24 to 40 inches thick. The silty material in

and areas where the subsoil and substratum of this Waymor soil have a higher clay content than is typical of the series.

The hazard of erosion is moderate. Reducing runoff

We—Willette muck. This nearly level soil is in drainage basins and depressions. Areas are irregularly

The solum ranges from 12 to 30 inches in thickness. The A1 or Ap horizon is 7 to 11 inches thick. It is black, very dark brown, very dark gray, or very dark grayish brown.



loam; moderate medium subangular blocky structure; friable; neutral; clear wavy boundary.

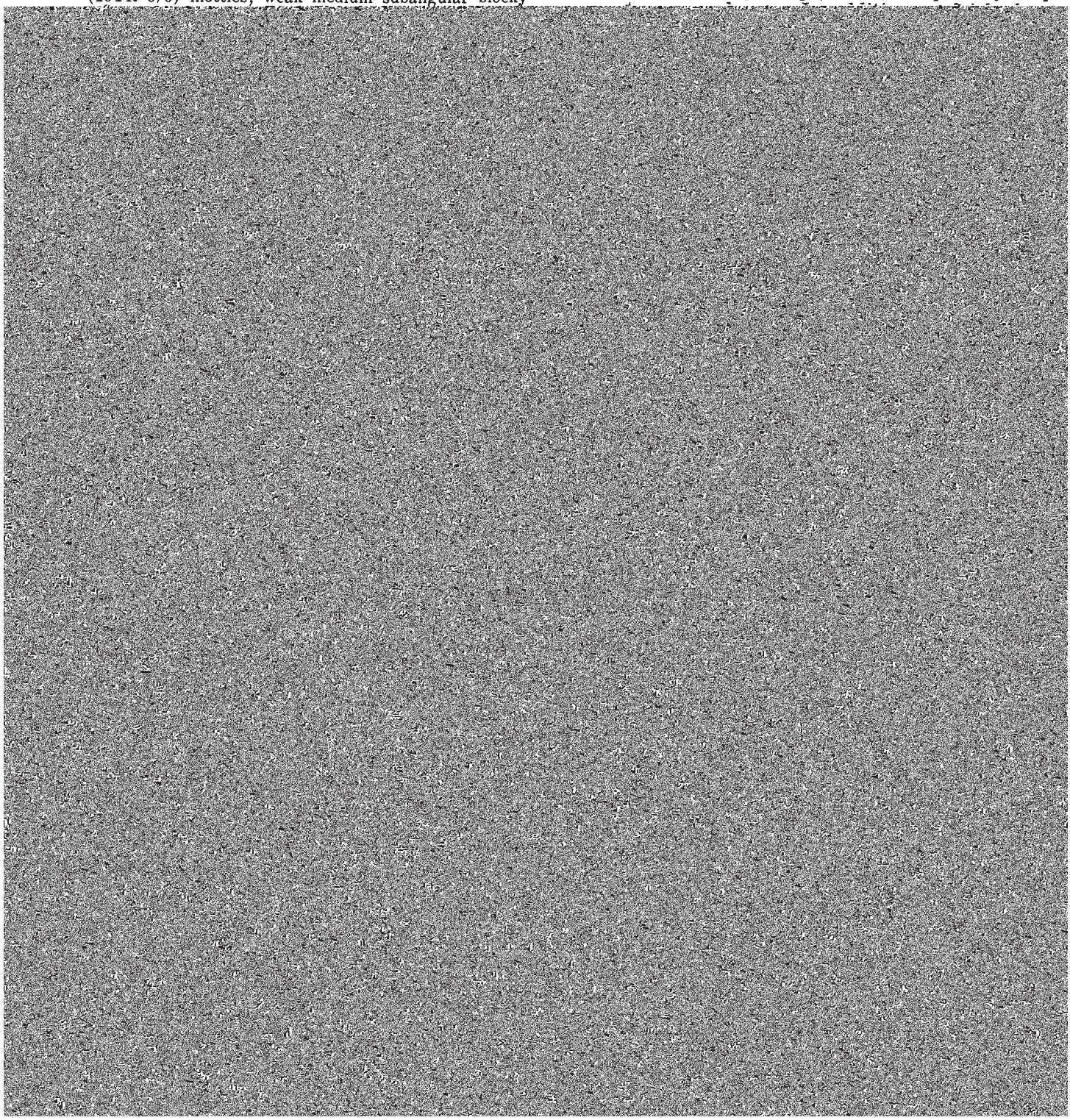
B2t—11 to 22 inches; dark yellowish brown (10YR 4/4) silty clay loam; strong fine subangular blocky structure; firm; thin clay films on faces of most peds; neutral; clear wavy boundary.

IIB3—22 to 24 inches; pale brown (10YR 6/3) stratified silt and very fine sand; few fine faint light gray (10YR 7/2) mottles and common fine prominent brownish yellow (10YR 6/6) mottles; weak medium subangular blocky

selected uses of soils to be considered in planning recreational facilities.

Crops and Pasture

The crops commonly grown in the survey area are corn, oats, hay, forage crops, and such specialty crops



lesser amounts. Poorly drained soils, such as those of the Pella series, generally require little or no lime.

Available water capacity is important in determining levels of fertilization and population of plants where no irrigation is planned. As an example, assuming that alfalfa and corn require 0.30 inch of water per day during their peak use period, the number of days that a given soil supports these crops without rainfall can be determined. Soils that have a high available water capacity (between 9 and 12 inches) support these crops for 30 to 40 days without rainfall if the moisture content of the soils is at field capacity at the start of this period. In contrast, soils that have a low available water capacity (between 3 and 6 inches) support these crops for only 10 to 20 days without rainfall under similar conditions. A high level of fertilization is generally not justified on soils that have very low or low available water capacity because crop growth is limited by the available water capacity. In addition, these soils are coarse textured or have a thin solum. Excessive nitrate fertilizer added to these

shrinkage, which is termed *continued subsidence*, goes on until mineral material or the water table is reached. The rate of continued subsidence depends upon the height of the water table. Subsidence can be stopped by maintaining the water level at the surface. It can be slowed by maintaining the water level as high as possible for the intended land use.

Controlling erosion.—Many of the soils in the county are moderately eroded. Examples are Hochheim silt loam and Kewaunee silty clay loam. Most of the soil loss is the result of sheet and rill erosion, although some gullying also occurs.

Terracing, grassed waterways, stripcropping (fig. 6), contour tillage, sod crops or cover crops in rotations, and mulching with crop residue help to control erosion.

Also effective in controlling erosion is minimum tillage. On soils used for row crops, this practice reduces the risk of erosion to a minimum. In the latest refinement of minimum tillage, a minimum area of soil is disturbed. Special no-till planters knives open the seedbed, place the seed and starter fertilizer, close the

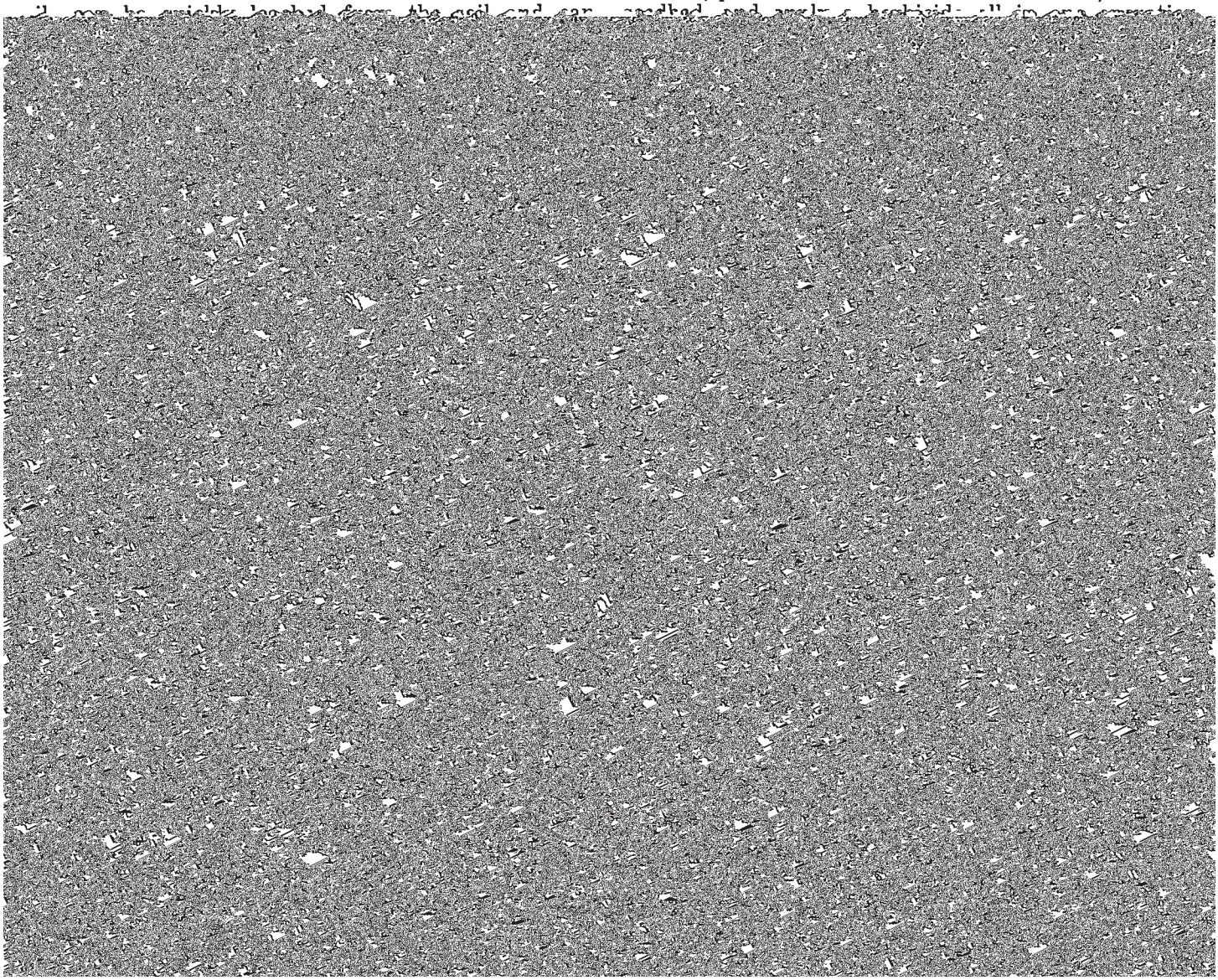


Figure 6.—Stripcropping on gently sloping Hochheim soils.

Pastures on soils assigned to capability class VI are difficult to renovate, and those assigned to class VII are not suitable for renovation. Where tillage is not practical, the soils are generally in native vegetation. Controlled grazing and the addition of commercial fertilizer help to maintain plant cover.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops (*28*). The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major

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

production and restrict their use to recreation, wildlife, 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

grown year after year without deterioration of soil tilth or serious decrease in organic-matter content.

CAPABILITY UNIT I-3

This unit consists of nearly level, well drained and moderately well drained silty soils. These soils are moderately permeable. Available water capacity is high. Natural fertility is medium or high. Runoff is

CAPABILITY UNIT IIe-2

Fox silt loam, 2 to 6 percent slopes, is the only soil in this unit. It is well drained. It is moderately permeable in the subsoil and very rapidly permeable in the substratum. Available water capacity is moderate. Natural fertility is medium.

This soil is not saturated long enough for the excess water to adversely affect plant growth. The root zone is generally limited by gravel and sand. In most areas the soil is subject to only slight erosion, but in some

If well managed, this soil is moderately well suited to corn, soybeans, small grain, legumes, and vegetables. It is well suited to pasture.

CAPABILITY UNT IIw-1

This unit consists of nearly level, poorly drained and very poorly drained silty and loamy soils. These soils are moderately permeable or slowly permeable. Available water capacity is moderate, high, or very high.

Unless these soils are drained, ground water is at or

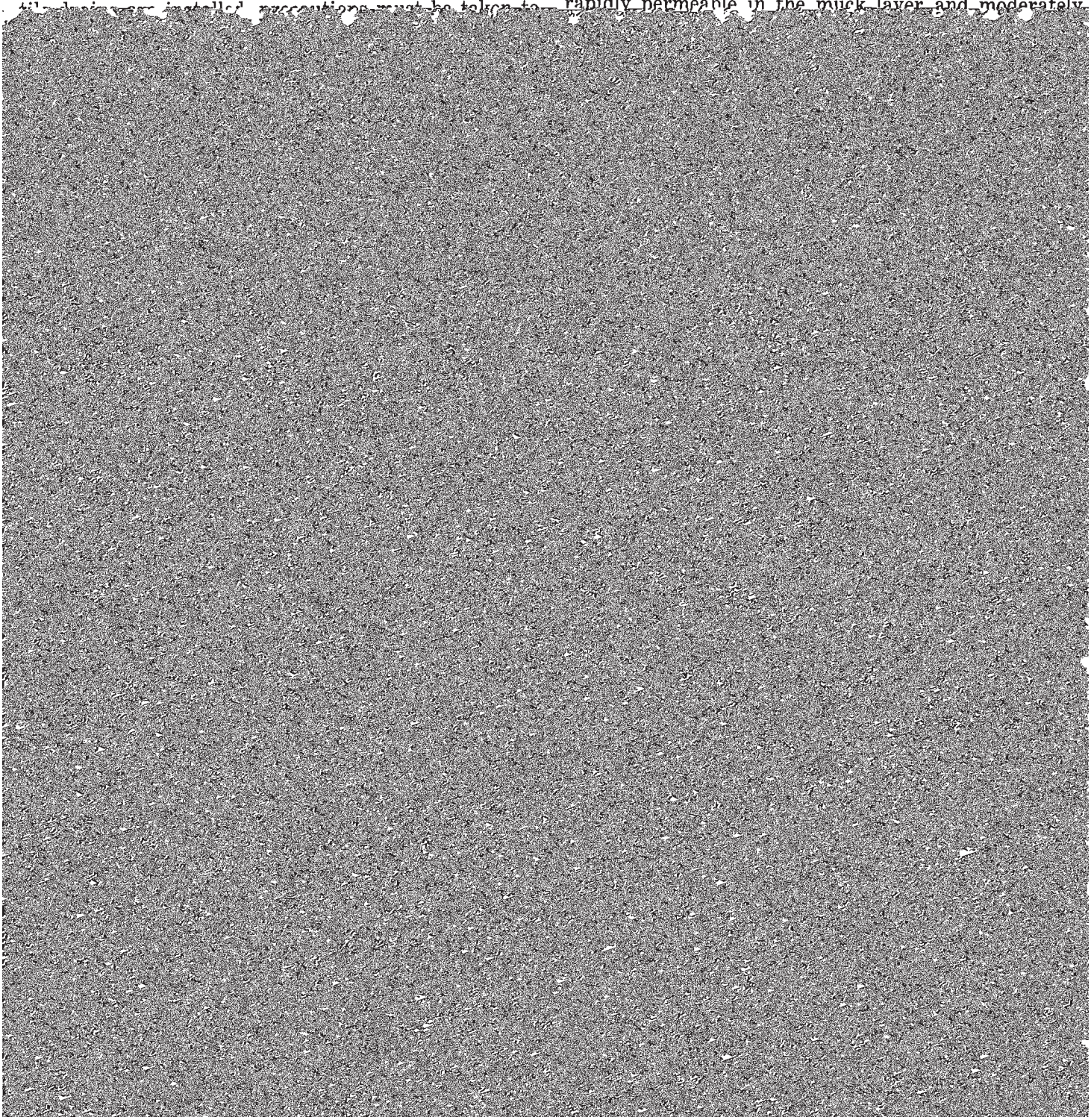
drained. It is moderately permeable. Available water capacity is high. Natural fertility is medium.

Unless drained, this soil is saturated at a depth of 1 to 3 feet during wet periods. It dries slowly in spring and after periods of heavy rainfall. It receives runoff from adjoining areas. Some areas are subject to ponding during wet periods and after heavy rainfall. Deep ditches can be used to lower the water table if suitable outlets are available. Tile drainage is questionable. If tile drains are installed, precautions must be taken to

but poor seedbed preparation because of wetness and the shallow root zone caused by seasonal saturation generally result in crop yields that are considerably lower than for drained areas. Undrained areas are suited to pasture or wetland wildlife habitat.

CAPABILITY UNIT IIw-8

Palms muck is the only soil in this unit. It is a nearly level, very poorly drained organic soil. It is moderately rapidly permeable in the muck layer and moderately



In some areas the soils are saturated at the surface or at a depth of 1 foot during wet periods. The soils and the land type receive runoff from surrounding areas and are subject to flooding and ponding during wet periods and after heavy rainfall. Diversions and grassed waterways intercept and safely remove surface water and prevent ponding. Cultivation at the proper moisture content, minimum tillage, and management of residue help to maintain good tilth.

If properly drained and protected from flooding, the soils and the land type are moderately well suited to corn and hay. Undrained areas can be used for pasture, but they are better suited to wetland wildlife habitat.

CAPABILITY UNIT IIs–1

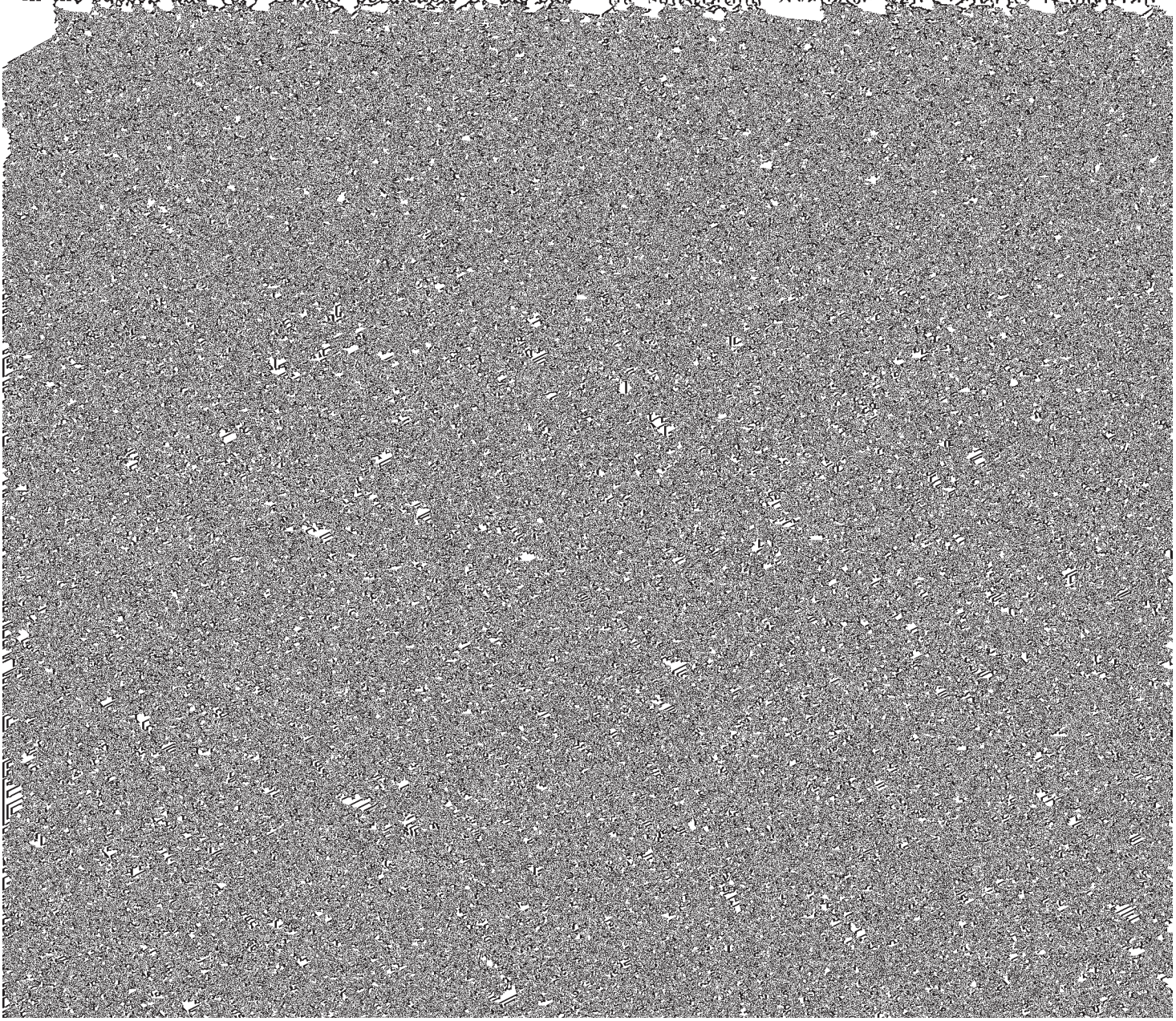
Fox silt loam, 0 to 2 percent slopes, is the only soil in this unit. It is well drained. It is moderately permeable in the subsoil and very rapidly permeable in the sub-

These soils are subject to moderate erosion and in many cropped areas have lost as much as 4 inches of the original surface layer. Crop rotations, close growing crops, contour farming, stripcropping, diversions, terraces, grassed waterways, minimum tillage, and good management of residue help to control erosion and maintain good tilth.

If well managed, these soils are suited to corn, soybeans, small grain, and legumes. They are well suited to pasture. The soils that have low or moderate available water capacity do not respond to fertilization so well as the other soils.

CAPABILITY UNIT IIIe–2

Fox silt loam, 6 to 12 percent slopes, eroded, is the only soil in this unit. It is well drained. It is moderately permeable in the subsoil and very rapidly permeable in the substratum. Available water capacity is moderate

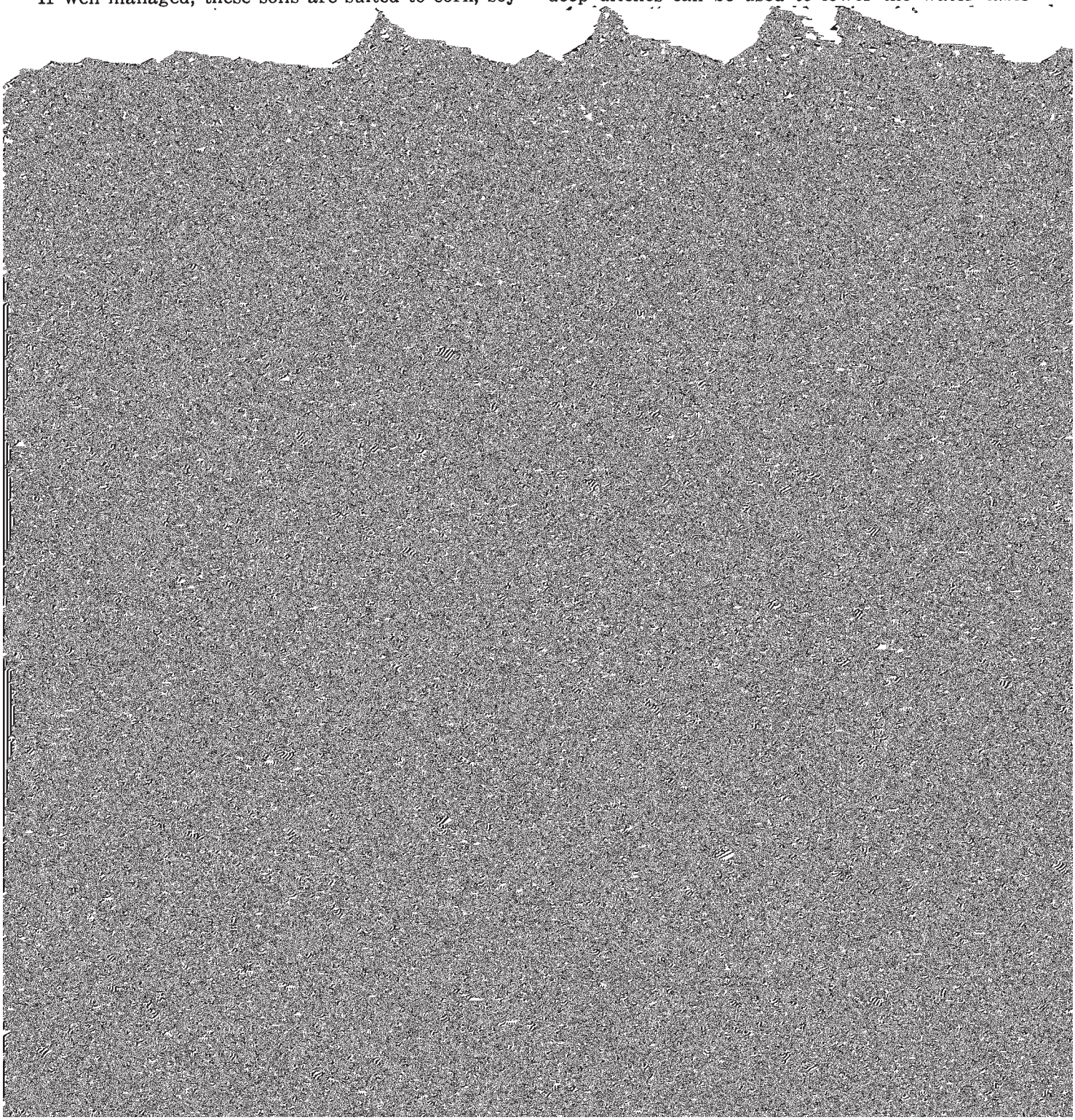


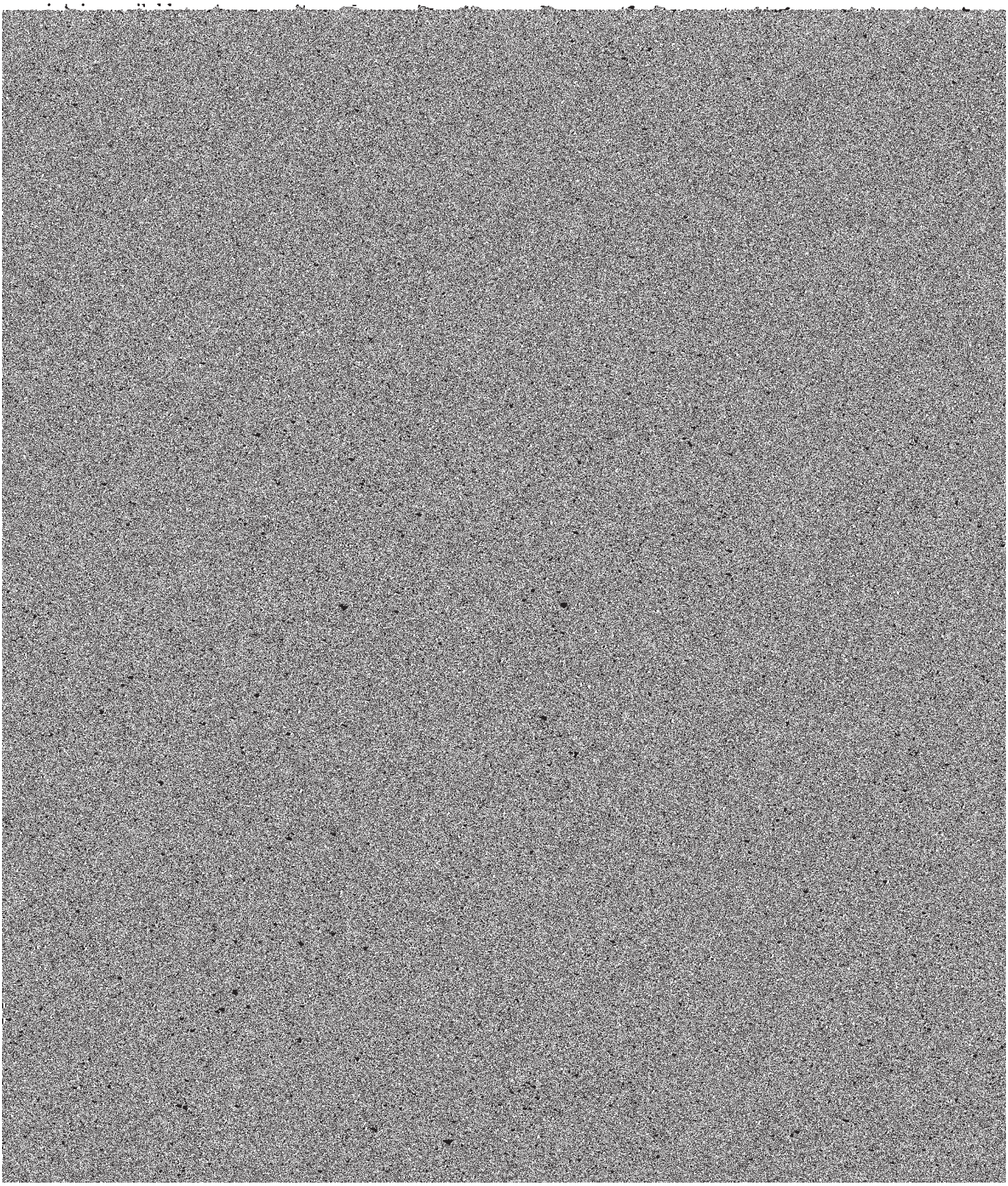
where erosion has removed the surface layer and exposed the subsoil. The soils dry slowly in spring and after heavy rainfall. Crop rotations, contour stripcropping, diversions, surface drainage, terraces, minimum tillage, and good management of residue help to control erosion, remove excess water, and maintain good tilth. These soils are easily worked if they are not eroded.

If well managed, these soils are suited to corn, soy-

organic soils. These soils are moderately rapidly permeable. Available water capacity is very high. Natural fertility is low.

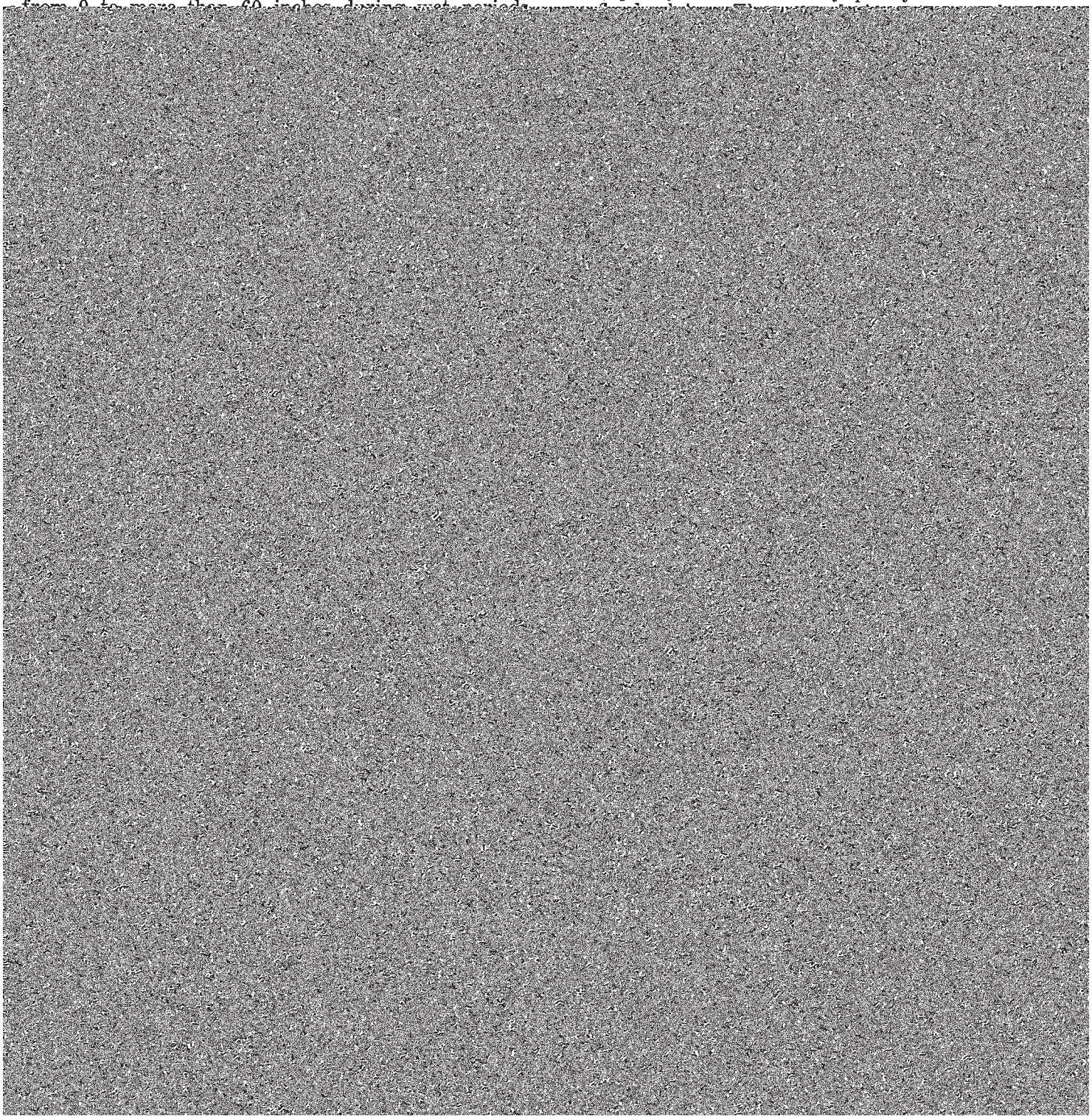
Unless these soils are drained, ground water is at or near the surface throughout the year. The soils receive runoff from adjoining areas, and some areas are subject to ponding and overflow. Tile drains and deep ditches can be used to lower the water table if





or well drained and moderately well drained. Permeability is moderately rapid, rapid, or very rapid, but is slow in the marl and sedimentary peat. Available water capacity is very high in the organic soils and low in the sandy soils. Natural fertility is low.

Unless these soils are drained, ground water is at or near the surface throughout the year in most areas. The sandy soils are saturated at a depth ranging from 0 to more than 60 inches during wet periods.



cially small seeded crops, are not likely to survive. The soil is suited to irrigation, but water moves through it rapidly. If irrigated, the soil is suited to more intensive cropping.

CAPABILITY UNIT Vw-14

Only Alluvial land, wet, is in this unit. This nearly level, poorly drained or very poorly drained land is

permeable in the subsoil and very rapidly permeable in the substratum or are very rapidly permeable throughout. Available water capacity is very low or low. Natural fertility is low.

These soils are not saturated long enough for the excess water to adversely affect plant growth. They are subject to severe erosion. Pasture and hay fields are difficult to renovate. Controlled grazing, renovation, and fertilization help to maintain adequate plant cover and control erosion.

Because of the severe erosion hazard and the low available water capacity, these soils are generally not suited to crops. If well managed, they are suited to

These soils are not saturated long enough for the excess water to adversely affect plant growth. They are subject to very severe erosion. Some areas that have been grazed are eroded. Controlled grazing and topdressing with fertilizer help to maintain plant cover and control erosion. In many areas these soils are gravelly.

Because of the very low available water capacity, the shallow root zone, the gravel, and the very severe erosion hazard, this soil is not suited to crops. If well managed, some of the less sloping areas are suited to pasture, but yields are low. Improved pasture is difficult to establish and maintain. Many pastures are in

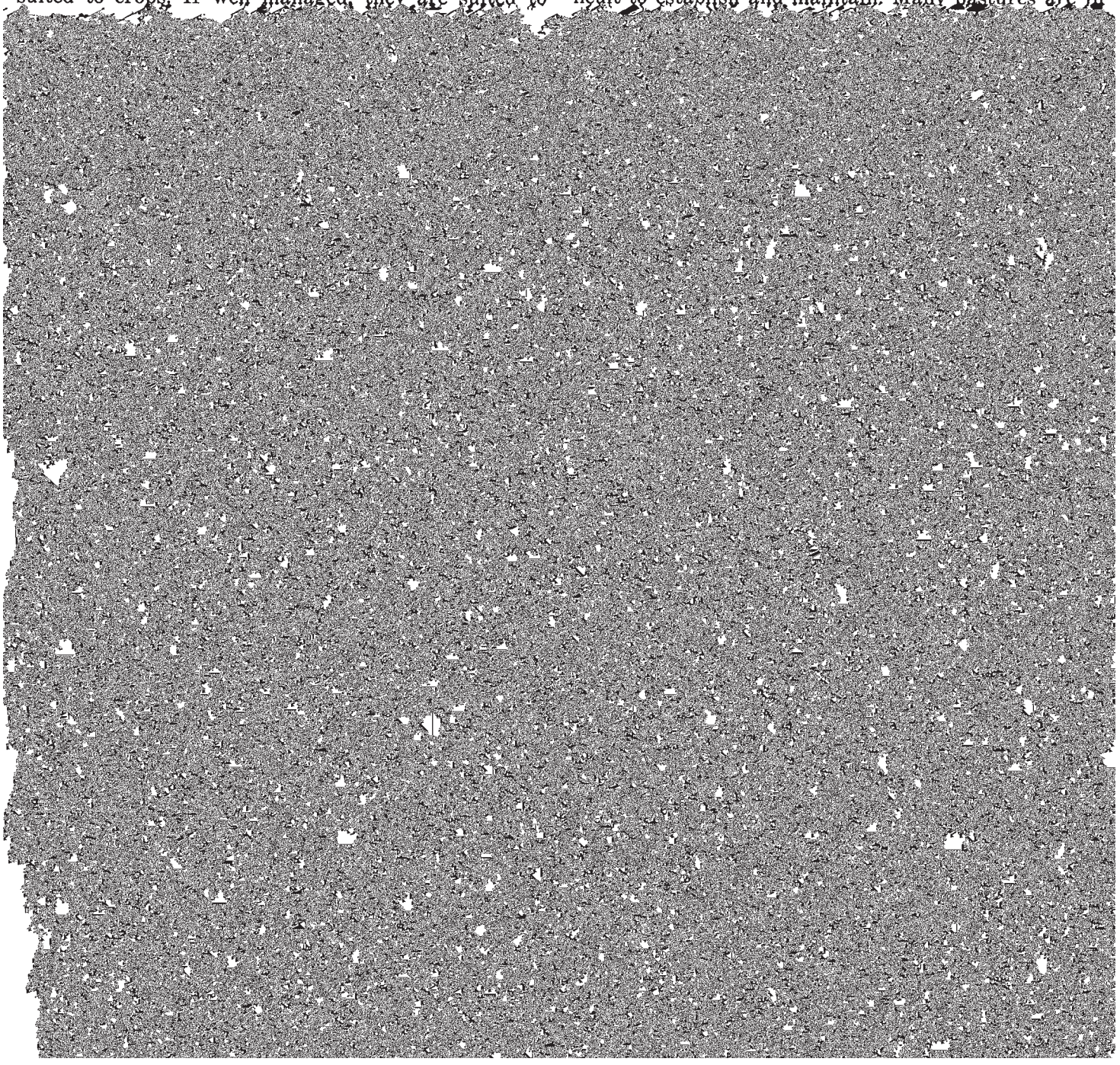


TABLE 2.—*Predicted average yields per acre of principal crops*

[Yields are those obtained under improved, or high level, management. Absence of a yield figure indicates that the crop is not suited to the soil or is not ordinarily grown on the soil. Only arable soils are listed]

Map symbol	Soil name	Corn		Oats [1]	Alfalfa-brome hay [2] (dry weight)
		Grain	Silage		
		Bu	*Tons*	*Bu*	*Tons*
Ag	Adrian muck [3]	90	15	50	
Ak	Adrian-Granby-Oakville complex				
	Adrian soil [3]	90	15	50	
	Granby soil [3]	60	10	50	3.0
	Oakville soil	50	8	40	2.5
Am	Alluvial land	50	8	40	2.25

TABLE 2.—*Predicted average yields per acre of principal crops—Continued*

Map symbol	Soil name	Corn		Oats [1]	Alfalfa-brome hay [2] (dry weight)
		Grain	Silage		
		Bu	*Tons*	*Bu*	*Tons*
Pa	Palms muck [3]	80	13	60	

and a few other hardwoods (fig. 7). The Boots-Houghton association supports a stand of tamarack and northern white cedar and considerable red maple, silver maple, green ash, white ash, and American elm. The elm is badly infected with Dutch elm disease and will probably be unimportant in future timber stands.

According to the latest published inventory of forest resources (*30*), about 17 percent, or 56,000 acres, of the county is in forest. Although nearly all of this acreage is commercial forest, about half is poorly stocked or grazed. According to this inventory, forest types are northern hardwoods, 25.5 percent; lowland hardwoods, 24 percent; conifers, 9.5 percent; oak, 8 percent; aspen, 3 percent; upland brush, 10.5 percent; and lowland brush, 19.5 percent.

Woodland groups

In table 3, the soils of Sheboygan County have been assigned to woodland groups to assist owners in planning the use of their soils for wood crops. Each group is made up of soils that are suited to the same kinds

The woodland group for each soil in the county is listed in the Guide to Mapping Units at the back of this survey.

Each woodland group is identified by a three-part symbol, such as 2c1 or 4w2. The first part, a number, indicates the potential productivity of the soil for trees. Numeral 1 means high; 2, moderately high; 3, moderate; 4, moderately low; 5, low; and 6, unproductive.

The potential productivity is expressed as a site index, or the average height of dominant and codominant trees of a given species at age 50 years. The site index for some of the more important species has been measured; for others it is estimated from measurements of the species on similar soils.

Site indexes used in Sheboygan County are based on recognized site index curves for silver maple and red maple, green ash, red oak and other upland oaks, sugar maple, black cherry,[3] aspen, swamp white oak, eastern white pine, basswood, tamarack, northern white cedar, red pine, and jack pine (*7,10,11,12,13,*

Annual yields for tree species were estimated from equipment commonly used in tending and harvesting

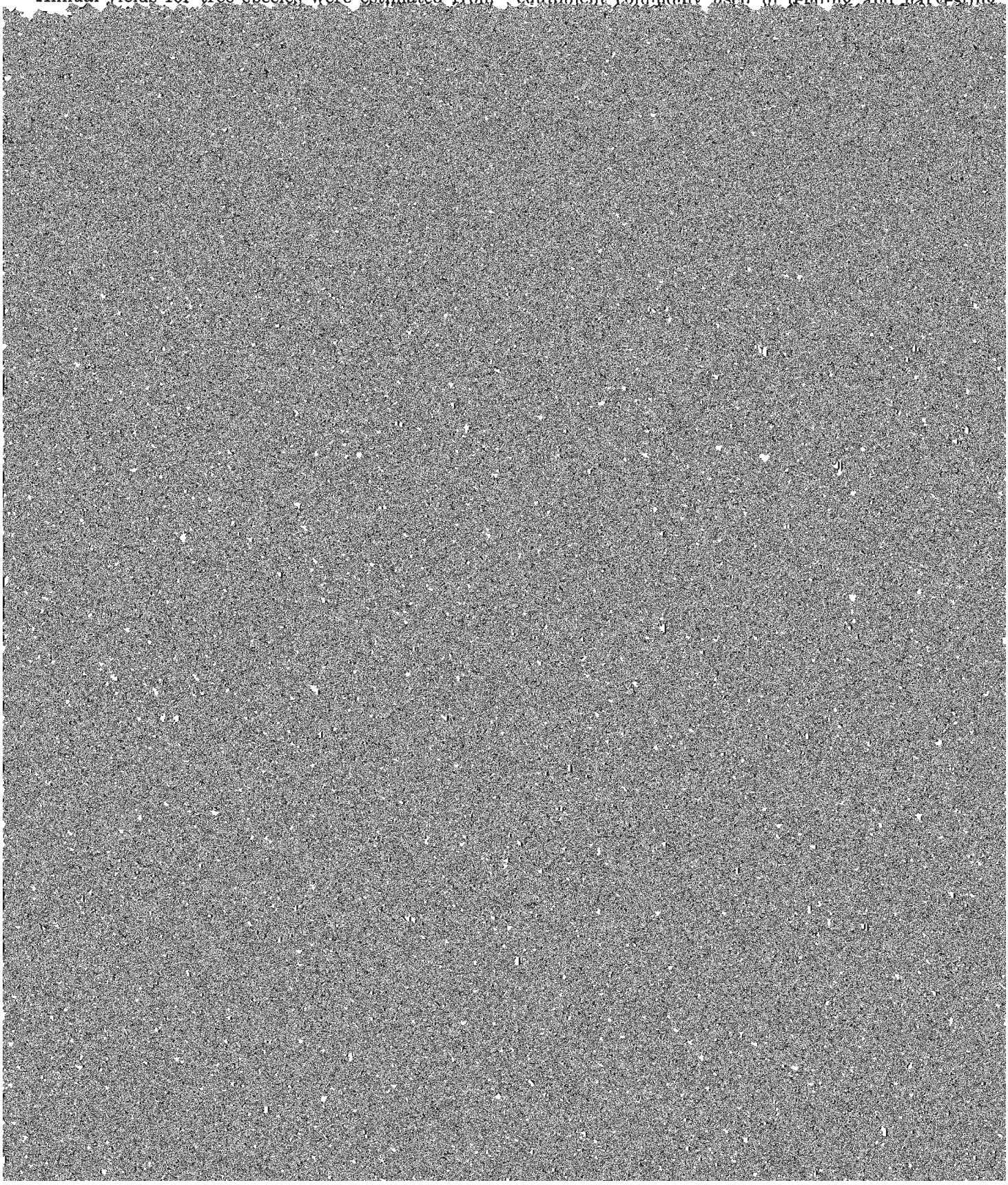


TABLE 3.—*Productivity and soil-related*

Woodland group and map symbol	Potential productivity			
	Tree species	Average site index	Number of plots	Yearly growth per acre
				Board feet
Group 1w1: Cw	Silver maple	80	2	190
	Red maple	76	2	170
	Green ash	81	2	—
	Northern red oak	79	2	310
Group 1o1: ScA, ScB, SrA, SrB, SrC2, ThA, ThB, ThC2, WbA, WbB, WbC2, ZuA, ZuB.	Northern red oak	72±6.8	8	265
	Sugar maple	64±2.0	7	100
	White and green ash	81	2	—
	Black cherry	74	2	—
	Quaking aspen	76	1	270
Group 1o2: KuA, YhA	Red oak	74	1	280
	Sugar maple	69	2	120
	Red maple	73	2	160
	White and green ash	66	2	—
Group 2w1: Ot, Py	Silver maple	80	2	19
	Red maple	79	1	190
	Green ash	77	2	—
	Red oak	75	1	285
	Swamp white oak	73	1	280
Group 2c1: KnA, KnB, KpB2, KpC2, ShA, ShB, SkC2.	Northern red oak	67±7.0	9	230
	Sugar maple	57±6.2	4	80
	White ash	60	2	—
	Eastern white pine	42	2	150
Group 2c2: MbA	Sugar maple	58	1	85
	White and green ash	78	2	—
	Basswood	72	1	—
Group 2c3: KpD2	Northern red oak	67	(1)	230
	Sugar maple	57	(1)	80
	Eastern white pine	42	(1)	150
Group 2o1: FsA, FsB, FsC2, HeA, HeB, HfA, HfB, HmB2, HmC2, HsC2, HtB, JuA.	Northern red oak	61	3	195
	Sugar maple	62	2	95
Group 2o2: KlA, LmA, MsA, NnA, NnB	Northern red oak	65	(1)	220
	Sugar maple	60	(1)	90
Group 2r1: HmD2, HmE, HsD2, HsE	Red oak [2]	59±4.5	7	185
	Sugar maple	59±3.6	9	90
	White ash	57	2	—
Group 3w1: Gb, Gg	Red maple	65	1	115
	White pine	58	2	380
	White and green ash	60	(1)	—
Group 3w2: Ph	Silver maple	80	(1)	190
	White ash	60	(1)	—
Group 3w3[3]: Ag, Ak, Bk, Ed, Hu, Mz, Pa, We.	Tamarack	46±8.3	6	350
	Northern white cedar	34	2	—
	Silver maple	78	2	180
	Red maple	65	1	115
Group 3d1: CeA, CeB, CeC2, CrC	Red oak, northern pin oak, black oak	58	(1)	180
	Eastern white pine	45	2	180
Group 3d2–3d3: CrD2, CrE, CrF	Red oak [2]	58±5.8	5	180
	Eastern white pine	49	1	180

See footnotes at end of table.

limitations by woodland groups

Species for reforestation	Limitations		
	Equipment	Erosion	Seedling mortality
Red maple, silver maple, green ash, white ash, white spruce	Severe	Slight	Moderate to severe.
Eastern white pine, red pine, white spruce	Slight	Slight	Slight.
White and green ash, red and silver maple, white spruce, eastern white pine.	Slight	Slight	Slight.
White and green ash, red and silver maple, white spruce.	Severe	Slight	Moderate to severe.
Eastern white pine, red pine, white spruce, white ash.	Slight	Slight	Moderate.
Eastern white pine, red pine, white spruce, white and green ash.	Slight	Slight	Moderate.
Eastern white pine, red pine, white spruce, white ash.	Moderate	Moderate	Slight on north-and east-facing slopes. Moderate on south- and west-facing slopes.
Red pine, eastern white pine, white spruce	Slight	Slight	Slight.
Red pine, eastern white pine, white spruce	Slight	Slight	Slight.
Eastern white pine, red pine, white spruce	Moderate	Moderate	Slight on north-and east-facing slopes. Moderate on south- and west-facing slopes.
Red and silver maple, white and green ash, white spruce.	Severe	Slight	Moderate to severe.
White and green ash, red and silver maple	Severe	Slight	Moderate to severe.
Not suitable for planting	Severe	Slight	Severe.
Red pine, eastern white pine, eastern red cedar, jack pine.	Slight	Slight	Moderate.
Red pine, eastern white pine, eastern red cedar, jack pine.	Moderate to severe	Moderate to severe	Moderate on north- and east-facing slopes. Moderate to severe on south- and west-facing slopes.

TABLE 3.—*Productivity and soil-related*

Woodland group and map symbol	Potential productivity			
	Tree species	Average site index	Number of plots	Yearly growth per acre
				Board feet
Group 3c1: KsC3	Red oak	58	(1)	180
	Sugar maple	55	(1)	75
Group 3c2: KsD3	Red oak	58	(1)	180
	Sugar maple	55	(1)	75
Group 3s1: OaB, OaC	Red oak [2]	50	1	130
	Red pine	43	1	170
	Eastern white pine	39	1	140
	Jack pine	50	1	60
Group 3o1: BmB, BmC2, Be, Bf	Red oak	60	(1)	190
	Sugar maple	55	(1)	75
Group 3o2: Am, FaA, MkA, Wa	Red oak	60	(1)	190
	White ash	55	(1)	—
Group 4w2: An, Ba, Ev, Lo, Mo, Na, Sm, Sw.	White and green ash	50	(1)	—
	Silver maple	70	(1)	140
Group 4o1: MgA	Silver maple	70	(1)	140
	White ash			
	American elm			
Group 6w1: Mf. Nonproductive, poorly drained loamy soils; not suitable for woodland.				
Group 6s1: Cx, Cy, Cz, Dn, Bd, Gp, Ma, Ry. Nonproductive sandy and droughty, or rocky soils or land types; not suitable for woodland.				

[1] Estimated.
[2] Includes northern red oak, northern pin oak, and black oak.

limitations by woodland groups—Continued

Species for reforestation	Limitations		
	Equipment	Erosion	Seedling mortality
Red pine, eastern white pine, white spruce	Slight	Severe	Moderate.
Red pine, eastern white pine, white spruce	Severe	Severe	Moderate on north- and east-facing slopes. Severe on south- and west-facing slopes.
Red pine, eastern white pine, jack pine	Slight	Slight	Moderate.
Red pine, eastern white pine, white spruce	Slight	Slight	Slight.

TABLE 4.—*Landscape and windbreak planting guide*

[The first letter in parentheses following species name 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]

Tree and shrub group series, and map symbols	Trees suitable for—				
	Shade	Street borders	Lawns	Hedges and screens	Windbreaks
	SUNNY SITES				
Group 1: Moderately well drained and well drained, medium textured soils; moderate to very high available water capacity. Alluvial land: Am. Bellevue: Be, Bf. Fox: FsA, FsB, FsC2. Hebron: HeA, HeB HfA, HfB. Hochheim: HmB2, HmC2, HmD2, HmE, HsC2, HsD2, HsE, HtB. Juneau: JuA. Kewaunee: KnA, KnB, KpB2, KpC2, KpD2, KsC3, KsD3. St. Charles: ScA, ScB. Saylesville: ShA, ShB, SkC2. Sisson: SrA	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 honeylocust (MO).	Norway maple (MR) Southern pin oak (MP). Thornless honeylocust (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) Horsechestnut (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	Norway maple (MP)	Blue beech (SP)	White-cedar (MC)	White-cedar (MC,P)

TABLE 4.—*Landscape and windbreak planting guide—Continued*

Tree and shrub group series, and map symbols	Trees suitable for—				
	Shade	Street borders	Lawns	Hedges and screens	Windbreaks
Lamartine: LmA. Loamy land, seeped: Lo. Manawa: MbA. Martinton: MgA. Matherton: MkA. Montgomery: Mo. Mosel: MsA. Navan: Na. Nenno: NnA, NnB. Otter: Ot. Pella: Ph. Poygan: Py. Sebewa: Sm. Wasepi: Wa. Yahara: YhA.	PARTIAL SHADE				
	Swamp white oak (LR). Hackberry (MR) Red maple (MO) Basswood (LL) Green ash (MO) White ash (LO)	Green ash (MO) Basswood (LO) Red maple (MO)	White spruce (MP) Mountainash (SO)	White-cedar (MC) White spruce (MP)	White-cedar (MC). White spruce (MP).
Group 4: Mainly very poorly drained	SUNNY SITES				

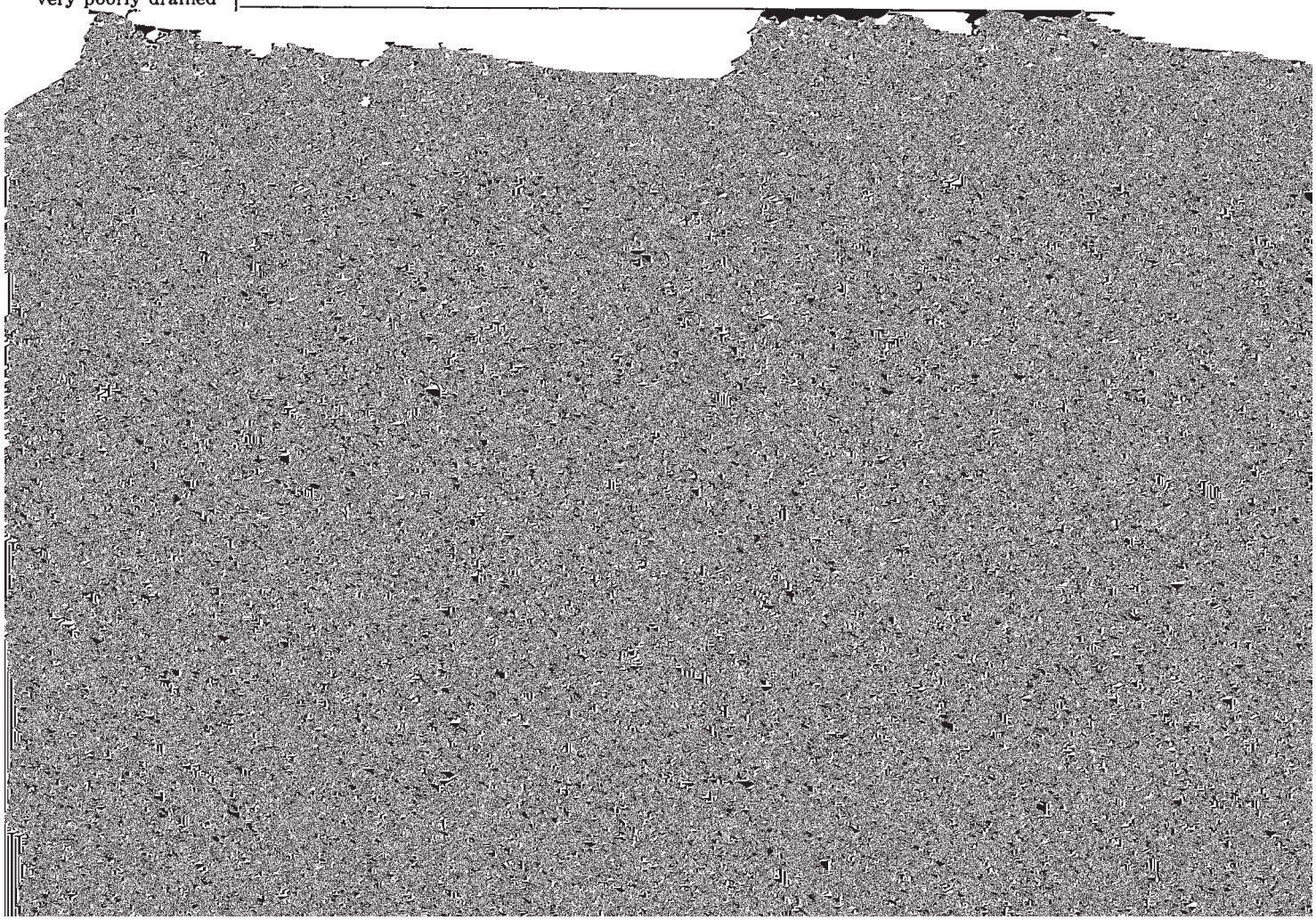


TABLE 5.—*Shrub and vine planting guide—Continued*

Tree and shrub group [1]	Plant species	Type of plant	Potential height	Suitable for—				
				Landscaping	Hedge, screen, and windbreak	Wildlife food and cover	Roadside planting	Ground cover
			Feet					
	Filbert (hazelnut)	Shrub	5–8			X	X	
	Forsythia	Shrub	4–8	X				
	Grape, wild	Vine				X	X	X
	Hawthorn or thornapple	Shrub	5–15			X	X	
	Honeysuckle (shrub type)	Shrub	6–12	X	X	X		
	Juniper, creeping	Shrub	1–2	X		X	X	X
	Juniper, Pfitzer	Shrub	8–10	X		X		
	Lilac	Shrub	8–10	X	X		X	
	Maple, Amur	Shrub	1	X	X			
	Mockorange	Shrub	6–9	X	X			
	Myrtle or periwinkle	Vine	1	X			X	X
	Ninebark, common	Shrub	6–9	X	X		X	
	Olive, autumn	Shrub	10–15	X	X	X		
	Peashrub, Siberian	Shrub	10–15		X	X	X	
	Pine, mugho	Shrub	6–9	X		X		
	Plum, American	Shrub	10–15			X	X	
	Privet, Amur	Shrub	10		X	X		
	Privet, Regels border	Shrub	6–9		X	X		
	Redcedar, eastern	Shrub	6–9		X	X	X	
	Rose (rugosa and horticultural varieties)	Shrub	2–6	X		X	X	
	Russian-olive	Shrub	10–15+	X	X	X		
	Snowberry	Shrub	3–4	X		X	X	X
	Spirea, Anthony Waterer	Shrub	2–3	X				
	Spirea, Vanhoutte	Shrub	5–6	X	X			
	Sumac, fragrant	Shrub	3	X		X	X	X
	Sumac, smooth	Shrub	6–10			X	X	
	Sumac, staghorn	Shrub	10–15			X	X	
	Viburnum, American cranberrybush	Shrub	7–9	X	X	X	X	
	Viburnum, arrowwood	Shrub	10–12	X	X	X		
	Viburnum, blackhaw	Shrub	8–10		X	X	X	
	Viburnum, mapleleaf	Shrub	3–5			X	X	
	Viburnum, nannyberry	Shrub	9–12		X	X	X	
	Viburnum, Rafinesque	Shrub	2–4			X	X	
	Viburnum, wayfaringtree	Shrub	4–9	X		X	X	
	Virginia creeper	Vine				X	X	X
	Wahoo, eastern	Shrub	4–9	X		X	X	
	Weigela	Shrub	4–8	X	X			
	Willows (shrub types, including	Shrub	2–8	X	X	X	X	

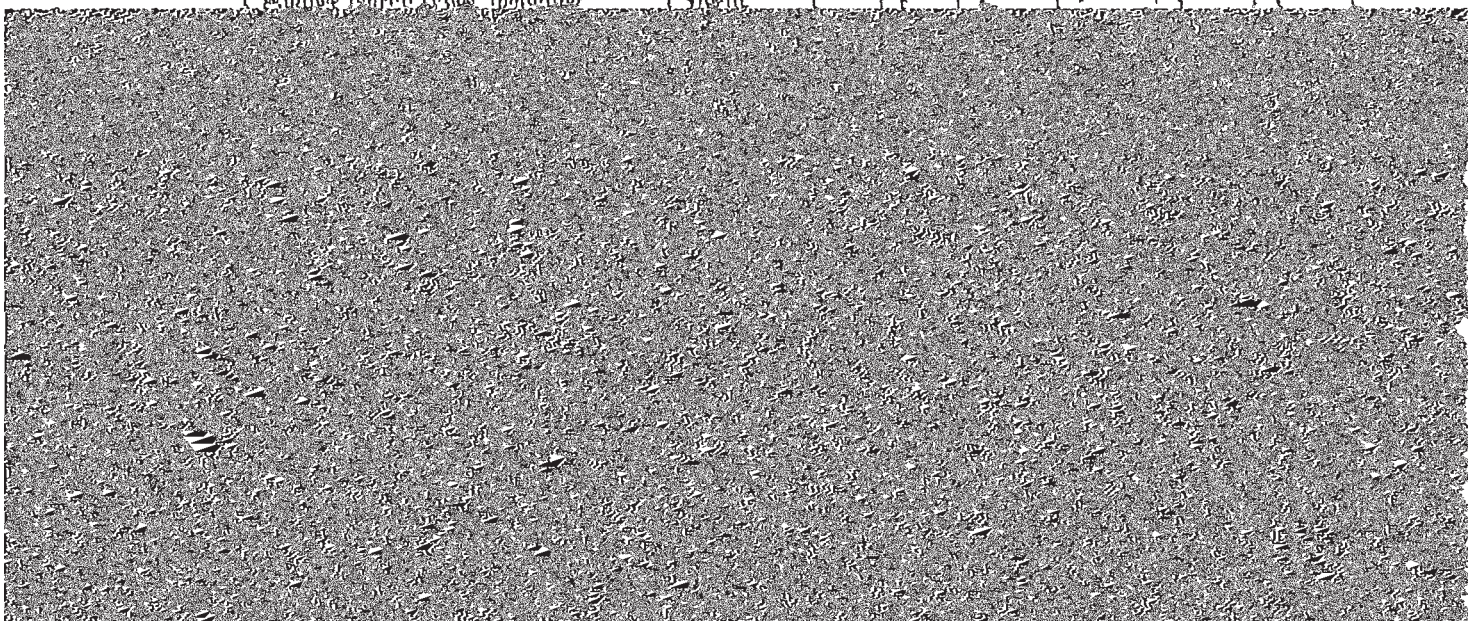


TABLE 5.—*Shrub and vine planting guide—Continued*

Tree and shrub group [1]	Plant species	Type of plant	Potential height	Suitable for—				
				Landscaping	Hedge, screen, and windbreak	Wildlife food and cover	Roadside planting	Ground cover
			Feet					
	Olive, autumn	Shrub	10–15	X	X	X		
	Peashrub, Siberian	Shrub	10–15		X	X	X	
	Pine, mugho	Shrub	6–9	X		X		
	Plum, American	Shrub	10–15			X	X	
	Privet, Amur	Shrub	10		X	X		
	Privet, Regels border	Shrub	6–9		X	X		
	Redcedar, eastern	Shrub	6–9		X	X	X	
	Russian-olive	Shrub	15+	X	X	X		
	Snowberry	Shrub	3–4	X		X	X	X
	Spirea, Anthony Waterer	Shrub	2–3	X				
	Spirea, Vanhoutte	Shrub	5–6	X	X			
	Sumac, fragrant	Shrub	3	X		X	X	X
	Sumac, smooth	Shrub	6–10			X	X	
	Sumac, staghorn	Shrub	10–15			X	X	
	Viburnum, blackhaw	Shrub	8–10		X	X	X	
	Viburnum, nannyberry	Shrub	9–12		X	X	X	
	Viburnum, Rafinesque	Shrub	2–4			X	X	
	Viburnum, wayfaringtree	Shrub	4–9	X		X	X	
	Virginia creeper	Vine				X	X	X
	Willows (shrub types, including pussywillow).	Shrub	2–8	X	X	X	X	
Group 3: Somewhat poorly drained to very poorly drained mineral soils.	Arborvitae (shrub type)	Shrub	3–7	X	X	X		
	Bayberry or waxmyrtle	Shrub	5–9	X		X		X
	Chokeberry, black	Shrub	1–3	X		X	X	X
	Dogwood, gray	Shrub	6–10			X	X	
	Dogwood, pagoda	Shrub	10–15			X	X	
	Dogwood, redosier	Shrub	3–9					
	Dogwood, roundleaf	Shrub	3–9			X	X	X
	Dogwood, silky	Shrub	6–10		X	X	X	
	Elder, American	Shrub	3–10			X	X	X
	Hawthorn or thornapple	Shrub	5–15			X	X	
	Honeysuckle (shrub type)	Shrub	6–12	X	X	X		
	Ninebark, common	Shrub	6–9	X	X		X	
	Olive, autumn	Shrub	10–15	X	X	X		
	Plum, American	Shrub	10–15			X	X	
	Russian-olive	Shrub	15+	X	X	X		
	Spirea, narrowleaf	Shrub	3–4				X	
	Spirea, Vanhoutte	Shrub	5–6	X	X			
	Viburnum, American cranberrybush	Shrub	7–9	X	X	X	X	
	Viburnum, mapleleaf	Shrub	3–5			X	X	
	Viburnum, nannyberry	Shrub	9–12		X	X	X	
	[illegible]	Shrub	4–9	X		X	X	

wildlife. This relationship is applicable to upland and wetland soils.

Wildlife benefits from food and cover plantings in areas used primarily or secondarily for wildlife production. It also benefits from such soil and water conservation practices as stripcropping, fertilization, and planting of trees on soils used for pasture, woodland, and other purposes.

Most of the major soils in the county are suited to fairly intensive farming and have a high potential for wildlife, but because the soils are in other uses, there is little wildlife habitat.

The soils of Sheboygan County have been assigned to nine groups for wildlife interpretation according to a statewide system of grouping and identification. Soils in group 5 do not occur in Sheboygan County. Soils in groups 6, 7, and 8, which are somewhat poorly drained and poorly drained or are organic, are the most important for wildlife. They occur in the valuable wetlands.

About 72,000 acres of the county is designated as wet soils that have a permanent or seasonal high water table or are subject to flooding. According to a 1971 survey, only 27,100 acres remains as wetlands. Thus, less than 40 percent of the original wetlands remain (fig. 8). This decrease has had an effect upon the species of wildlife in the county.

In table 6 the soils in Sheboygan County are rated

TABLE 6.—*Soil interpretation for*

Wildlife group, description of soils, series, and map symbols	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants
Group 1: Well drained and moderately well drained soils; silty or loamy throughout; not subject to flooding. Cut and fill land, loamy: Cy. Fox: FsA, FsB, FsC2. Hebron: HeA, HeB, HfA, HfB. Hochheim: HmB2, HmC2, HmD2, HmE, HsC2, HsD2, HsE, HtB. St. Charles: ScA, ScB. Sisson: SrA, SrB, SrC2. Theresa: ThA, ThB, ThC2. Waymor: WbA, WbB, WbC2. Zurich: ZuA, ZuB.	Good if slope is 0 to 6 percent, fair if 6 to 12, poor if more than 12; hazard of water erosion.	Good if slope is 0 to 12 percent, fair if 12 to 20, poor if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.
Group 2: Well drained and moderately well drained soils; clayey subsoil. Silty and clayey land types. Cut and fill land, clayey: Cz. Kewaunee: KnA, KnB, KpB2, KpC2, KpD2, KsC3, KsD3. Rough broken land: Ry. Saylesville: ShA, ShB, SkC2.	Good if slope is 0 to 6 percent, fair if 6 to 12, unsuitable if more than 12.	Good if slope is 0 to 12 percent, fair if 12 to 20, unsuitable if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.
Group 3: Well drained and moderately well drained, droughty sandy soils. Boyer: BmB, BmC2. Oakville: OaB, OaC.	Fair: hazard of water erosion	Good	Good
Group 4: Droughty soils that are shallow over gravel and sand. Casco: CeA, CeB, CeC2, CrC, CrD2, CrE, CrF.	Fair if slope is 0 to 6 percent, poor if more than 6; hazard of water erosion.	Good if slope is 0 to 12 percent, fair if 12 to 20, poor if more than 20.	Good if slope is 0 to 20 percent, fair if more than 20.
Group 6: Somewhat poorly drained soils. Fabius: FaA. Kendall: KlA. Kibbie: KuA. Lamartine: LmA. Manawa: MbA. Martinton: MgA. Matherton: MkA. Mosel: MsA. Nenno: NnA, NnB. Wasepi: Wa. Yahara: YhA.	Good if drained, fair if undrained and wet.	Good if drained, fair if undrained and wet; few species suited.	Fair: wet; some species not suited.

for their suitability for the production of various elements of wildlife habitat. These elements are defined in the following paragraphs.

Grain and seed crops are corn, oats, sorghum, wheat, barley, rye, and soybeans that are used as food and cover by wildlife.

Grasses and legumes are such grasses as switchgrass, bromegrass, timothy, and fescue and such legumes as alfalfa, red clover, sweet clover, and vetch that are used by wildlife for food and cover.

garsticks, aster, and goldenrod are important in this group.

Woody plants are shrubs, hardwood trees, and coniferous trees. Shrubs are low growing woody plants, including conifers less than 8 feet tall, that furnish fruit, seeds, browse, and cover for wildlife. Examples are viburnum, dogwood, and hazelnut. Hardwood trees, such as oak, maple, cherry, and nut trees, furnish mast, fruit, seeds, dens, cover, and browse for wildlife. Coniferous trees more than 8 feet tall, such as pine, fir,

wildlife habitat elements—Continued

Woody plants		Wetland plants for food and cover	Shallow and deep water developments
Hardwoods, trees, and shrubs	Coniferous trees		
Poor: very wet; few species suited.	Poor: very wet; few species suited.	Good	Good.
Poor: wet; some species suited	Fair: wet; some species not not suited.	Good	Good if slope is 0 to 2 percent, fair if more than 2; wet.
Fair: hazard of flooding	Fair: hazard of flooding; some species not suited.	Poor: few species suited	Poor if slope is 0 to 2 percent, unsuitable if more than 2; moderate permeability.
Poor: few species suited; very low available water capacity.	Poor: few species suited; very low available water capacity.	Unsuitable: very low available water capacity; insufficient soil moisture.	Unsuitable: shallow to fissured dolomite or gravel.

during the growing season. Type 4 wetlands are deep marshes that are covered with 6 inches to about 3 feet of water during the growing season.

Deep water developments are more than 5 feet deep and formed by dug-out areas or embankments. Common plants are coontail, water lilies, milfoil, and water weed. The deep water areas consist of ponds, lakes, and type 5 wetlands (*23*). Type 5 wetlands are open freshwater areas that include shallow ponds and reservoirs or wet areas where water is less than 10 feet deep.

Table 7 lists the important wildlife species in Sheboygan County and shows the importance of the various habitat elements for the stated kinds of wildlife.

The suitability of a particular soil for a given species of wildlife can be determined by the use of tables 6 and 7. For example, critical elements of the habitat for ring-necked pheasants are grasses and legumes, wild herbaceous upland plants, and herbaceous wetland plants. Only a combination of soil groups can be well suited to all these habitat elements. An environment

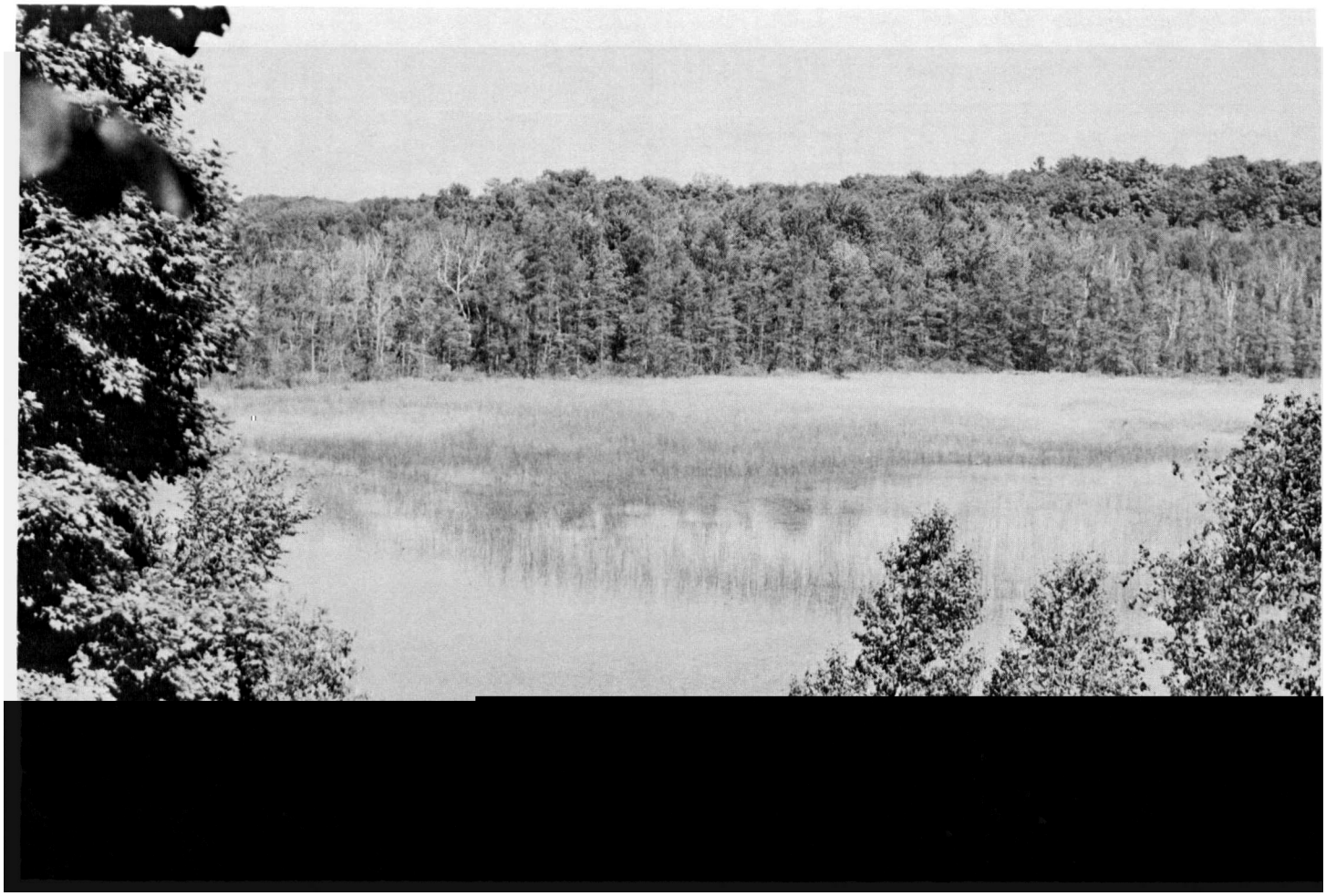


Figure 8.—Butler Lake in Mitchell Township is one of the few remaining wetlands in Sheboygan County. Houghton soils are along the shoreline.

having soils in group 1, well drained loamy soils, and soils in group 8, organic soils, is desirable.

Recreation

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 8 the soils of Sheboygan County have been placed in nine recreation groups, and the symbols of the soils assigned to each group are given. The soils are rated according to limitations that affect their use for camp areas, playgrounds, picnic areas, paths and trails, and golf course fairways.

In table 8 the soils are rated as having slight, moderate, and severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these is required.

Camp areas are used intensively for tents, small camp trailers, and the accompanying activities of outdoor living. Little preparation of the site is required other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, no flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, no flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic areas are attractive natural or landscaped tracts that are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads.

TABLE 7.—*Importance of selected elements of wildlife habitat*

[Numeral 1 indicates little or no value; 2, some value; 3, important; 4, very important. An asterisk indicates a key or critical element. Dashes indicate the element is not applicable to use by the stated kind of wildlife]

Selected wildlife species	Grain and seed crops		Grasses and legumes		Wild herbaceous upland plants	Woody plants			Wetland plants for food and cover	Water areas	
						Hardwood		Coniferous trees			
	Harvested	Unharvested	Harvested	Unharvested		Shrubs	Trees			Shallow	Deep
Migratory waterfowl:											
Ducks	3	3	1	3	3	----	1	----	*4	*4	4
Geese	4	*4	4	1	----	----	----	----	2	3	3
Upland game birds:											
Hungarian partridge	4	4	3	4	4	1	----	----	1	----	----
Pheasant	4	4	----	*4	*4	4	----	1	*4	3	----
Quail	4	4	2	4	4	*4	2	1	4	3	----
Woodcock	----	----	1	3	3	4	4	2	3	----	----
Small game:											
Rabbits, cottontail	3	4	3	*4	*4	*4	3	1	2	3	----
Raccoon	3	4	----	1	1	2	4	----	1	*4	4
Squirrels, fox and gray	3	4	----	1	1	2	*4	1	----	----	----
Large game:											
Deer	3	4	3	3	4	4	4	4	3	3	2
Furbearers:											
Beaver	----	----	----	----	----	4	*4	----	4	4	*4
Fox, red [1]	2	3	2	3	3	3	2	1	3	3	1
Mink [1]	----	----	----	----	----	2	1	1	3	*4	*4
Muskrat	1	1	----	----	----	1	----	----	4	*4	*4

[1] Carnivorous species not strictly dependent on elements listed.

The best soils are firm when wet but not dusty when dry; are free from flooding during the season of use; and do not have slopes or stoniness that greatly increase the cost of leveling sites or of building access roads.

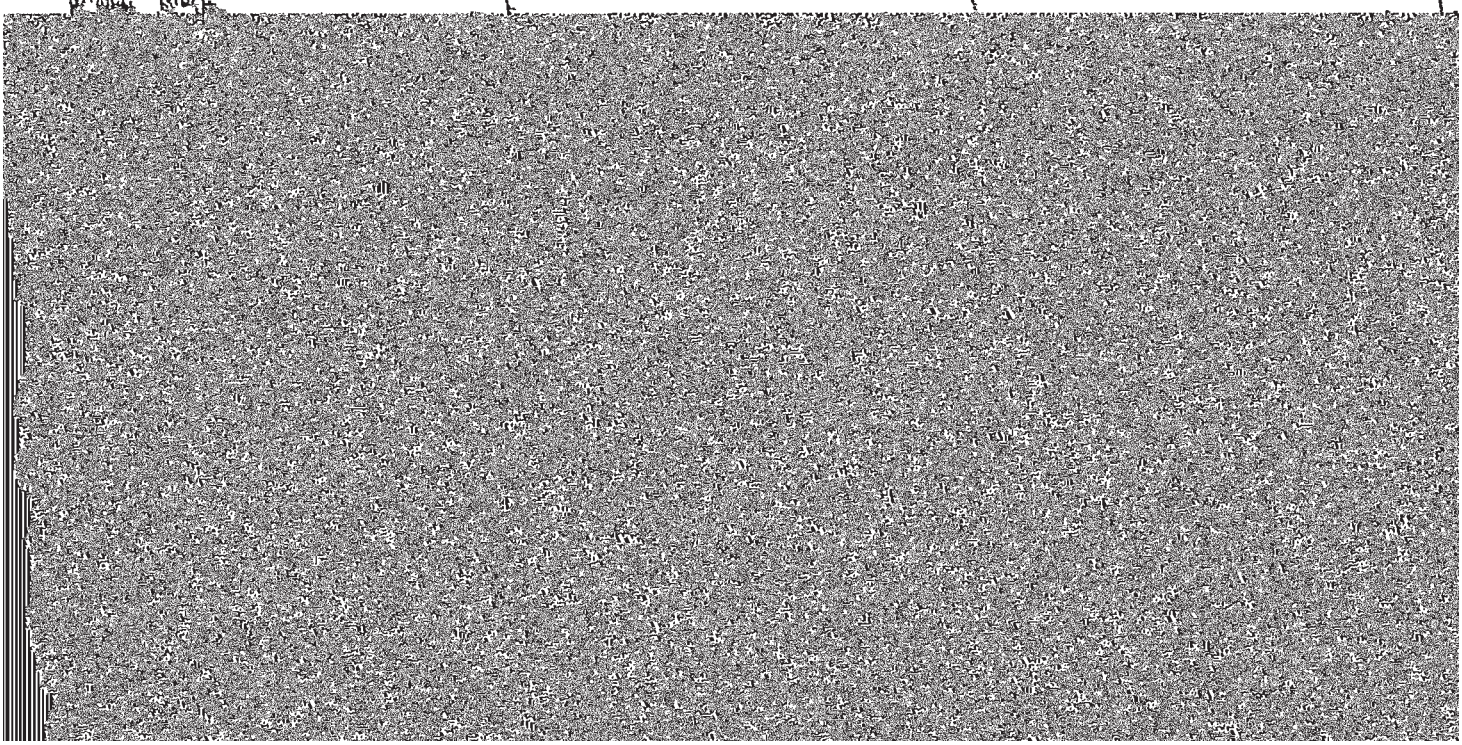
Paths and trails are used for local and cross-country travel by foot or horseback. Design and layout should

about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engi-

TABLE 8.—*Degree and kind of*

Recreation groups, descriptions of soils, and map symbols	Camp areas	Playgrounds
Group 1: Mainly well drained soils; loamy surface layer; moderately or moderately rapidly permeable subsoil. Some soils in this group have a gravelly surface layer and are very rapidly permeable. Casco: CeA, CeB, CeC2, CrC, CrD2, CrE, CrF. Cut and fill land, loamy: Cy. Hebron: HeA, HeB, HfA, HfB. Sisson: SrA, SrB, SrC2.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; some areas are stony or gravelly.	Slight if slope is 0 to 2 percent, moderate if 2 to 6, severe if more than 6; erosive; some areas are stony or gravelly.
Group 2: Well drained and moderately well drained soils; silty or loamy surface layer; moderately and moderately slowly permeable subsoil. Fox: FsA, FsB, FsC2. Hochheim: HmB2, HmC2, HmD2, HmE, HsC2, HsD2, HsE, HtB. Kewaunee: KnA, KnB. St. Charles: ScA, ScB. Saylesville: ShA, ShB, SkC2. Theresa: ThA, ThB, ThC2. Waymor: WbA, WbB, WbC2. Zurich: ZuA, ZuB.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; surface is wet and soft after rains; compacts easily when wet.	Slight if slope is 0 to 2 percent, moderate if 2 to 6, severe if more than 6; erosive; compacts easily when wet; leveling can expose sand and gravel in some areas or bedrock in Hochheim-Knowles complex.
Group 3: Well drained and moderately well drained sandy and gravelly soils; droughty. Boyer: BmB, BmC2. Cut and fill land, sandy and gravelly: Cx. Oakville: OaB, OaC.	Moderate if slope is 0 to 12 percent, severe if more than 12; erosive; droughty; subject to soil blowing.	Severe: erosive; droughty; subject to soil blowing; difficult to maintain good vegetative cover.
Group 4: Somewhat poorly drained soils Fabius: FaA. Kendall: KlA. Kibbie: KuA. Lamartine: LmA. Manawa: MbA. Martinton: MgA. Mosel: MsA.	Moderate: sites remain wet for moderately long periods.	Moderate: soil saturated at a depth of less than 3 feet during wet periods; subject to occasional ponding; sod easily damaged.



limitation for recreational use

Picnic areas	Paths and trails	Golf course fairways
Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; some areas are stony or gravelly.	Slight if slope is 0 to 12 percent, moderate if 12 to 20, severe if more than 20.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; some areas are stony or gravelly.
Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; compacts easily when wet; some areas are stony or gravelly.	Slight if slope is 0 to 12 percent, moderate if 12 to 20, severe if more than 20; muddy and slippery when wet; some areas are stony or gravelly.	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12; erosive; some areas are stony or gravelly.
Moderate if slope is 0 to 12 percent, severe if more than 12; erosive; droughty; subject to soil blowing.	Moderate if slope is 0 to 12 percent, severe if more than 12; erosive; droughty; paths difficult to maintain.	Moderate if slope is 0 to 6 percent, severe if more than 6; erosive; droughty; difficult to maintain turf.

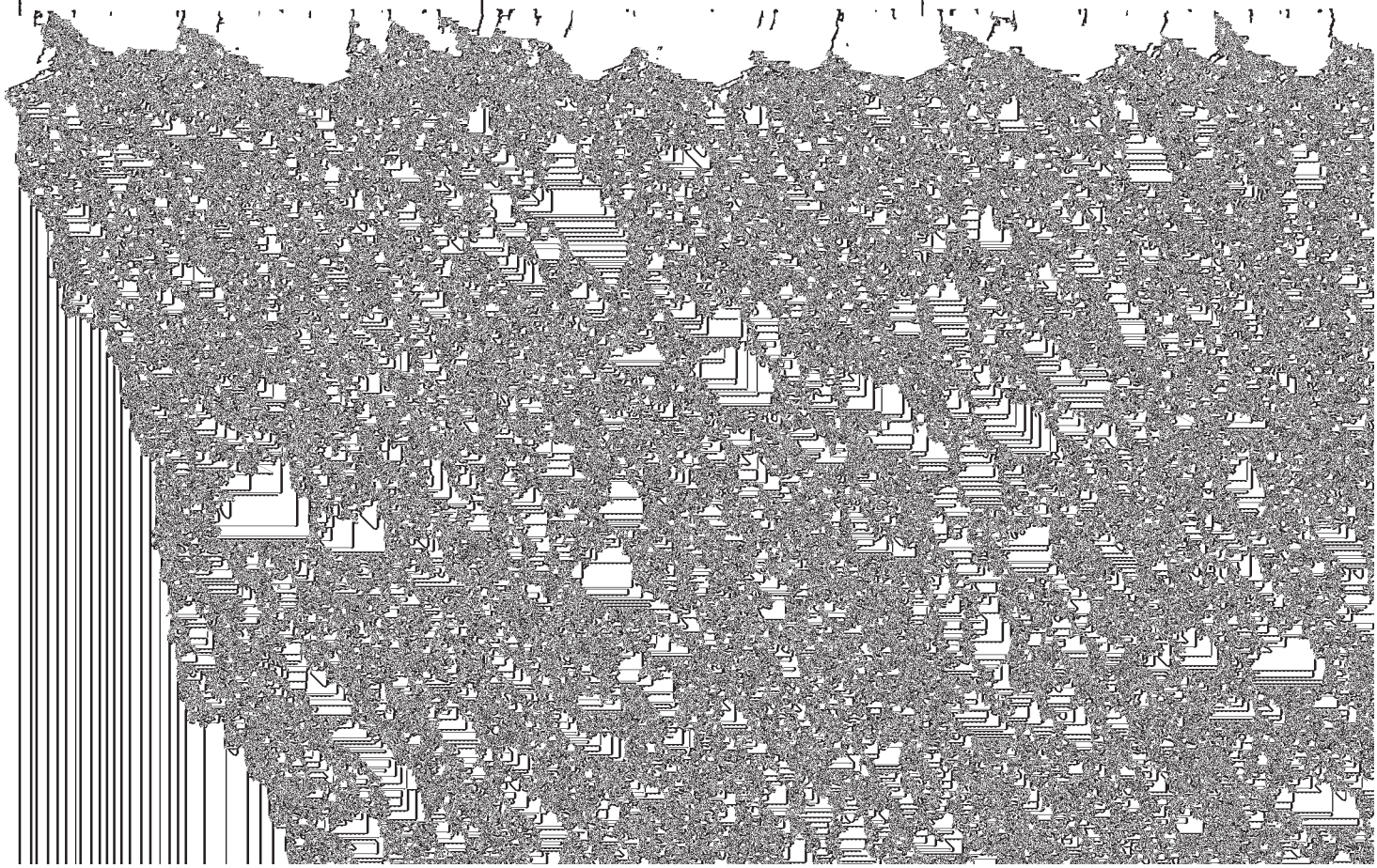


TABLE 8.—*Degree and kind of*

Recreation groups, descriptions of soils, and map symbols	Camp areas	Playgrounds
Montgomery: Mo. Navan: Na. Otter: Ot. Pella: Ph. Poygan: Py. Sebewa: Sm. Stony land, wet: Sw.		
Group 9: Mainly very poorly drained organic soils; sandy areas in places. Adrian: Ag, Ak. Boots: Bk. Edwards: Ed. Houghton: Hu. Muskego: Mz. Palms: Pa. Willette: We.	Severe: sites are wet for long periods; subject to ponding; very low trafficability.	Severe: sites are wet for long periods; subject to ponding; very low trafficability.

dicting performance of structures on the same or similar kinds of soil in other locations.

6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is in tables 9, 10, and 11, which show, respectively, several estimated soil properties significant in engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 9 and 10, and it also can be used to make other useful maps.

This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 5 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning in soil science that may not be familiar to engineers. The Glossary defines many of these terms.

Engineering classification

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*2*) used by the SCS engineers, Department of Defense, and others, and the AASHTO system (*1*) adopted by the American Association of State Highway and Transportation Officials.

The Unified system is used to classify soils according to engineering uses for building material or for the support of structures other than highways. Soils are classified according to particle size distribution, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes and 11 dual classes. There are eight classes of coarse grained soils that are subdivided on the basis of gravel and sand content. These are identified as GW, GP, GM, GC, SW, SP, SM, and SC. Six classes of fine grained soils are subdivided on the basis of the plasticity index. Nonplastic classes are ML, MH, OL, and OH; plastic classes are CL and CH. There is one class of highly organic soils, Pt. Dual classifications used for a specific range of particle sizes are SP–SM, SW–SM, SU–SC, SW–SC, GP–GM, GW–GM, GP–GC, and GW–GC. For a specific range of liquid limits and plasticity indexes, the dual classifications of CL–ML, SC–SM, and GC–GM are used. For borderline cases, usually both possible classifications are listed.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system a soil is classified in one of seven basic groups ranging from A–1 through A–7 on the basis of grain size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils, which have high bearing strength and are the best soils for subgrade, or foundation. At the other extreme, in group A–7, are clay soils, which have low strength when wet and are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils,

limitation for recreational use—Continued

Picnic areas	Paths and trails	Golf course fairways
Severe: sites are wet for long periods; subject to ponding; very low trafficability.	Severe: sites are wet for long periods; subject to ponding; very low trafficability.	Severe: sites are wet for long periods; subject to ponding; very low trafficability.

with group index numbers in parentheses, is shown in table 11; the estimated classification, without group index numbers, is given in table 9 for all soils mapped in the survey area.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary. Stones, cobbles, and gravel are used as textural modifiers where present in the soil.

Estimated soil properties

erately fine textured or fine textured soils that have layers that impede the downward movement of water. These soils have a slow infiltration rate and a slow rate of water transmission. *Group D* contains mainly clay soils that have high shrink-swell potential; soils that have a high permanent water table; soils that have a clay pan or clay layer at or near the surface; and shallow soils over a nearly impervious substratum. The soils have a very slow infiltration rate and a very slow rate of water transmission.

Soil texture is described in table 9 in the standard terms used by the Department of Agriculture. These terms are based on the percentage of sand, silt, and clay in soil material that is less than 2.0 millimeters in

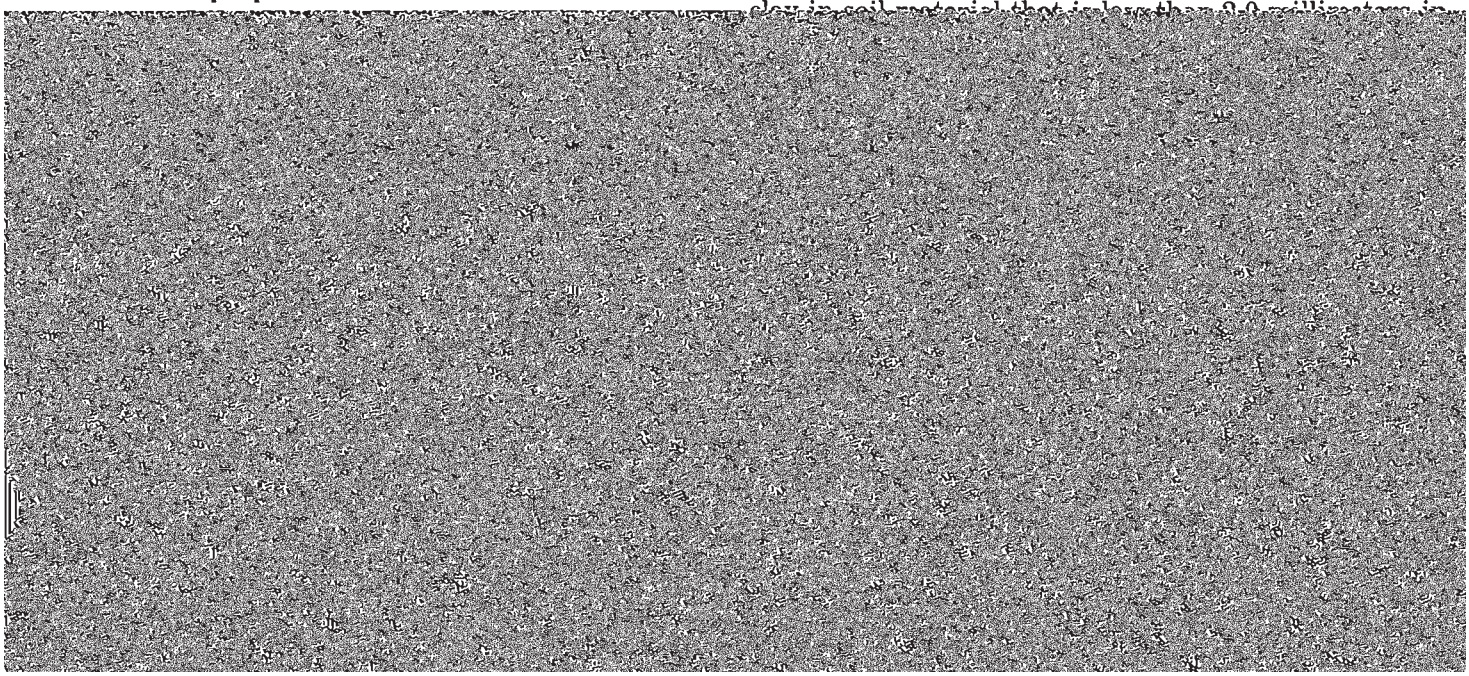
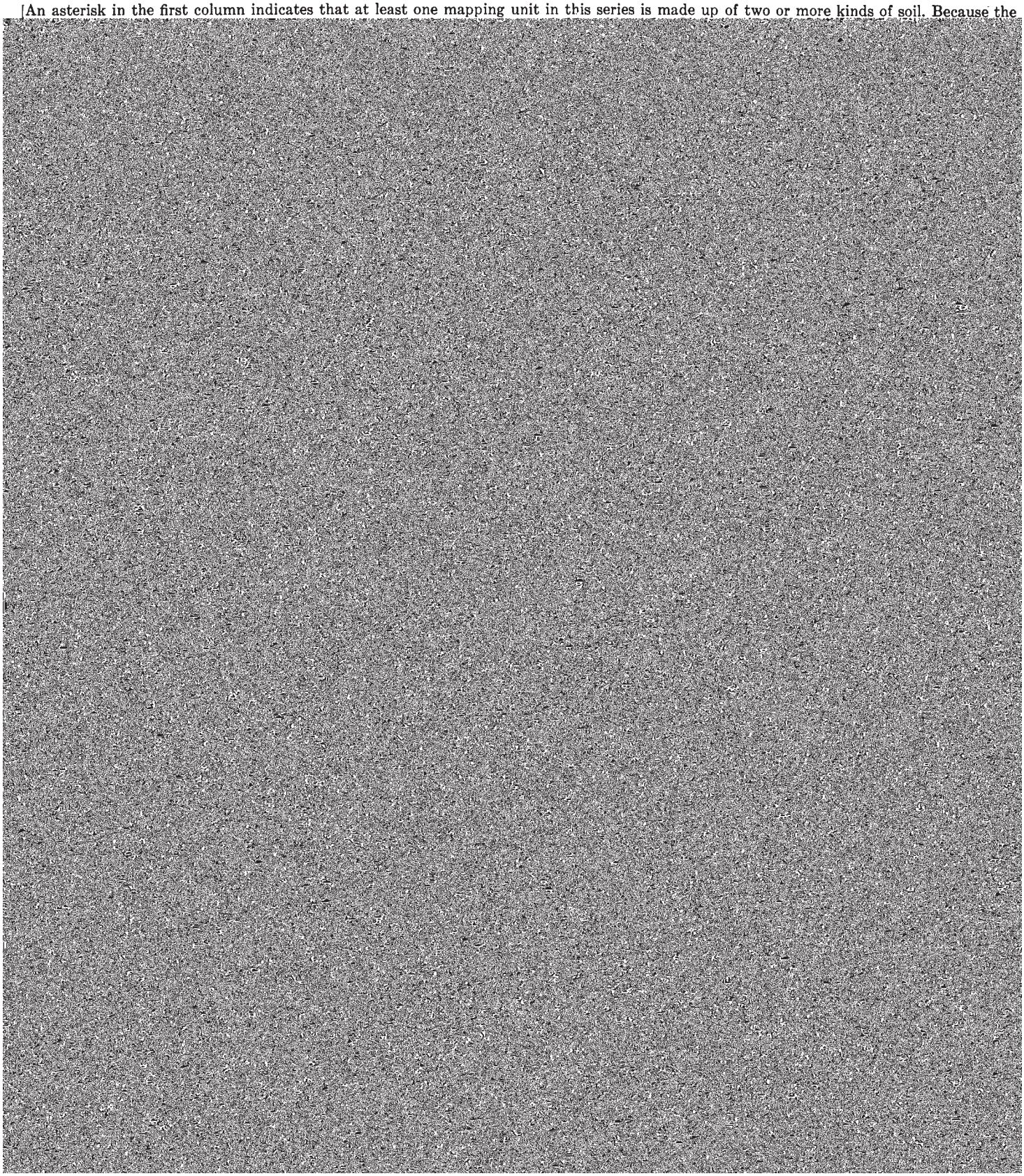


TABLE 9.—*Estimates of soil properties*

[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. Because the



significant in engineering

soils in such mapping units can have different properties and limitations, it is necessary to follow carefully the instructions for referring to to be rated or that no estimate was made. The symbol > means greater than; the symbol < means less than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In/hr*	*In/in of soil*	*pH*			
					NP	2.0–6.0	0.35–0.45	6.1–7.8		High	Low to moderate.
100	90–95	60–75	1–4		NP	6.0–20.0	0.05–0.07	7.4–7.8	Low	High	Low.
95–100	95–100	65–90	36–65	<30	NP–5	0.6–2.0	0.22–0.24	6.1–7.8	Low	High	Low.
95–100	80–90	80–90	75–85	30–45	16–30	0.6–2.0	0.18–0.20	6.1–7.8	Moderate	High	Low.
85–95	70–90	60–70	25–45		NP	2.0–6.0	0.11–0.13	7.4–8.4	Low	High	Low.
100	95–100	10–30	0–1			>20.0					
100	100	85–100	55–85	<30	NP–4	0.6–2.0	0.22–0.24	6.6–7.3	Low	Low	Low.
100	100	85–100	80–90	25–40	13–20	0.6–2.0	0.18–0.20	6.6–7.3	Moderate	Low	Low.
100	100	60–95	50–70	20–30	5–15	0.6–2.0	0.17–0.19	6.6–7.3	Low	Low	Low.
100	100	85–100	40–80		NP	0.6–2.0	0.20–0.24	7.4–7.8	Low	Low	Low.
95–100	90–100	70–85	45–50	<19	NP–4	2.0–6.0	0.16–0.18	7.4–8.4	Low	Low	Low.
95–100	90–100	70–90	30–34		NP	2.0–6.0	0.10–0.13	7.4–8.4	Low	Low	Low.
95–100	90–100	60–70	5–15		NP	6.0–20.0	0.05–0.07	7.4–8.4	Low	Low	Low.
						2.0–6.0	0.35–0.45	6.1–7.8		Moderate	Low to moderate.
						2.0–6.0	0.35–0.45	6.1–7.8		Moderate	Low to moderate.
						2.0–6.0	0.35–0.45	6.1–7.8		Moderate	Low to moderate.
95–100	90–100	45–70	15–30		NP	6.0–20.0	0.10–0.12	6.1–7.8	Low	Low	Low.
95–100	80–100	55–85	25–40		NP	2.0–6.0	0.12–0.14	6.1–7.8	Low	Low	Low.
60–90	30–75	30–60	5–10		NP	>20.0	0.02–0.04	7.4–8.4	Low	Low	Low.
95–100	90–100	85–95	50–70	<30	NP–5	0.6–2.0	0.20–0.22	6.1–7.3	Low	Low	Low.
85–100	80–90	70–90	45–55	25–40	11–20	0.6–2.0	0.16–0.18	6.1–7.3	Moderate	Low	Low.
30–95	30–90	10–90	3–10		NP	>20.0	0.02–0.04	7.4–8.4	Low	Low	Low.
100	100	90–100	70–90	20–30	5–9	0.6–2.0	0.22–0.24	6.6–7.8	Low	Moderate	Low.
100	100	80–100	80–95	30–40	10–20	0.6–2.0	0.18–0.20	6.6–7.8	Moderate	High	Low.
100	100	80–100	50–70	<30	NP–10	0.6–2.0	0.17–0.19	6.6–7.8	Low	High	Low.
100	100	70–100	70–80		NP	0.6–2.0	0.18–0.20	7.4–8.4	Low	High	Low.
						6.0–20.0	0.02–0.04				
						0.6–6.0	0.10–0.12				
						0.2–0.6	0.10–0.12				

TABLE 9.—*Estimates of soil properties*

Soils series and map symbols	Depth to seasonal high water table	Hydrologic group	Depth from surface	USDA texture	Classification		Coarse fragments greater than 3 inches
					Unified	AASHTO	
	Ft		*In*				*Pct*
Dune land: Dn Too variable to be rated.	>5						
Edwards: Ed	[2] 0–1	B/D	0–38	Muck	Pt		
			38–60	Marl			
Elvers: Ev	[2] 0–1	D	0–22	Silt loam	ML	A–4	0
			22–60	Muck	Pt		
Fabius: FaA	[2] 1–3	B	0–12	Loam	ML	A–4	0–5
			12–16	Clay loam	CL	A–6	0–5
			16–19	Gravelly sandy loam	SM	A–2 or A–4	5–10

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In/hr*	*In/in of soil*	*pH*			
						2.0–6.0	0.35–0.45	6.1–7.8		High	Low to moderate.
						0.06–0.2	0.25–0.35	7.4–8.4		High	Low.
100	100	100	70–90	<30	NP–4	0.6–2.0	0.22–0.24	6.1–7.8	Low	High	Low.
						2.0–6.0	0.35–0.45	6.1–7.8		High	Low to moderate.
95–100	90–100	85–95	60–70	25–35	4–7	0.6–2.0	0.20–0.22	6.6–7.3	Low	Moderate	Low.
95–100	90–100	90–100	70–80	30–40	11–21	0.6–2.0	0.15–0.19	6.6–7.8	Moderate	Moderate	Low.
70–85	70–85	60–60	30–40	10–19	1–4	0.6–2.0	0.10–0.12	6.6–7.8	Low	Moderate	Low.
65–75	40–45	30–80	1–4		NP	2.0–6.0	0.02–0.04	7.9–8.4	Low	Low	Low.
95–100	90–100	65–80	20–35		NP	2.0–6.0	0.06–0.08	7.9–8.4	Low	Low	Low.
95–100	95–100	90–95	70–90	30–35	5–10	0.6–2.0	0.22–0.24	6.6–7.3	Low	Low	Low.
95–100	85–100	85–95	70–85	25–30	12–20	0.6–2.0	0.15–0.19	6.1–7.8	Moderate	Low	Low.
65–75	40–60	20–40	2–5		NP	>20.0	0.02–0.04	7.4–8.4	Low	Low	Low.
100	100	50–70	20–40		NP	6.0–20.0	0.10–0.12	6.1–7.3	Low	High	Low.
100	95–100	50–70	5–15		NP	6.0–20.0	0.06–0.08	6.1–7.3	Low	High	Low.
95–100	95–100	90–95	70–80	30–35	5–10	2.0–6.0	0.22–0.24	6.6–8.4	Low	Moderate	Low.
80–85	60–85	65–75	25–30		NP	2.0–6.0	0.10–0.12	7.4–8.4	Low	Moderate	Low.

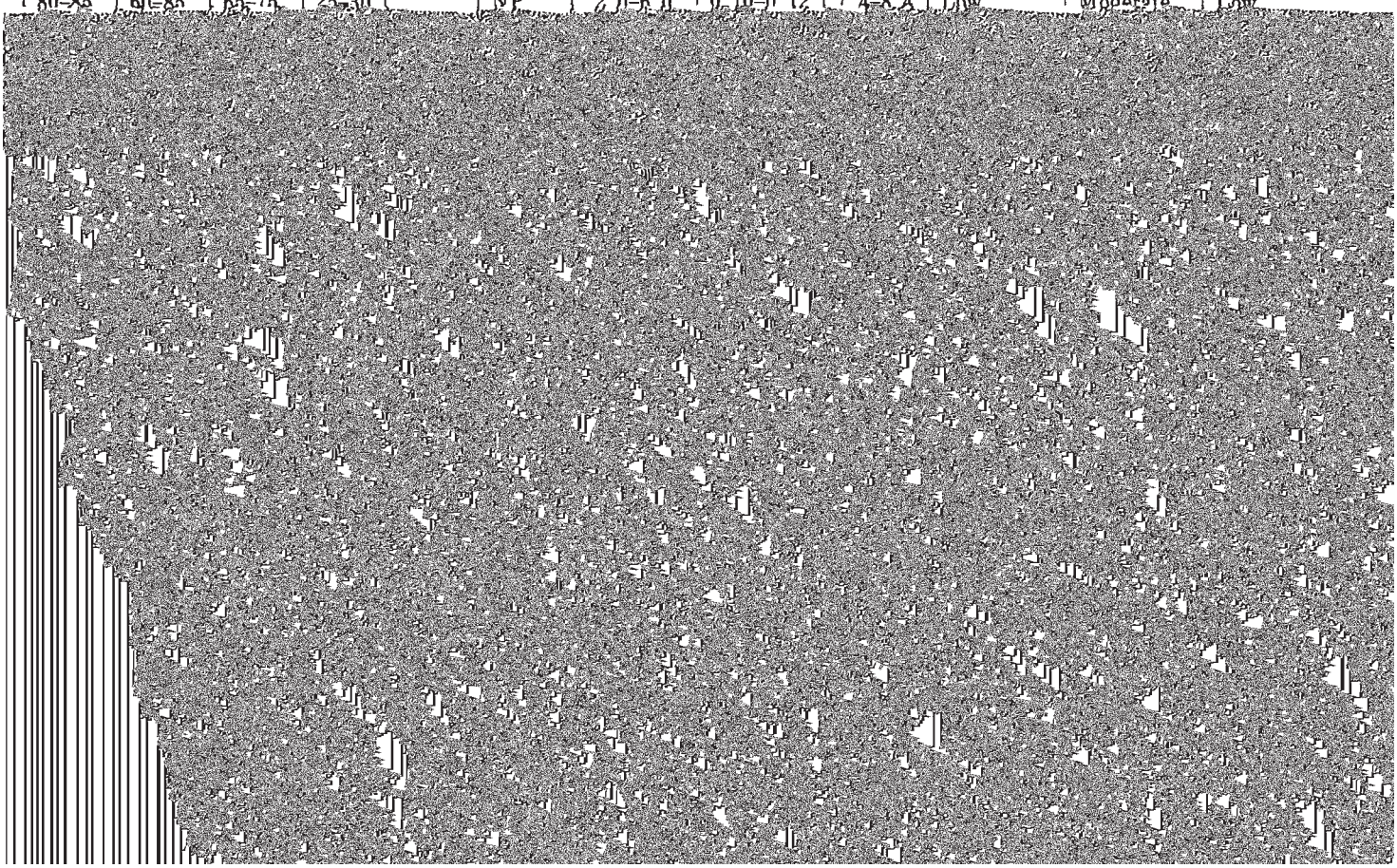


TABLE 9.—*Estimates of soil properties*

Soils series and map symbols	Depth to seasonal high water table	Hydrologic group	Depth from surface	USDA texture	Classification		Coarse fragments greater than 3 inches
					Unified	AASHTO	
	Ft		*In*				*Pct*
Kibbie: KuA	[2] 1–3	B	0–8	Silt loam	ML	A–4	0
			8–18	Clay loam	CL	A–6	0
			18–60	Silt, very fine sand, and silt loam.	ML	A–4	0
Knowles	>5	B	0–8	Silt loam	CL–ML or CL	A–4	0
Mapped only with Hochheim soils.			8–26	Silty clay loam and clay loam.	CL	A–6 or A–7	0
			26–60	Dolomite.			
Lamartine: LmA	1–3	B	0–14	Silt loam	CL or CL–ML	A–4	0
			14–28	Clay loam and silty clay loam.	CL	A–6	0–5
			28–60	Gravelly sandy loam	SM	A–2 or A–4	5–10
Loamy land, seeped: Lo	0–1						
Too variable to be rated.							
Made land: Ma.							
Too variable to be rated.							
Manawa: MbA	[2] 1–3	C	0–8	Silt loam	CL or CL–ML	A–4	0
			8–18	Clay	CL	A–7	0
			18–60	Silty clay loam	CL	A–6	0
Marsh: Mf	[2] 0–1						
Too variable to be rated for most items.							
Martinton: MgA	[2] 1–3	B	0–10	Silt loam	ML	A–4	0
			10–36	Silty clay	CH	A–7	0
			36–60	Silt loam and silty clay loam.	CL	A–6	0
Matherton: MkA	[2] 1–3	B	0–16	Silt loam	CL or CL–ML	A–4	0
			16–29	Clay loam and silty clay loam.	CL	A–6	0–5
			29–60	Sand and gravel	SP	A–1 or A–3	5–10
Montgomery: Mo	0–1	D	0–12	Silty clay loam	CL	A–7	0
			12–25	Silty clay	CH	A–7	0
			25–60	Silt, clay, and very fine sand.	CL	A–7	0
Mosel: MsA	1–3	C	0–9	Loam	ML	A–4	0
			9–26	Clay loam	CL–ML or CL	A–4	0
			26–60	Silty clay loam	CL	A–7	0
Muskego: Mz	[2] 0–1	D	0–40	Muck	Pt	----------	--------
			40–60	Coprogenous material	OH	----------	--------
Navan: Na	[2] 0–1	D	0–11	Loam	ML	A–4	0
			11–30	Sandy clay loam and loam.	CL, ML, SM or SC	A–6 or A–2	0
			30–36	Silty clay loam	CL	A–6 or A–7	0
			36–60	Silt and clay	CL	A–7	0
Nenno: NnA, NnB	[2] 1–3	B	0–8	Silt loam	CL or CL–ML	A–4	0
			8–20	Clay loam and loam	CL	A–6 or A–7	0
			20–60	Gravelly loam	ML	A–4	5–15
Oakville: OaB, OaC	3–>5	A	0–12	Loamy fine sand	SM	A–2	0
			12–60	Sand and fine sand	SM or SP–SM	A–2	0

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In/hr*	*In/in of soil*	*pH*			
100	100	90–100	70–90	20–40	5–8	0.6–2.0	0.22–0.24	6.6–7.8	Low	High	Low.
100	100	90–100	70–80	30–35	15–20	0.6–2.0	0.15–0.19	6.6–7.8	Low	High	Low.

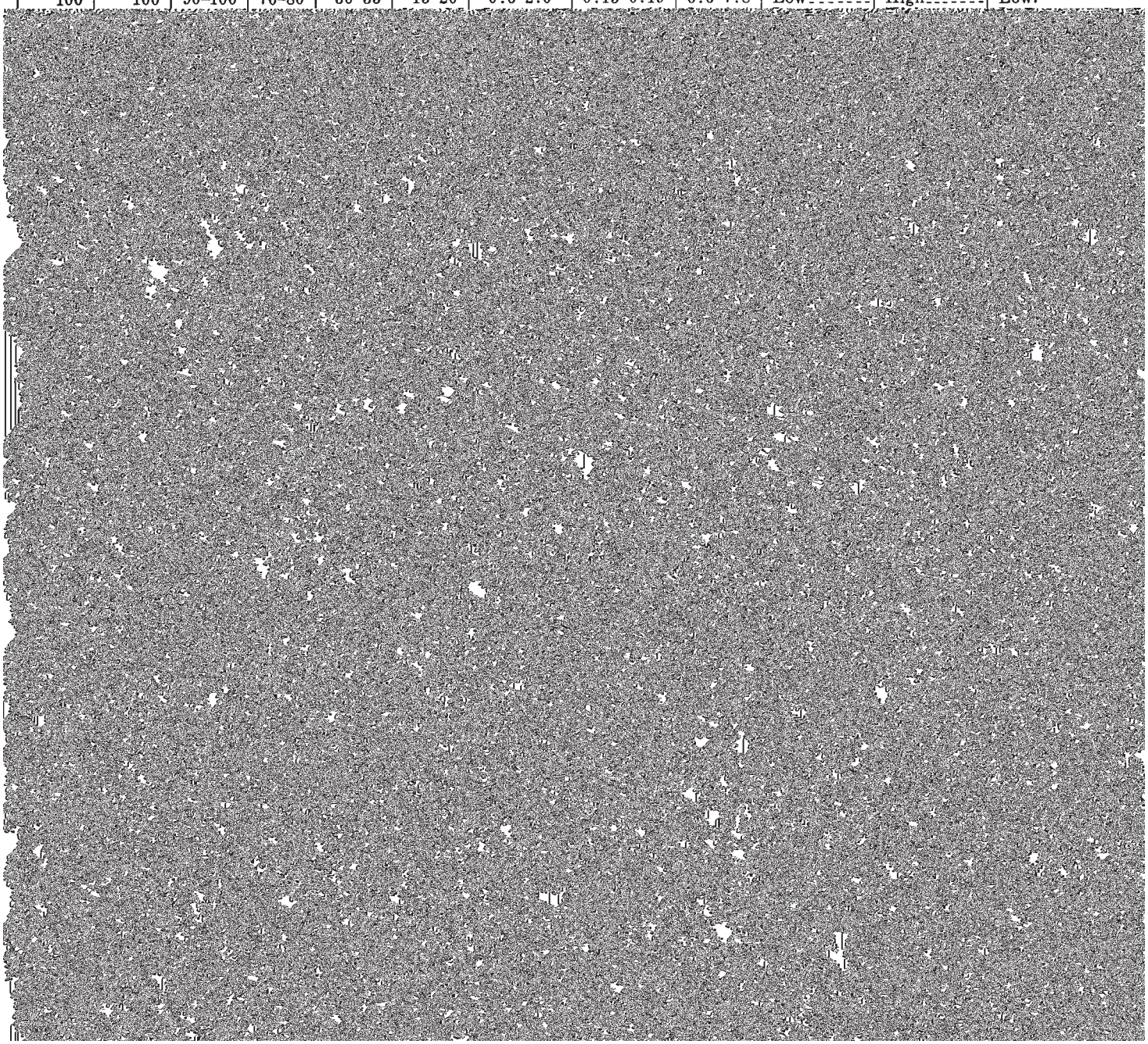


TABLE 9.—*Estimates of soil properties*

Soils series and map symbols	Depth to seasonal high water table	Hydrologic group	Depth from surface	USDA texture	Classification		Coarse fragments greater than 3 inches
					Unified	AASHTO	
	Ft		*In*				*Pct*
Otter: Ot	[2] 0–1	B/D	0–16	Silt loam	CL	A–6	0
			16–36	Silty clay loam and silt loam.	CL	A–6	0
			36–60	Silt loam	CL	A–6	0
Palms: Pa	[2] 0–1	A/D	0–36	Muck	Pt		
			36–60	Silt loam	CL or CL–ML	A–4 or A–6	0
Pella: Ph	[2] 0–1	B/D	0–16	Silt loam	ML	A–4	0
			16–35	Silty clay loam	CL	A–6	0
			35–60	Silt loam	ML	A–4	0
Poygan: Py	[2] 0–1	D	0–11	Silty clay loam	CL or CH	A–7	0
			11–24	Silty clay loam	CL or CH	A–7	0
			24–60	Silty clay	CL	A–6 or A–7	0
Rodman	>5	A	0–9	Gravelly sandy loam	SM	A–2 or A–4	0–10
			9–60	Gravel and sand	SP, SP–SM, SW, SW–SM, GP, GW, GP–GM, GW–GM	A–1	5–15
Mapped only with Casco soil.							
Rough broken land: Ry	>5						
Too variable to be rated for most items.							
St. Charles: ScA, ScB	3–>5	B	0–15	Silt loam	ML	A–4	0
			15–42	Silty clay loam and silt loam.	CL	A–6	0
			42–54	Loam	ML	A–4	0
			54–60	Silt loam and loam	CL or CL–ML	A–4	0–5
Saylesville: ShA, ShB, SkC2	3–>5	C	0–7	Silt loam	CL or CL–ML	A–4	0
			7–29	Silty clay loam and silty clay.	CH	A–7	0
			29–60	Silt loam and silty clay loam.	CL	A–6	0
Sebewa: Sm	[2] 0–1	B/D	0–10	Silt loam	ML	A–4	0
			10–20	Silty clay loam	CL	A–6	0
			20–33	Gravelly clay loam	CL	A–6	0–5
			33–60	Sand and gravel	SP–SM	A–1	10–20
Sisson: SrA, SrB, SrC2	>5	B	0–10	Very fine sandy loam	CL or CL–ML	A–4	0
			10–23	Clay loam	CL	A–6	0
			23–60	Silt and very fine sand	ML or CL–ML	A–4	0
Stony land, wet: Sw	0–1						
Too variable to be rated for most items.							
Theresa: ThA, ThB, ThC2	>5	B	0–11	Silt loam	CL or CL–ML	A–4	0
			11–30	Silty clay loam and clay loam.	CL	A–7	0
			30–35	Gravelly clay loam	CL	A–6 or A–7	0–5
			35–60	Gravelly sandy loam	SM	A–2 or A–4	5–10
Wasepi: Wa	[2] 1–3	B	0–14	Sandy loam	SM	A–2	0
			14–29	Sandy loam and loamy sand.	SM or SC	A–2	0–5
			29–60	Sand and fine sand	SP–SM	A–2 or A–3	0–5
Waymor: WbA, WbB, WbC2	>5	B	0–9	Silt loam	CL or CL–ML	A–4	0
			9–31	Silty clay loam and clay loam.	CL	A–6 or A–7	0–5
			31–60	Loam	CL or CL–ML	A–4	0–10

See footnotes at end of table.

significant in engineering—Continued

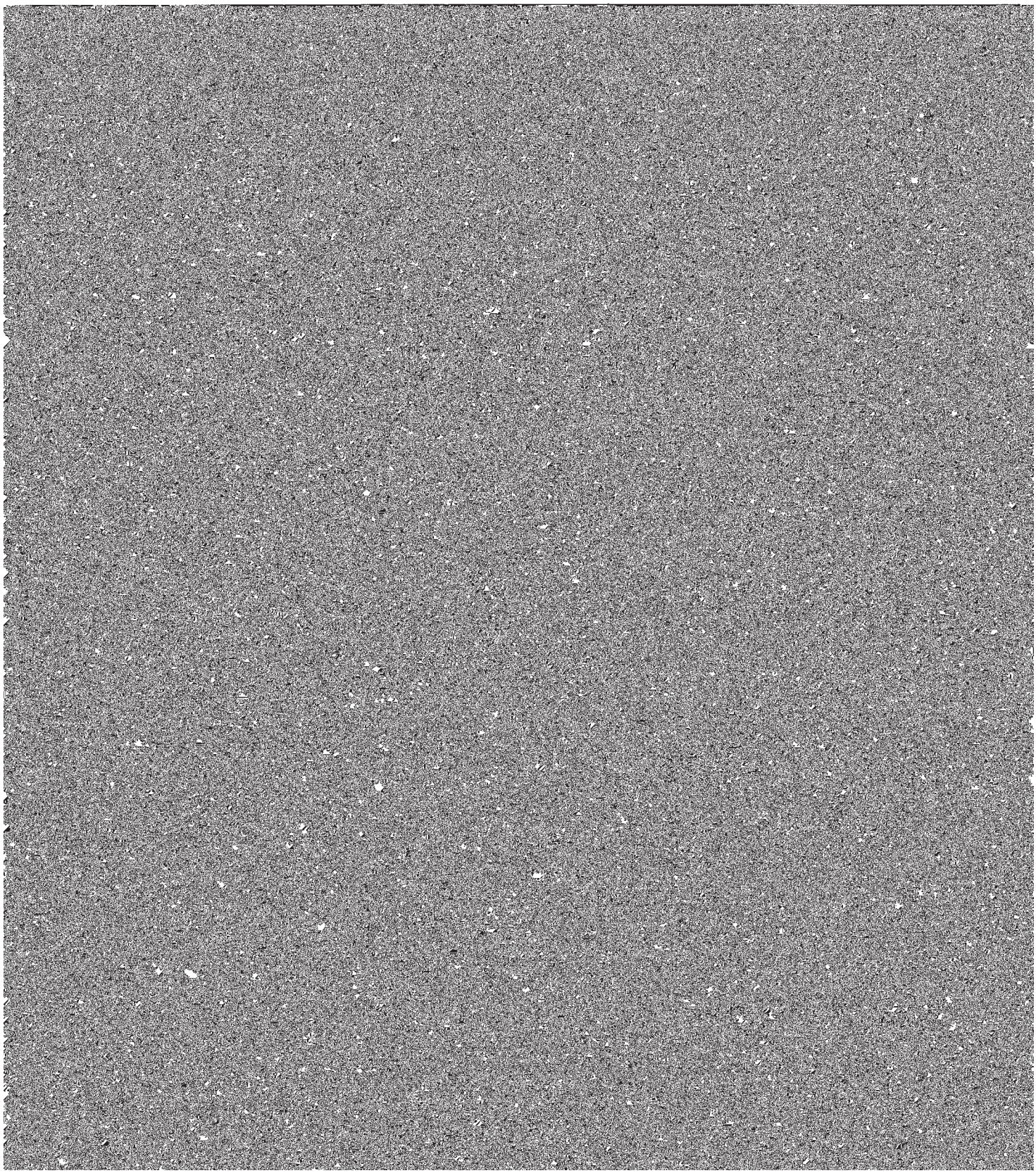


TABLE 9.—*Estimates of soil properties*

Soils series and map symbols	Depth to seasonal high water table	Hydrologic group	Depth from surface	USDA texture	Classification		Coarse fragments greater than 3 inches
					Unified	AASHTO	
	Ft		*In*				*Pct*
Willette: We	[2] 0–1	A/D	0–24	Muck	Pt		
			24–29	Coprogenous material	Pt		
			29–60	Silty clay	CL	A–7	0
Yahara: YhA	1–3	B	0–14	Very fine sandy loam	ML	A–4	0

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*In/hr*	*In/in of soil*	*pH*			
						2.0–6.0	0.35–0.45	6.1–7.8		High	Low to moderate.
						0.6–0.2	0.25–0.35	7.4–7.8	High	High	Low.
100	100	90–100	85–90	45–50	25–30	0.06–0.2	0.10–0.12	7.4–8.4	High	High	Low.
100	100	85–95	50–65	<30	NP–5	0.6–2.0	0.20–0.22	7.4–7.8	Low	High	Low.
100	100	85–95	40–80	<30	NP–5	0.6–2.0	0.18–0.20	7.4–8.4	Low	High	Low.
100	100	85–95	75–85	30–35	5–8	0.6–2.0	0.22–0.24	6.1–7.8	Low	Low	Low.
100	100	85–95	80–85	41–45	20–25	0.6–2.0	0.18–0.20	6.1–7.8	Low	Low	Low.
100	100	85–95	75–80		NP	0.6–2.0	0.18–0.20	7.4–8.4	Low	Moderate	Low.

[2] Soils are subject to flooding, ponding, or occasional overflow of short duration.
[3] NP means nonplastic.

suitability of the soils for all listed purposes except ponds and reservoirs, embankments, drainage for crops and pasture, terraces and diversions, and grassed waterways. For these particular uses, table 10 lists those soil features not to be overlooked in planning, installation, and maintenance.

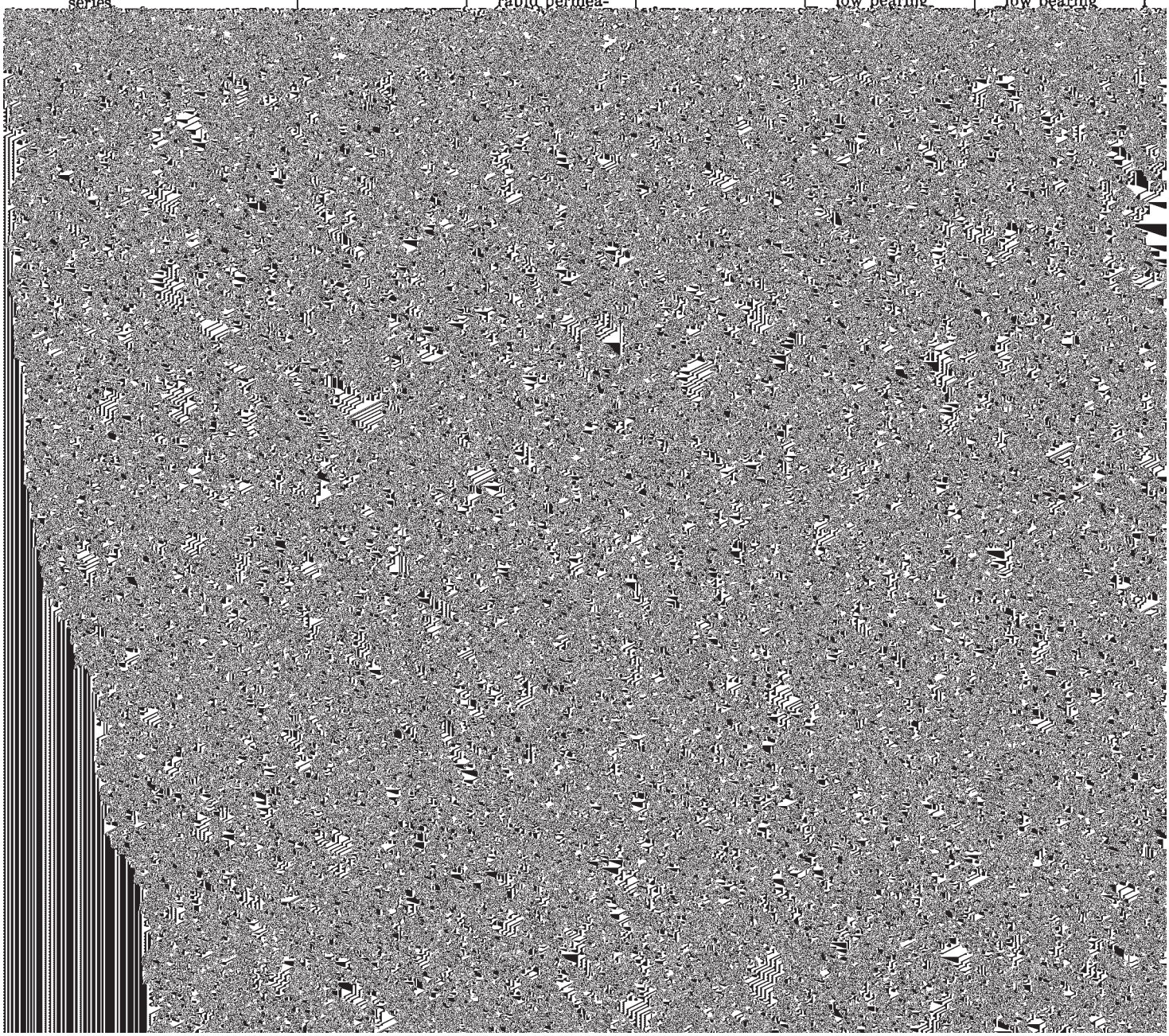
Soil limitations are expressed as slight, moderate, and severe. *Slight* means that soil properties are generally favorable for the rated use, or limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are unfavorable, and difficult

for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. It is assumed that the embankment is compacted to medium density and the pond is protected from flooding. Properties that affect the pond floor and the embankment are considered. Those that affect the pond floor are permeability, organic matter, and slope. If the floor needs to be leveled, depth to bedrock is important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the content of stones, if any, that influences the ease of excavation and compaction of the

TABLE 10.—*Engineering*

[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. Because the other series that appear in

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
*Adrian: Ag, Ak For Granby part of Ak, see Granby series; for Oakville part of Ak, see Oakville series	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; rapid permea-	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; low bearing	Very severe: high water table; subject to frequent flooding; low bearing



interpretations

soils in such mapping units can have different properties and limitations, it is necessary to follow carefully the instructions for referring to the first column of this table]

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Poor: high water table; high compressibility; low bearing capacity.	Unsuited: high water table; poorly graded sand substratum.	Poor: oxidizes rapidly; high water table.	High water table; rapid permeability in substratum.	Organic material not suitable; poor stability in substratum; piping hazard.	High water table; moderately rapid and rapid permeability; poor stability in substratum.	Slopes of 0 to 2 percent; very poorly drained; organic material.
Poor: moderate frost action potential; low shear strength in most places.	Unsuited: fines	Fair or poor: sandy to loamy; variable texture.	Soil material variable; subject to flooding.	Soil material variable; piping hazard; low to medium shear strength; medium to high permeability of compacted material.	Subject to flooding.	Slopes of 0 to 2 percent; well and moderately well drained; subject to frequent flooding.
Poor: seasonal high water table; high frost action potential.	Unsuited: fines	Poor: seasonal high water table.	Soil material variable; seasonal high water table; subject to frequent flooding.	Soil material variable; low to medium shear strength; medium to high permeability of compacted material; piping hazard.	Seasonal high water table; subject to frequent flooding.	Slopes of 0 to 2 percent; poorly or very poorly drained; subject to frequent flooding.
Poor: seasonal high water table.	Poor: seasonal high water table.	Poor: seasonal high water table.	Seasonal high water table; moderate permeability.	Seasonal high water table; fair to good stability and compaction; medium shear strength; stones.	Seasonal high water table; moderate permeability; subject to flooding or ponding.	Slopes of 0 to 2 percent poorly drained; calcareous till at a depth of 24 to 40 inches; stones.
Fair: seasonal high water table.	Sand: good Gravel: unsuited; fines.	Poor; sandy	Very rapid permeability; seasonal high water table.	Medium shear strength; medium permeability of compacted soil; piping hazard.	Seasonal high water table; very rapid permeability.	Slopes of 2 to 6 percent; sandy; difficult to vegetate; subject to soil blowing.
Fair: medium to low shear strength.	Unsuited: fines	Good	Moderate permeability; seasonal high water table in some places.	Medium to low shear strength; piping hazard.	Not needed	Slopes of 0 to 2 percent; subject to occasional flooding; well drained and moderately well drained.
Fair: medium shear strength.	Fair for sand: excess fines. Unsuited for gravel: fines.	Good	Moderately rapid permeability.	Medium shear strength; piping hazard.	Not needed	Slopes of 0 to 2 percent; subject to occasional flooding; well drained and moderately well drained.

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Boots: Bk	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; organic material.	Very severe: high water table; subject to frequent flooding; organic material.	Very severe: high water table; subject to frequent flooding; moderately rapid permeability.	Very severe: high water table; susceptible to frost action; organic material.
Boyer: BmB, BmC2	Slight if slope is 2 to 6 percent, moderate if 6 to 12.[1]	Severe: very rapid permeability in substratum.[1]	Slight if slope is 2 to 6 percent, moderate if 6 to 12.	Severe: very rapid permeability in substratum.[1]	Slight if slope is 2 to 6 percent, moderate if 6 to 12.
*Casco: CeA, CeB, CeC2, CrC, CrD2, CrE, CrF.	Slight if slope is 0 to 6 percent,	Severe: very rapid permea-	Slight if slope is 0 to 6 percent,	Severe: very rapid permea-	Slight if slope is 0 to 6 percent,

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Elvers: Ev	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding; high frost action potential.
Fabius: FaA	Severe: seasonal high water table.	Severe: seasonal high water table; moderately rapid permeability in substratum.	Severe: seasonal high water table.	Severe: seasonal high water table; moderately rapid permeability in substratum.	Moderate: seasonal high water table; moderate frost action potential.
Fox: FsA, FsB, FsC2	Slight if slope is 0 to 6 percent, moderate if 6 to 12.[1]	Severe: very rapid permeability in substratum.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12.	Severe: very rapid permeability in substratum; danger of ground water contamination.[1]	Moderate: moderate shrink-swell potential; moderate frost action potential.
Granby: Gb	Severe: high water table; subject to occasional flooding; rapid permeability.	Severe: high water table; subject to occasional flooding; rapid permeability.	Severe: high water table; subject to occasional flooding.	Severe: high water table; rapid permeability; subject to occasional flooding.	Severe: high water table; subject to occasional flooding.
Granby variant: Gg	Severe: high water table; subject to occasional flooding; very rapid permeability in substratum.	Severe: high water table; very rapid permeability in substratum; subject to occasional flooding.	Severe: high water table; subject to occasional flooding.	Severe: high water table; very rapid permeability in substratum.	Severe: high water table; subject to occasional flooding.
Gravel pit: Gp	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.[1]	Severe: very rapid permeability.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.	Severe: very rapid permeability.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12, severe if more than 12.
Hebron: HeA, HeB	Severe: moderately slow permeability in substratum.	Slight if slope is 0 to 2 percent, moderate if 2 to 6; seasonal high water table in places.	Moderate: moderate shrink-swell potential; moderate frost action potential; seasonal high water table in places.	Moderate: difficult to work when wet; seasonal high water table in places.	Severe: low shear strength; seasonal high water table in places.

See footnote at end of table.

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Poor: high water table; low bearing capacity; organic material in lower part; high frost action potential.	Unsuited: fines.	Poor: high water table.	Moderately rapid permeability in organic material; high water table.	Organic material; unstable; low shear strength.	High water table; moderately rapid permeability in organic material; banks unstable.	Slopes of 0 to 2 percent; poorly drained; organic material in lower part.
Fair: seasonal high water table.	Fair for sand: high content of gravel. Good for gravel.	Fair: thin layer.	Moderate permeability in subsoil; moderately rapid permeability in substratum; seasonal high water table.	High shear strength; high permeability in compacted subsoil material.	Somewhat poorly drained; moderately rapid permeability; seasonal high water table.	Slopes of 0 to 3 percent; somewhat poorly drained; sand and gravel at a depth of 12 to 20 inches.
Fair for subsoil: moderate strength; moderate frost action potential. Good for substratum.	Fair for sand: high content of gravel. Fair for gravel: high content of sand.	Fair: thin layer.	Very rapid permeability in substratum.	Medium shear strength and compressibility in subsoil; high shear strength and low compressibility in substratum; high permeability in compacted substratum material.	Not needed.	Slopes of 0 to 12 percent; sand and gravel at a depth of 24 to 40 inches; stones.
Poor: high water table.	Good for sand: high water table. Unsuitable for gravel: fines.	Poor: too sandy; high water table.	Rapid permeability; high water table.	Medium shear strength; high permeability in compacted material; piping hazard.	High water table; rapid permeability; subject to occasional flooding.	Slopes of 0 to 2 percent; poorly drained or very poorly drained; sandy; subject to occasional flooding.
Poor: high water table.	Fair for sand and gravel: well graded to poorly graded sand and gravel; high water table.	Poor: high water table.	Very rapid permeability in substratum; high water table.	Medium shear strength; high permeability in compacted material; piping hazard.	High water table; moderately rapid permeability in subsoil; very rapid permeability in substratum.	Slopes of 0 to 2 percent; poorly drained; sandy; subject to occasional flooding.
Good if slope is 0 to 12 percent, fair if 12 to 20, poor if more than 20.	Good for sand and gravel.	Poor: gravelly.	Very rapid permeability.	Good stability; pervious; high permeability in compacted material.	Not needed.	Not applicable.
Poor: low shear strength.	Unsuited: fines.	Fair: thin layer.	Moderately slow permeability in substratum.	Medium shear strength and compressibility.	Not needed.	Slopes of 0 to 6 percent; moderately slow permeability in substratum.

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Hebron variant: HfA, HfB	Severe: moderately slow permeability in substratum.	Slight if slope is 0 to 2 percent, moderate if 2 to 6; seasonal high water table in places.	Moderate: moderate shrink-swell potential; moderate frost action potential; seasonal high water table in places.	Moderate: difficult to work when wet; seasonal high water table in places.	Moderate: moderate shrink-swell potential; seasonal high water table in places.
*Hochheim: HmB2, HmC2, HmD2, HmE, HsC2, HsD2, HsE, HtB. For Casco part of HsC2, HsD2, and HsE, see Casco series; for Sisson part of HsC2, HsD2, and HsE, see Sisson series; for Knowles part of HtB, see Knowles series.	Slight if slope is 1 to 6 percent, moderate if 6 to 12, severe if more than 12.	Moderate if slope is 1 to 6 percent, severe if more than 6; moderate permeability.	Slight if slope is 1 to 6 percent, moderate if 6 to 12, severe if more than 12.	Slight if slope is 1 to 12 percent, moderate if 12 to 20, severe if more than 20.	Moderate if slope is 1 to 12 percent, severe if more than 12; moderate frost action potential.
Houghton: Hu	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; moderately rapid permeability.	Very severe: high water table; subject to frequent flooding; high frost action potential.	Very severe: high water table; subject to frequent flooding; moderately rapid permeability.	Very severe: high water table; subject to frequent flooding; low strength; high frost action potential.
Juneau: JuA	Severe: subject to frequent flooding of short duration.	Moderate: subject to frequent flooding of short duration; seasonal high water table in places.	Severe: subject to frequent flooding of short duration; high frost action potential.	Severe: subject to frequent flooding of short duration; seasonal high water table in places.	Severe: subject to frequent flooding of short duration; high frost action potential.
Kendall: KlA	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding; high frost action potential.	Severe: seasonal high water table; subject to occasional flooding.	Severe: subject to occasional flooding; high frost action potential.
Kewaunee: KnA, KnB, KpB2, KpC2, KpD2, KsC3, KsD3.	Severe: moderately slow permeability.	Slight if slope is 0 to 2 percent, moderate if 2 to 6, severe if more than 6.	Moderate: clayey subsoil; moderate shrink-swell potential; seasonal high water table in places.	Severe: clayey subsoil; difficult to work; seasonal high water table in places.	Severe: clayey subsoil; difficult to work; low strength.
Kibbie: KuA	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: high frost action potential; subject to occasional flooding.

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Poor: low shear strength in substratum.	Unsuited: fines.	Fair: thin layer.	Moderately slow permeability in substratum.	Medium shear strength and compressibility.	Not needed.	Slopes of 0 to 6 percent; moderately slow permeability in substratum.
Good if slope is 1 to 12 percent, moderate if 12 to 20, severe if more than 20.	Unsuited: fines; can be underlain in places at a depth of 6 to more than 12 feet by stratified sand and gravel.	Fair: thin layer; gravelly or cobbly in places.	Moderate permeability; slopes generally prohibitive.	Medium shear strength; good compaction characteristics; piping hazard.	Not needed.	Slopes of 1 to 30 percent; complex slopes; calcareous till at a depth of 12 to 24 inches; stones.
Poor: high water table; organic material; high frost action potential.	Unsuited: organic material.	Poor: oxidizes rapidly; high water table.	High water table; moderately rapid permeability.	Low shear strength; high compressibility; hard to pack.	High water table; moderately rapid permeability; subject to frequent flooding.	Slopes of 0 to 2 percent; very poorly drained; organic material.
Poor: low shear strength; high frost action potential.	Unsuited: fines.	Good.	Moderate permeability; flooding for short periods.	Low shear strength; piping hazard.	Not needed.	Slopes of 0 to 3 percent; flooded for short periods; piping hazard.
Poor: medium to low shear strength; high frost action potential	Unsuited: fines.	Fair: thin layer.	Moderate permeability; seasonal high water table.	Medium to low shear strength; medium compressibility.	Seasonal high water table; moderate permeability.	Slopes of 0 to 3 percent; moderate permeability; somewhat poorly drained; subject to occasional flooding.
Poor: low shear strength.	Unsuited: fines; some small areas are underlain by sand and gravel at a depth of more	Fair for silt loam on slopes of 0 to 12 percent; thin layer; poor on steeper slopes. Poor for silty clay	Moderately slow permeability; clayey subsoil.	Low shear strength; medium compressibility; moderate shrink-swell potential.	Not needed.	Slopes of 0 to 20 percent; clayey subsoil; moderately slow permeability.

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Knowles Mapped only with Hochheim soils.	Severe: fractured dolomite bedrock at a depth of 20 to 40 inches.[1]	Severe: fractured dolomite bedrock at a depth of 20 to 40 inches.[1]	Severe: dolomite bedrock near the surface.	Severe: fractured dolomite bedrock at a depth of 20 to 40 inches.[1]	Moderate: shallow to bedrock; low strength; moderate frost action potential.
Lamartine: LmA	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; high frost action potential; subject to occasional flooding.
Loamy land, seeped: Lo	Severe: high water table.	Severe: high water table.	Severe: high water table; high frost action potential.	Severe: high water table.	Severe: high water table; organic portions have low strength; high frost action potential.
Made land: Ma	Severe: nonsoil material.	Severe: nonsoil material.	Severe: nonsoil material.	Severe: nonsoil material.	Severe: nonsoil material.
Manawa: MbA	Severe: seasonally perched water table; subject to occasional flooding; slow permeability.	Severe: seasonally perched water table; subject to occasional flooding.	Severe: seasonally perched water table; subject to occasional flooding.	Severe: seasonally perched water table; subject to occasional flooding; clayey subsoil.	Severe: low shear strength; subject to occasional flooding.
Marsh: Mf	Very severe: flooded most of the year.	Very severe: flooded most of the year.	Very severe: flooded most of the year.	Very severe: flooded most of the year.	Very severe: flooded most of the year.
Martinton: MgA	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: subject to occasional flooding; clayey subsoil.	Severe: high frost action potential; low shear strength; subject to occasional flooding.
Matherton: MkA	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding; rapid permeability in substratum.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding; rapid permeability in substratum.	Severe: subject to occasional flooding; high frost action potential.
Montgomery: Mo	Severe: high water table; slow permeability; subject to flooding.	Severe: high water table.	Severe: high water table; subject to flooding; low shear strength; high shrink-swell potential.	Severe: high water table; subject to flooding; clayey subsoil.	Severe: very poorly drained; subject to flooding; low shear strength; high shrink-swell potential.

See footnote at end of table.

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Moderate: moderate frost action potential; moderate strength; moderate shrink-swell potential.	Unsuited: fines.	Fair: thin layer.	Fractured dolomite bedrock at a depth of 20 to 40 inches; moderate permeability.	Medium to low shear strength; piping hazard; dolomite bedrock at a depth of 20 to 40 inches.	Not needed.	Slopes of 1 to 6 percent; dolomite at a depth of 20 to 40 inches.
Poor: low shear strength; high frost action potential.	Unsuited: fines.	Good.	Moderate permeability; seasonal high water table.	Low shear strength; moderate shrink-swell potential; piping hazard.	Seasonal high water table; moderate permeability.	Slopes of 0 to 3 percent; somewhat poorly drained; piping hazard.
Poor: high water table; high frost action potential.	Unsuited: fines.	Poor: high water table; variable material.	Variable material; many springs.	Variable material; organic portions have low strength.	High water table; many springs.	Slopes of 2 to 20 percent; poorly drained; seepage areas.
Poor: nonsoil material.	Unsuited: nonsoil material or oily sand.	Poor: nonsoil material.	Nonsoil material.	Nonsoil material.	Not needed.	Nonsoil material.
Poor: low shear strength.	Unsuited: fines.	Fair: thin layer.	Slow permeability; seasonal high water table.	Low shear strength; medium compressibility; moderate shrink-swell potential.	Seasonal perched water table; slow permeability.	Slopes of 0 to 3 percent; somewhat poorly drained; clayey subsoil; slow permeability.
Very severe: flooded most of the year.	Unsuited: fines.	Poor: flooded most of the year.	Flooded most of the year.	Variable characteristics; flooded most of the year.	Not feasible; outlets generally not available; flooded most of the year.	Slopes of 0 to 2 percent; very poorly drained.
Poor: high frost action potential; low shear strength.	Unsuited: fines.	Fair: thin layer.	Moderately slow permeability; seasonal high water table.	Low shear strength; medium compressibility; moderate shrink-swell potential.	Moderately slow permeability; seasonal high water table; subject to occasional flooding.	Slopes of 0 to 3 percent; somewhat poorly drained; subject to occasional flooding.
Poor: high frost action potential.	Fair for sand; high content of gravel. Good for gravel.	Fair: thin layer.	Rapid permeability in substratum; seasonal high water table.	Medium shear strength and compressibility; medium to high permeability in compacted material.	Moderate permeability in subsoil; rapid permeability in substratum; seasonal high water table; subject to occasional flooding.	Slopes of 0 to 3 percent; somewhat poorly drained; subject to flooding.
Poor: very poorly drained; high shrink-swell potential; low shear strength.	Unsuited: fines.	Poor: very poorly drained; thin layer.	Slow permeability; seasonal high water table.	Low shear strength; high shrink-swell potential.	Slow permeability; seasonal high water table; subject to flooding.	Slopes of 0 to 2 percent; very poorly drained; subject to flooding; clayey subsoil.

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Mosel: MsA	Severe: seasonal high water table; moderately slow permeability in substratum.	Severe: seasonal high water table.	Severe: seasonal high water table; subject to rare flooding; high frost action potential.	Severe: seasonal high water table.	Severe: high frost action potential.
Muskego: Mz	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; high frost action potential.	Very severe: high water table; subject to frequent flooding.	Very severe: high water table; subject to frequent flooding; high compressi bility; high frost action potential.
Navan: Na	Severe: high water table; subject to flooding; slow permeability in substratum.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding; high frost action potential; low shear strength.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding; high frost action potential.
Nenno: NnA, NnB	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: seasonal high water table; subject to occasional flooding.	Severe: high frost action potential; subject to occasional flooding.
Oakville: OaB, OaC	Slight if slope is 0 to 6 percent, moderate if 6 to 12; very rapid permeability; seasonal high water table in places.[1]	Severe: very rapid permeability.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12; seasonal high water table in places.	Severe: very rapid permeability.[1]	Slight if slope is 0 to 6 percent, moderate if 6 to 12.
Otter: Ot	Severe: high water table; subject to frequent flooding.	Severe: high water table; subject to frequent flooding.	Severe: high water table; subject to frequent flooding; high frost action potential.	Severe: high water table; subject to frequent flooding; high frost action potential.	Severe: high water table; high frost action potential; subject to frequent flooding.
Palms: Pa	Very severe: high water table;	Very severe: high water table;	Very severe: high water table;	Very severe: high water table;	Very severe: high water table;

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Poor: low shear strength; high frost action potential.	Unsuited: fines..	Fair: thin layer.	Moderately slow permeability in substratum; seasonal high water table.	Medium to low shear strength; fair to good compaction characteristics;	Seasonal high water table; moderate permeability in subsoil;	Slopes of 0 to 3 percent; somewhat poorly drained; moderately slow

TABLE 10.—*Engineering*

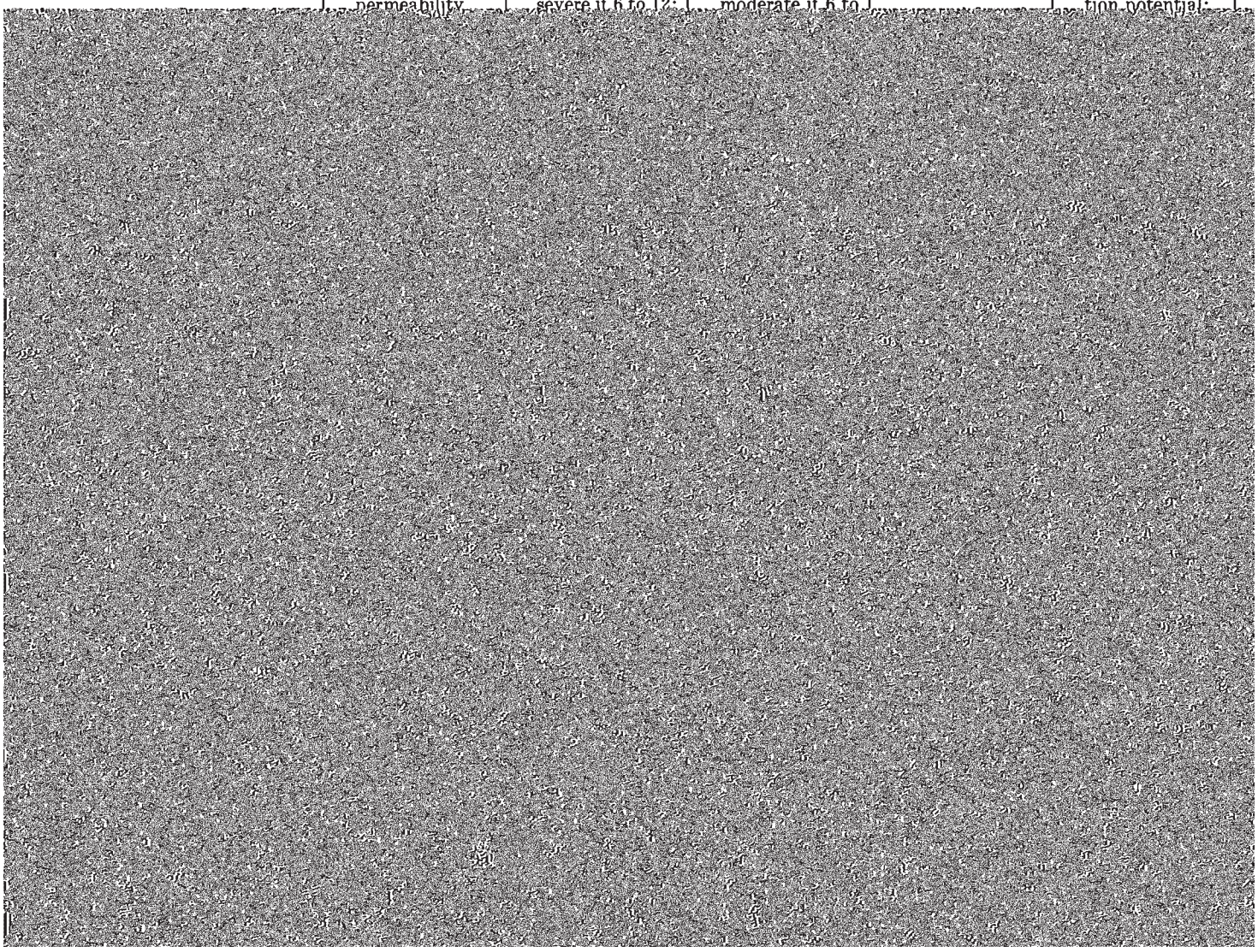
Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Pella: Ph	Severe: high water table; subject to flooding.	Severe: high water table.	Severe: high water table; subject to flooding; high frost action potential.	Severe: high water table; subject to flooding.	Severe: high water table; subject to flooding; high frost action potential; low shear strength.
Poygan: Py	Severe: high water table; subject to frequent flooding; slow permeability.	Severe: high water table; subject to frequent flooding.	Severe: high water table; subject to frequent flooding; high frost action potential.	Severe: high water table; subject to frequent flooding; clayey subsoil.	Severe: high water table; subject to frequent flooding; high frost action potential; low shear strength.
Rodman Mapped only with Casco soils.	Moderate if slope is 6 to 12 percent, severe if more than 12	Severe: very rapid permeability in substratum; slope	Moderate if slope is 6 to 12 percent, severe if more than 12	Severe: very rapid permeability in substratum	Moderate if slope is 6 to 12 percent, severe if more than 12

interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions

TABLE 10.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Dwellings with basements	Sanitary landfill (trench type)	Local roads and streets
Theresa: ThA, ThB, ThC2	Slight if slope is 0 to 6 percent, moderate if 6 to 12; moderate permeability.	Moderate if slope is 0 to 6 percent, severe if more than 6; moderate permeability.	Slight if slope is 0 to 6 percent, moderate if 6 to 12.	Slight: moderate permeability.	Severe: low shear strength.
Wasepi: Wa	Severe: seasonal high water table.	Severe: seasonal high water table; rapid permeability in substratum.	Severe: seasonal high water table.	Severe: seasonal high water table; rapid permeability in substratum.	Severe: high frost action potential.
Waymor: WbA, WbB, WbC2	Moderate: lower end of moderate permeability	Moderate if slope is 0 to 6 percent, severe if 6 to 12;	Slight if slope is 0 to 6 percent, moderate if 6 to	Slight	Moderate: moderate frost action potential;



interpretations—Continued

Suitability as source of—			Soil features affecting—			
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Terraces and diversions
Fair: low shear strength in subsoil; moderate frost action potential; moderate shrink-swell potential.	Unsuited: fines.	Fair: thin layer.	Moderate permeability.	Low shear strength; piping hazard.	Not needed.	Slopes of 0 to 12 percent; complex slopes; calcareous till at a depth of 24 to 40 inches.
Poor: high frost action potential.	Good for sand in substratum. Unsuitable for gravel: fines.	Fair: thin layer.	Rapid permeability in substratum; seasonal high water table.	Medium shear strength: medium to high permeability of compacted material; pip-	Rapid permeability in substratum; seasonal high water table.	Slopes of 0 to 2 percent; somewhat poorly drained.

rial resistant to seepage and piping and with favorable stability, shrink-swell potential, shear strength, and compactibility. Stones and organic material in a soil are among factors that are unfavorable.

Drainage for crops and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; alkalinity; and availability of outlets for drainage.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Engineering test data

Table 11 contains engineering test data for some of the major soil series in Sheboygan County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limit and plastic limit. The

TABLE 11.—*Engineering*

[Tests were performed by Wisconsin Department of Transportation, Division of

Soil name and location	Parent material	Report number	Depth	Moisture density [1]	
				Maximum dry density	Optimum moisture
			In	*Lb/ft*	*Pct*
Boyer loamy sand:					
SE1/4SE1/4 sec. 11, T. 14 N., R. 22 E. (Modal profile)	Outwash sand and gravel.	571-WI-71-2-1	14-22	----------	----------
		571-WI-71-2-2	26-60	----------	----------
Colwood silt loam:					
SW1/4SW1/4 sec. 14, T. 13 N., R. 21 E. (Modal profile)	Lacustrine deposits	571-WI-71-6-1	11-27	----------	----------
		571-WI-71-6-2	40-60	----------	----------
Hochheim silt loam:					
SW1/4NW1/4 sec. 8, T. 15 N., R. 21 E. (Modal profile)	Glacial till (loamy)	569-WI-71-2-1	10-18	----------	----------
		569-WI-71-2-2	22-60	126.4	9.4
Kewaunee silt loam:					
NW1/4SE1/4 sec. 33, T. 15 N., R. 23 E. (subsoil contains slightly less clay than modal profile).	Glacial till (moderately fine textured).	569-WI-71-1-1	8-22	----------	----------
		569-WI-71-1-2	36-60	----------	----------
NW1/4NE1/4 sec. 13, T. 14 N., R. 21 E. (Modal profile)	Glacial till (moderately fine textured).	572-WI-71-2-1	13-24	----------	----------
		572-WI-71-2-2	34-60	----------	----------
Theresa silt loam:					
SE1/4SW1/4 sec. 26, T. 14 N., R. 20 E. (Modal profile)	Glacial till (loamy)	571-WI-71-1-1	20-30	----------	----------
		571-WI-71-1-2	34-60	134.7	8.2
NE1/4NE1/4 sec. 13, T. 16 N., R. 20 E. (Modal profile)	Glacial till (loamy)	572-WI-71-3-1	16-30	----------	----------
		572-WI-71-3-2	35-60	134.7	8.2
Waymor silt loam:					
SW1/4NW1/4 sec. 15 T. 13 N., R. 22 E. (Modal profile)	Glacial till (loamy)	571-WI-71-3-1	9-19	----------	----------
		571-WI-71-3-2	29-60	124.7	11.2
SW1/4NW1/4 sec. 8, T. 15 N., R. 23 E. (Modal profile)	Glacial till (loamy)	571-WI-71-4-1	9-21	----------	----------
		571-WI-71-4-2	31-60	123.5	11.4
Zurich silt loam:					
SE1/4SE1/4 sec. 31, T. 14 N., R. 21 E. (Modal profile)	Lacustrine deposits	569-WI-71-3-1	11-22	----------	----------
		569-WI-71-3-2	24-60	120.6	11.6

[1] Based on AASHTO Designation T 99-57, Method A (*1*).

[2] Mechanical analysis according to the AASHTO Designation T 88-57 (*1*). Results by this procedure may differ somewhat from the results obtained by the Soil Survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from the calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes of soil.

mechanical analyses were made by combined sieve and hydrometer methods.

Compaction, or moisture-density, data are important in earthwork. If a soil material is compacted at a successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 9.

Shrinkage limit is the percentage of moisture at which shrinkage of the soil material stops.

Shrinkage ratio is the relation of change in volume of the soil material to the water content of the soil material when at the shrinkage limit. The change in volume of the soil material, and the water content is expressed as a percentage of the weight of the soil material when ovendry.

Linear shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the given value to the shrinkage limit.

test data

Highways. Absence of an entry indicates that no determination was made]

Mechanical analysis [2]										Liquid limit [3]	Plasticity index [4]	Classification	
Percentage less than 3 inches passing sieve—							Percentage smaller than—						
1 inch	¾ inch	⅜ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm			AASHTO [5]	Unified [6]
										Pct			
				100	97	25	21	16	15		[1] NP	A-2-4(0)	SM
	100	97	85	65	49	9	6	2	1		NP	A-1-6(0)	SP-SM
					100	95	90	27	21	33.4	13.2	A-6(9)	CL
					100	74	53	11	8		NP	A-4(8)	ML
				100	96	83	80	42	35	44.2	24.6	A-7-6(15)	CL
88	86	85	84	75	67	34	28	6	5		NP	A-2-4(0)	SM
				100	97	83	82	56	44	49.1	30.0	A-7-6(18)	CL
				100	97	85	82	46	31	30.0	15.2	A-6(10)	CL
				100	97	81	79	56	47	57.2	35.9	A-7-6(19)	CH
100	99	98	97	95	92	74	69	38	30	39.1	21.6	A-6(12)	CL
			100	98	87	55	53	36	32	39.3	20.7	A-6(8)	CL
94	90	82	77	73	63	30	24	8	5		NP	A-2-4(0)	SM
			100	98	90	67	62	35	30	46.6	28.1	A-7-6(15)	CL
99	93	82	76	69	61	40	31	9	7		NP	A-4(1)	SM
				100	98	75	73	51	42	42.5	24.1	A-7-6(14)	CL
	100	98	96	93	89	71	66	29	21	24.8	10.3	A-4(7)	CL
				100	99	88	86	59	47	46.2	25.0	A-7-6(15)	CL
100	99	97	96	93	89	69	64	29	20	24.4	9.9	A-4(7)	CL
				100	96	81	78	38	32	45.2	24.8	A-7-6(15)	CL
						77	56	11	7		NP	A-4(8)	ML

[3] Based on AASHTO Designation T 89–60 (*1*).
[4] Based on AASHTO Designation T 90–56 and AASHTO Designation T 91–54 (*1*).
[5] Based on AASHTO Designation M 145–49 (*1*).
[6] Based on ASTM Standard Designation D 2487–69 (*2*).
[7] NP means nonplastic.

Formation and Classification of Soils

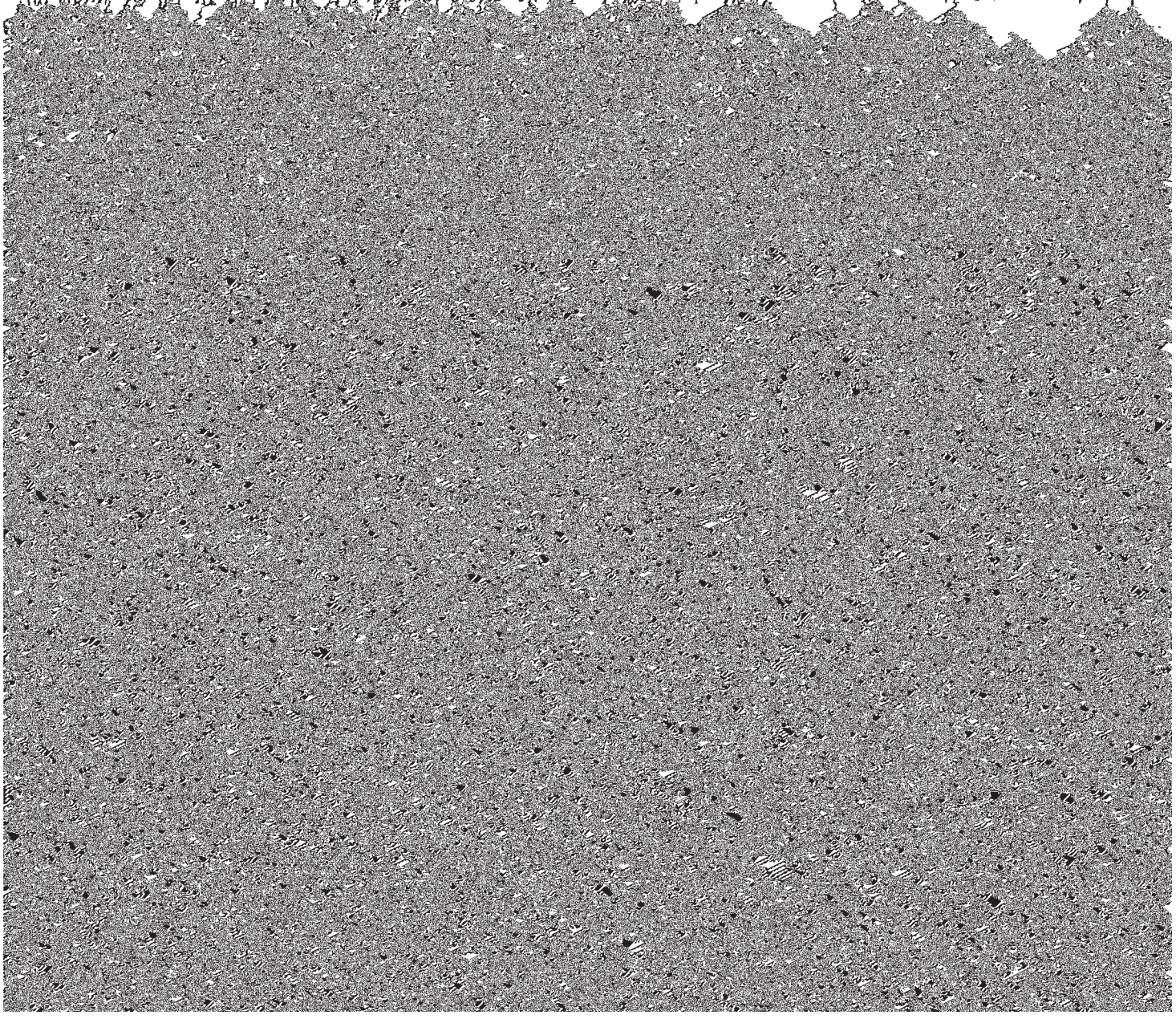
This section describes the factors of soil formation that have affected the formation of soils in Sheboygan County. It also explains the system of soil classification currently used and assigns each soil series or land type to the classes of that system. The soil series and land types in the county and a profile representative of each series are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the composition of the parent material; the relief, or lay of the land; the climate under which

As a result of these soil-forming processes, Theresa soils now have a surface layer of dark grayish brown silt loam. The subsoil is yellowish brown silty clay loam in the upper part and brown clay loam in the lower part. The underlying material is unweathered calcareous glacial till that has changed little since it was deposited by the glacier. Processes that were active in the formation of Theresa soils were the *accumulation* of organic matter in the surface layer, the *removal* of clay from the upper part of the profile, the *addition* of clay to the lower part of the profile, and the *transformation* of some of the material in place.

In varying degrees, all of these processes are occurring in all soils of the county. The kind of parent material and the relief, or topography, have, to a large extent, determined the processes that have been dominant in the formation of all soils and have thus caused dif-



Montgomery, and Saylesville soils formed in these sediments. These shallow lakes favored the growth of aquatic plants. The organic Adrian, Boots, Houghton, Muskego, Palms, and Willette soils formed in the partly decomposed remains of these plants.

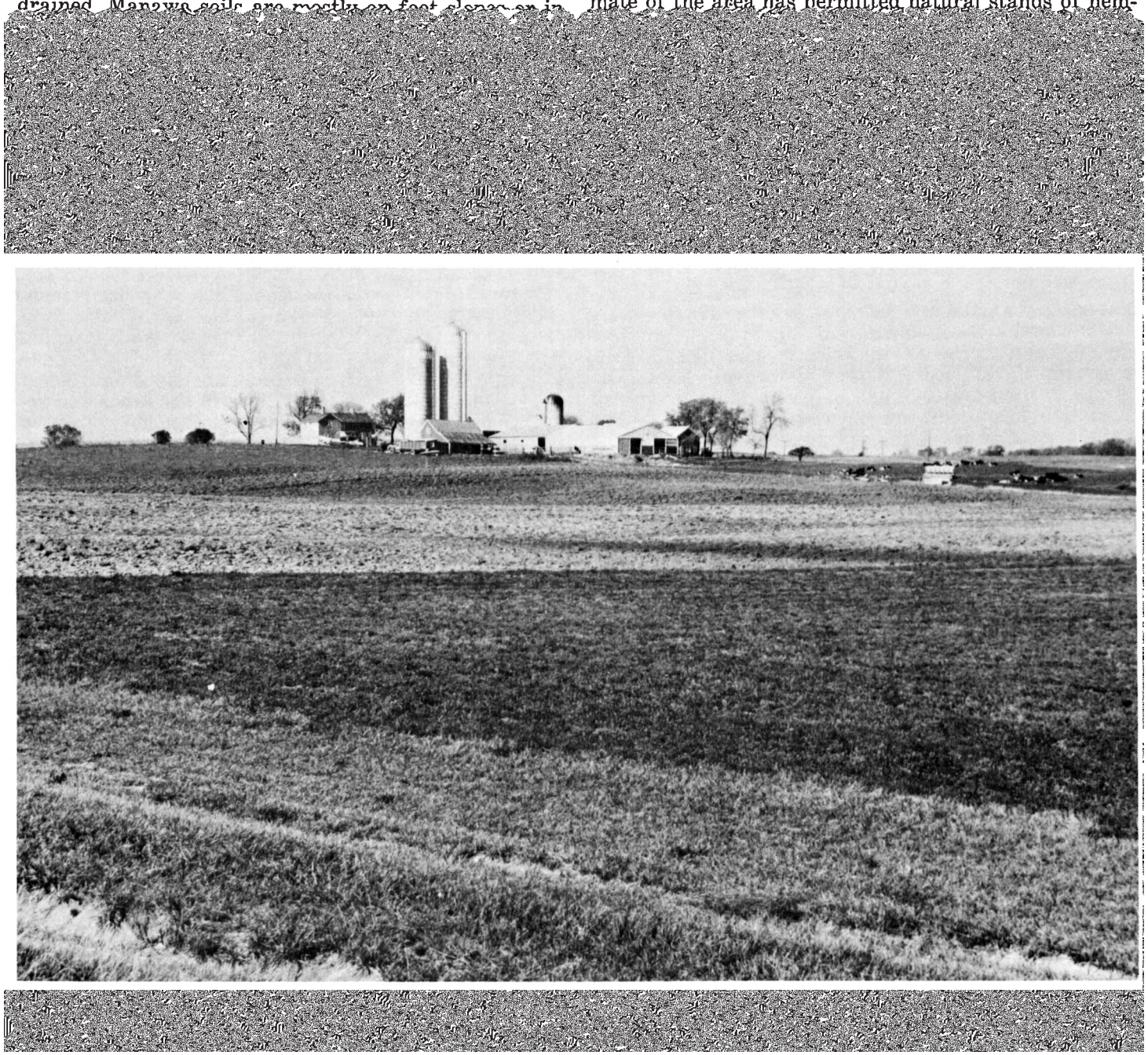
Relief and drainage

The drainage of soils is determined, to a great extent, by relief and the position of the soils on the landscape. For example, Kewaunee, Manawa, and Poygan soils formed in a thin silty mantle and calcareous silty clay loam or silty clay glacial till. Kewaunee soils generally are higher on the landscape (fig. 9). They typically are gently sloping and sloping and are well drained. Manawa soils are mostly on flat slopes or in

Climate and plants and animals

Differences in climate within the survey area are too small to have caused any major differences in the soils. Lake Michigan, however, has a modifying influence on the climate in areas adjacent to the lake. It is the cause of a lag in seasonal temperature changes, which is more pronounced in spring, summer, and fall. Temperatures in spring and early in summer are as much as 10 to 15 degrees cooler than those a few miles inland. In fall, because of the warm lake water, night temperatures are higher than those a short distance inland.

The modifying effect of Lake Michigan on the climate of the area has permitted natural stands of hem-



the soil surface. He has planted grasses, such as Kentucky bluegrass and bromegrass, which through their fine, fibrous root systems have added organic matter to the upper part of the soil.

The addition of lime has not only neutralized soil acidity but also has created a more favorable environment for beneficial soil bacteria. The increased bacterial action, in turn, has hastened the decomposition of organic matter, which darkens many cultivated soils.

gories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. The same property or subdivisions of this property may be used in several different categories. In table 12, the soil series of Sheboygan County are

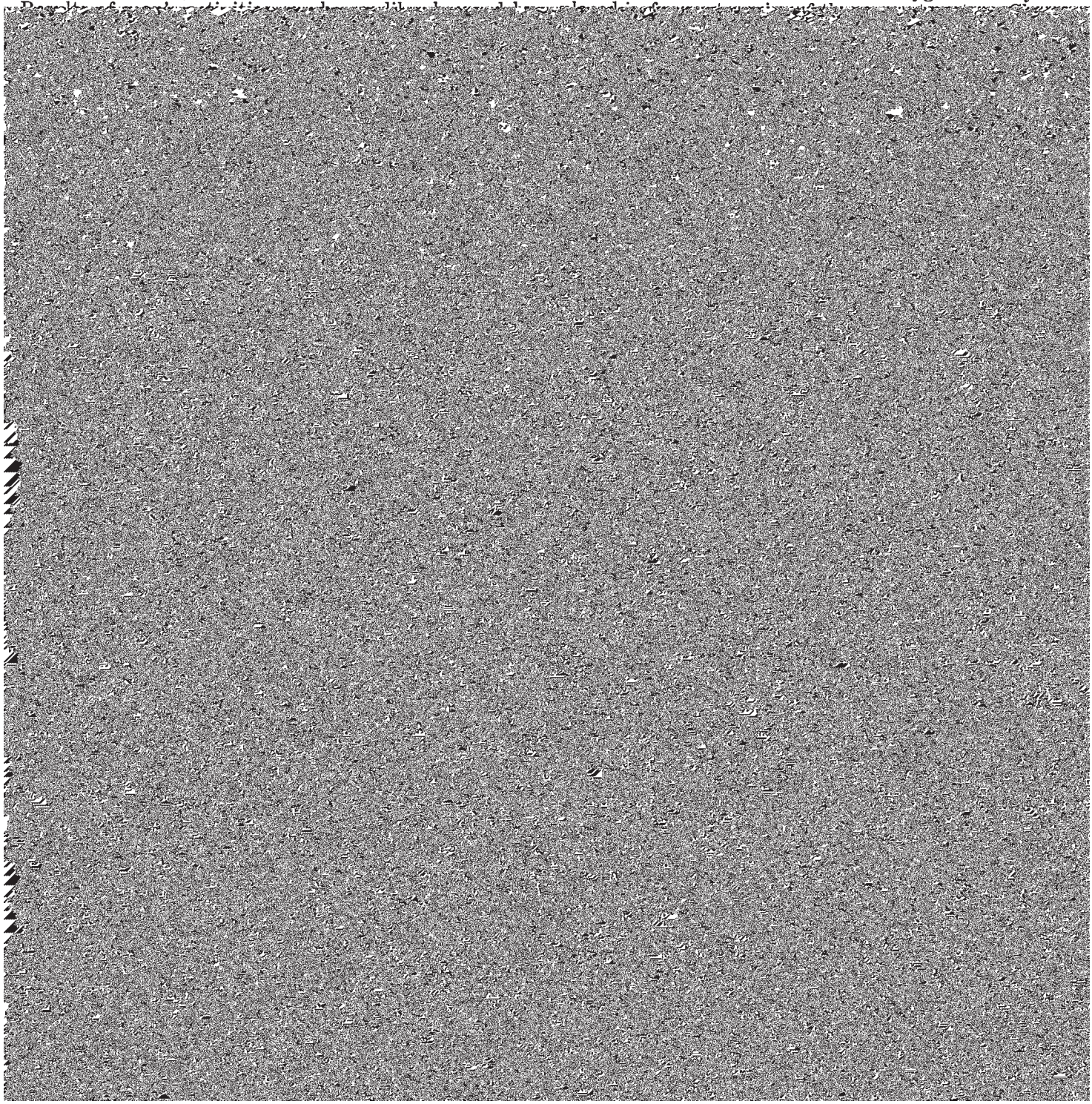
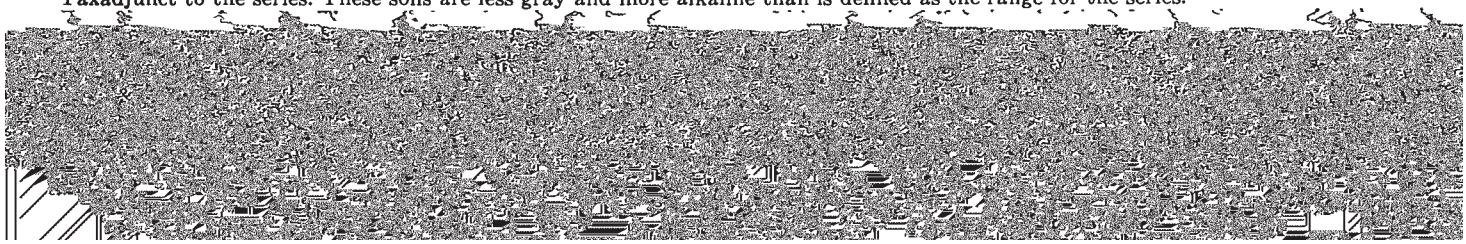


TABLE 12.—*Classification of soils*

Soils	Family	Subgroup or great group	Order
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic	Terric Medisaprists	Histosols.
Alluvial land	Loamy, mixed, nonacid, mesic	Typic Udifluvents	Entisols.
Alluvial land, wet	Loamy, mixed, nonacid, mesic	Fluvaquents	Entisols.
Barry	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Bellevue	Fine-loamy, mixed, mesic	Fluventic Hapludolls	Mollisols.
Bellevue variant	Sandy, mixed, mesic	Fluventic Hapludolls	Mollisols.
Boots	Euic, mesic	Typic Medihemists	Histosols.
Boyer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Casco	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Colwood	Fine-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Cut and fill land, clayey	Clayey, mixed, nonacid, mesic	Typic Udorthents	Entisols.
Cut and fill land, loamy	Loamy, mixed, nonacid, mesic	Typic Udorthents	Entisols.
Cut and fill land, sandy and gravelly.	Sandy-skeletal, mixed, nonacid, mesic	Typic Udorthents	Entisols.
Dune land	Mixed, mesic	Typic Udipsamments	Entisols.
Edwards	Marly, euic, mesic	Limnic Medisaprists	Histosols.
Elvers	Coarse-silty, mixed, nonacid, mesic	Thapto-Histic Fluvaquents	Entisols.
Fabius	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Aquic Argiudolls	Mollisols.
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Granby	Sandy, mixed, mesic	Typic Haplaquolls	Mollisols.
Granby variant	Sandy-skeletal, mixed, mesic	Typic Haplaquolls	Mollisols.
Hebron [1]	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Hebron variant	Coarse-loamy over clayey, mixed, mesic	Typic Hapludalfs	Alfisols.
Hochheim [2]	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Houghton	Euic, mesic	Typic Medisaprists	Histosols.
Juneau	Coarse-silty, mixed, nonacid, mesic	Typic Udifluvents	Entisols.
Kendall [3]	Fine-silty, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Kewaunee [4]	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
Kibbie [5]	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Knowles	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Lamartine [6]	Fine-silty, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Loamy land, seeped	Loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Manawa [7]	Fine, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Martinton [8]	Fine, illitic, mesic	Aquic Argiudolls	Mollisols.
Matherton [9]	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Montgomery	Fine, mixed, mesic	Typic Haplaquolls	Mollisols.
Mosel	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Muskego	Coprogenous, euic, mesic	Limnic Medisaprists	Histosols.
Navan	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Nenno	Fine-loamy, mixed, mesic	Aquic Argiudolls	Mollisols.
Oakville	Mixed, mesic	Typic Udipsamments	Entisols.
Otter	Fine-silty, mixed, mesic	Cumulic Haplaquolls	Mollisols.
Palms	Loamy, mixed, euic, mesic	Terric Medisaprists	Histosols.
Pella	Fine-silty, mixed, mesic	Typic Haplaquolls	Mollisols
Poygan	Fine, mixed, mesic	Typic Haplaquolls	Mollisols.
Rodman [10]	Sandy-skeletal, mixed, mesic	Typic Hapludolls	Mollisols.
Rough broken land	Fine, mixed, nonacid, mesic	Typic Udorthents	Entisols.
St. Charles	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Saylesville	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Argiaquolls	Mollisols.
Sisson	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Stony land, wet	Loamy-skeletal, mixed, mesic	Haplaquolls	Mollisols.
Theresa	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Wasepi	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Waymor	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Willette	Clayey, illitic, euic, mesic	Terric Medisaprists	Histosols.
Yahara [11]	Coarse-loamy, mixed, mesic	Aquic Hapludolls	Mollisols.
Zurich	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.

[1] Taxadjunct to the series. These soils are redder throughout the subsoil than is defined as the range for the series.
[2] Taxadjunct to the series. These soils have a lighter colored surface layer than is defined as the range for the series.
[3] Taxadjunct to the series. These soils are less gray and more alkaline than is defined as the range for the series.



12). An example is the fine-loamy, mixed, mesic family of Typic Haplaquolls.

regular and has many kames, eskers, and potholes (fig. 10). The highest points are more than 200 feet above the surrounding landscape. West of the Kettle Moraine the soils are mostly gently sloping. Elevation ranges

the result of glacial action, which buried the underlying Niagara dolomite bedrock with unconsolidated deposits ranging from a few feet to several hundred feet in thickness. The outstanding physical feature of the landscape is the Kettle Moraine, which crosses the western part of the county in a northeast-southwest direction from the north-central part of Rhine Township to the Crooked Lake Area in the northwestern part of Scott Township. The Kettle Moraine ranges from ½ mile to 4 miles in width. It is made up mainly of glacial drift deposited by large masses of glacial ice known as the Lake Michigan and Green Bay Lobes. Most areas of the steep and very steep Casco and Rodman soils are in this area. This area is a source of sand and gravel and has many gravel pits.

As the glaciers retreated, they left a mass of loamy material or glacial till in the western half of the county. Hochheim, Theresa, and other soils formed in this material. Drumlins are the most common landscape feature in this area.

Water from the melting glaciers transported, sorted, and deposited some of the glacial till as stratified gravel and sand on outwash plains. Casco, Fox, and other soils formed in this material (fig. 11). These areas are sources of sand and gravel.

In some glacial lake basins silt, fine sand, and clay accumulated to form lacustrine soils. In other places residue from water-tolerant plants accumulated to form organic soils.

The reddish brown loamy and clayey soils in the eastern half of the county are a result of a later glacial stage. Sediments in Lake Michigan were reworked by the readvance of the Lake Michigan Lobe and deposited mainly as gently sloping ground moraines. This area is commonly known as the "red clay" area. Kewaunee, Manawa, and other soils formed in these deposits. In many places the soils have a severe limitation for onsite sewage disposal systems because they have moderately low permeability.

Climate [6]

The climate of Sheboygan County is classified as continental. It is typical of a continental location in the middle latitudes but is somewhat modified by the proximity to Lake Michigan. Winters are long, cold, and snowy, and summers are warm and occasionally humid. Spring and fall are at times short and are mixtures of both summer and winter. The character of the seasons varies widely from year to year. All seasons are marked by storms that accompany changes from one air mass to another, particularly from late in fall through the middle of spring, when changes often occur every 2 to 4 days.

[6] By HANS C. ROSENDAL, State climatologist, National Weather Service, U.S. Department of Commerce.

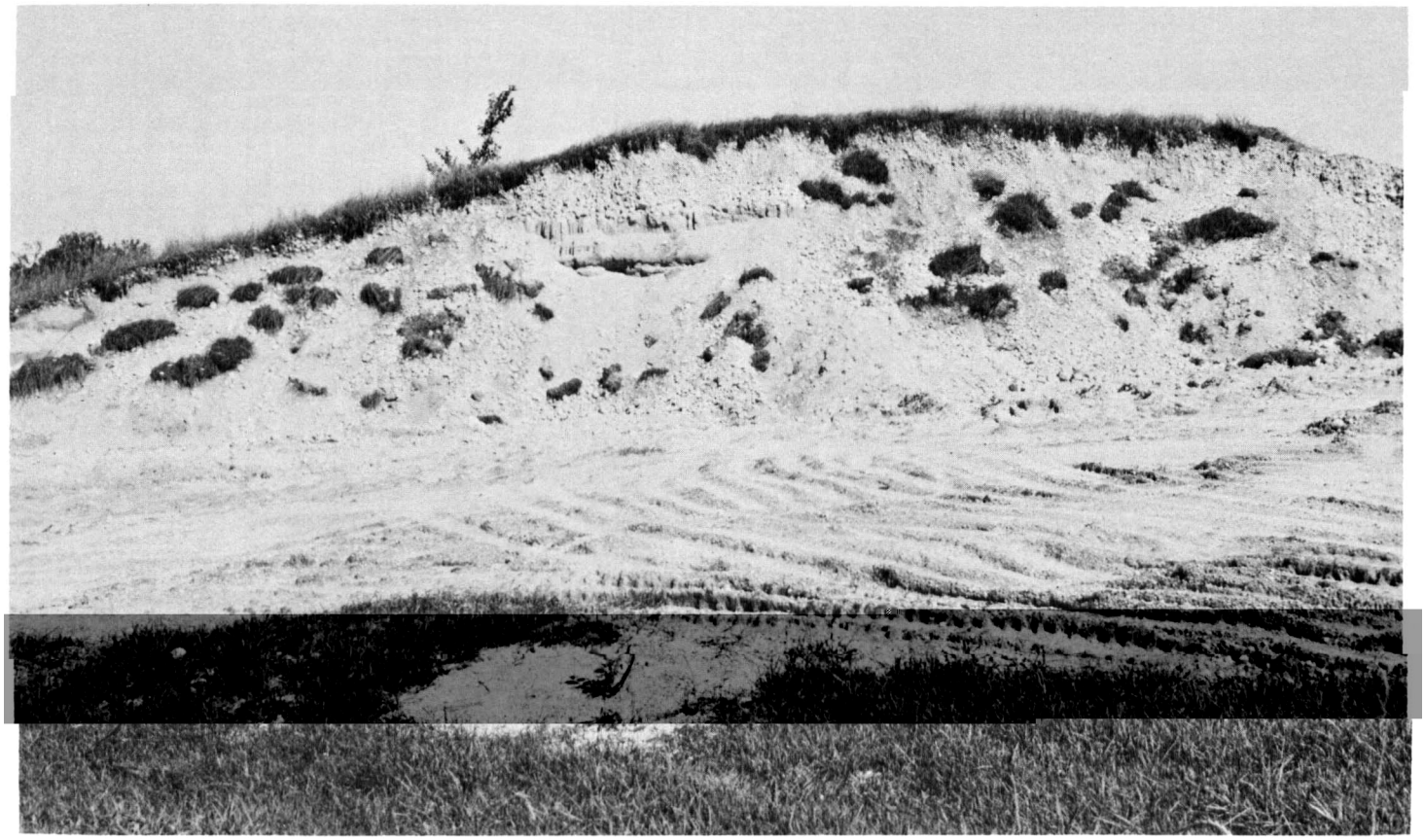


Figure 11.—Exposure of stratified gravel and sand. Casco, Fox, and Rodman soils are underlain by gravel and sand.

Data in tables 13 and 14 are fairly representative of the climate of the county. The weather station from which most of these data were obtained is in Plymouth, which is near the center of Sheboygan County about 15 miles from Lake Michigan. Temperatures during spring and summer average slightly higher away from the lake in the western part of the county, whereas during autumn and winter they are slightly warmer near the lake. Also, higher elevations tend to experience a decrease in the daily and annual temperature ranges, whereas increases in these ranges occur at lower elevations and over large expanses of marshlands because of a lowering of minimum temperatures through cold-air pooling.

Table 13 gives temperature and precipitation data. The temperature range from season to season, as well as from year to year, is quite large. During the last 40 years, days with temperatures of 90°F or higher have ranged from 0 in 1962, 1951, and 1950 to 26 in 1955. Days with 0° or lower have ranged from 3 in 1953 to 38 in 1963. Both the hottest and coldest periods occurred in 1936. From July 7 to July 14, 8 consecutive days had temperatures greater than 100°, while the period January 20 to February 12 had 24 consecutive days below 0°.

Precipitation is generally ample for the growth of all crops common to the latitude. In about 50 percent of the years, precipitation falls in the 5-month period from May through September. Since 1910 there has never been a month without a measurable amount of precipitation. Intensities of about 1.25 inches in 1 hour, 1.85 inches in 6 hours, and 2.60 inches in 24 hours can be expected to occur about once in 2 years. The greatest amount of precipitation to fall in 24 hours was 4.96 inches on August 4, 1924. Normally, for the 3 summer months, the first parts of June and August

TABLE 13.—*Temperature and precipitation data*

[All data from Plymouth, Wis. Elevation 845 feet]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Average maximum	Average minimum	Average monthly 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	28	12	45	−10	1.5	0.5	2.8	20	5.7
February	30	13	47	−8	1.4	.4	2.6	19	5.6
March	39	23	60	4	1.9	.8	3.3	11	3.7
April	54	34	75	22	2.7	1.1	4.2	2	.7
May	66	44	85	32	3.0	1.2	4.8	(1)	0
June	76	54	91	42	3.5	1.6	5.6	0	0
July	82	60	92	49	2.9	1.2	5.2	0	0
August	81	59	92	48	2.7	1.4	5.0	0	0
September	72	51	89	37	3.0	1.0	6.5	0	0
October	60	41	79	26	2.1	.6	4.0	(1)	0
November	44	28	64	10	2.1	.7	4.0	3	2.0
December	32	17	50	−4	1.5	.5	3.2	12	3.3
Year	55	36	[2] 94	[3] −15	28.3	21.0	37.5	67	4.6

[1] Less than 0.5 day. [2] Average annual maximum. [3] Average annual minimum.

TABLE 14.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Plymouth, Wis. Elevation 845 feet]

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 12	April 18	April 27	May 11	May 24
2 years in 10 later than	March 30	April 5	April 14	April 29	May 12
5 years in 10 later than	March 27	April 2	April 11	April 25	May 9
Fall:					
1 year in 10 earlier than	November 3	October 26	October 16	October 5	September 26
2 years in 10 earlier than	November 17	November 8	October 30	October 18	October 8
5 years in 10 earlier than	November 20	November 11	November 2	October 21	October 11

are the wettest periods. The likelihood of 1 inch or more of rain falling during the periods May 31 to June 6 and August 2 to August 8 is once in 3 years. The period August 23 to August 29 is the driest, and the likelihood of a trace or less of rain is once in 5 years. Annual snowfall has ranged from 19 inches in 1958 to 99 inches in 1959.

Thunderstorms have occurred on an average of 35 days per year, and individual years range from 20 to 45 days. Hail has fallen on an average of 2 days per year and in extreme years on 0 and 5 days.

Wind, sunshine, and humidity records are not available at Plymouth, but sunshine and humidity records at Green Bay and wind records at Appleton can be used. Prevailing winds are from the northwest in winter and from the southwest in summer. Annually, the wind blows from the northwest about one-fifth of the time and from the southwest about one-fifth of the

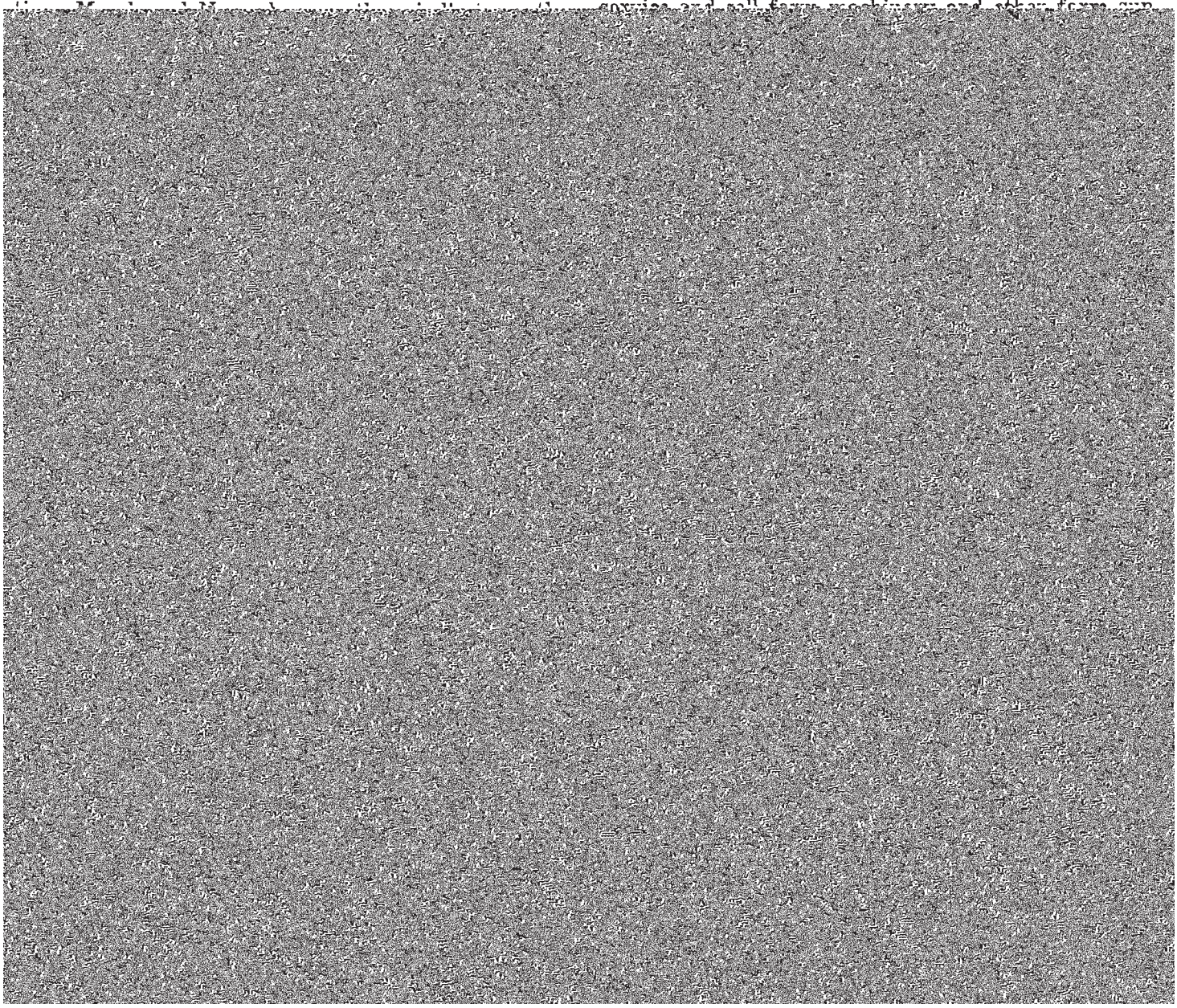
The Sheboygan city port has one municipal wharf and two privately owned wharfs. The major products shipped are fuel oil, crude oil, pig iron, coal, and newsprint.

Sheboygan County is served by ten public high schools and two colleges.

Industry

About 42 percent of the jobs in Sheboygan County are in manufacturing. The major industries manufacture plumbing fixtures, engines, machinery, textiles, utensils, shoe leathers, cheese, and plastics (*29*). Most of this manufacturing is done in Sheboygan, Kohler, and Plymouth.

Food processing plants are in Sheboygan, Cedar Grove, and Random Lake. The livestock markets are primarily in Oostburg and Plymouth. Businesses that



(12) Gevorkiantz, S. R. 1957. Site index curves for aspen in the Lake States. USDA Forest Serv., Lake States Forest Exp. Stn. Tech. Note 464.
(13) Gevorkiantz, S. R. 1957. Site index curves for white cedar in the Lake States. USDA Forest Serv., Lake States Forest Exp. Stn. Tech. Note 472.
(14) Gevorkiantz, S. R. 1957. Site index curves for white pine in the Lake States. USDA Forest Serv., Lake States Forest Exp. Stn. Tech. Note. 483.
(15) Gevorkiantz, S. R. 1957. Site index curves for red pine in the Lake States. USDA Forest Serv., Lake States Forest Exp. Stn. Tech. Note 484.
(16) Gevorkiantz, S. R. 1957. Site index curves for red oak in the Lake States. USDA Forest Serv., Lake States Forest Exp. Stn. Tech. Note 485.
S(17) Gevorkiantz, S. R. 1957. Site index curves for tamarack in the Lake States. USDA Forest Serv., Lake States Forest Exp. Stn. Tech. Note 492

material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

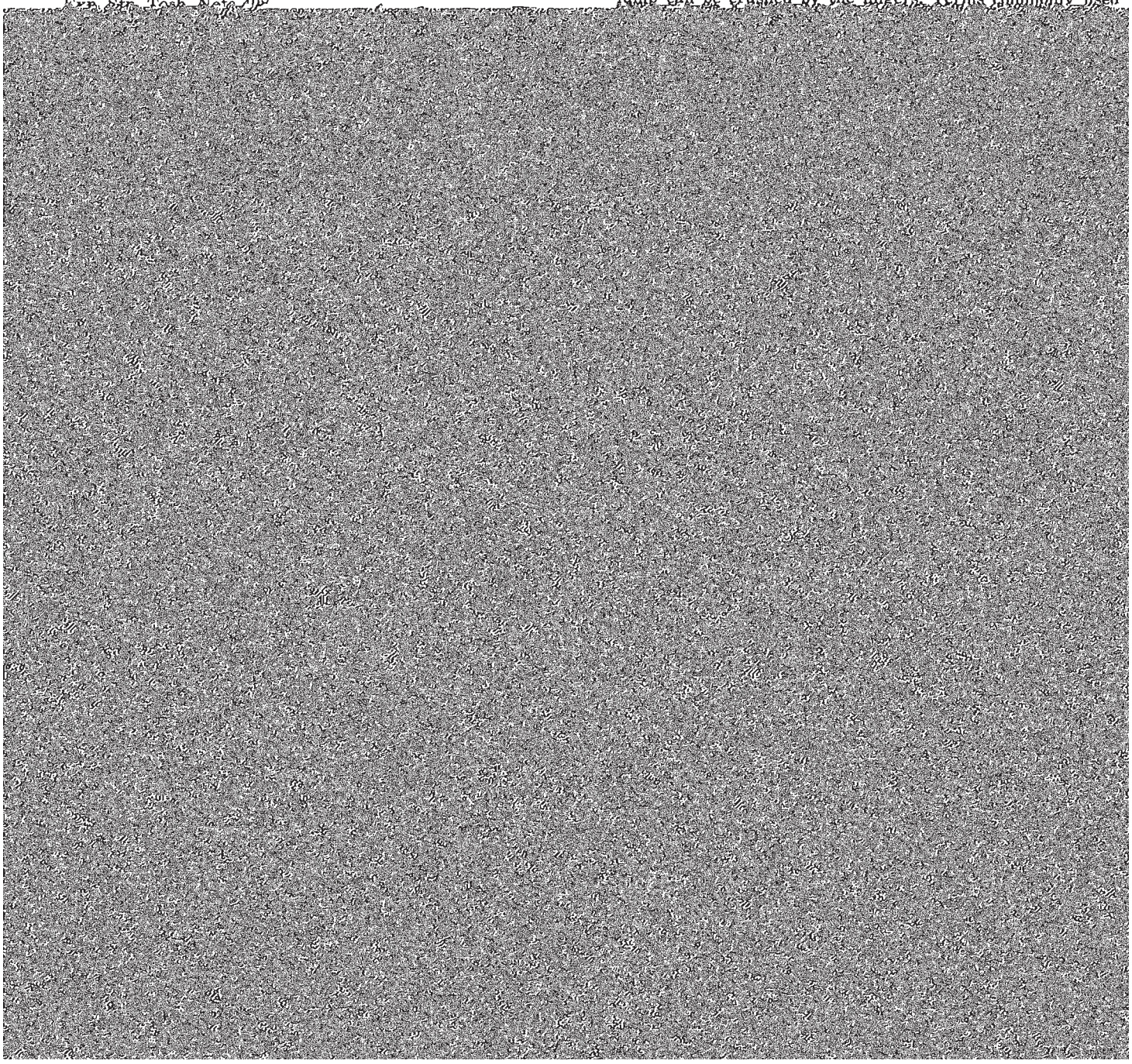
Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used



or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

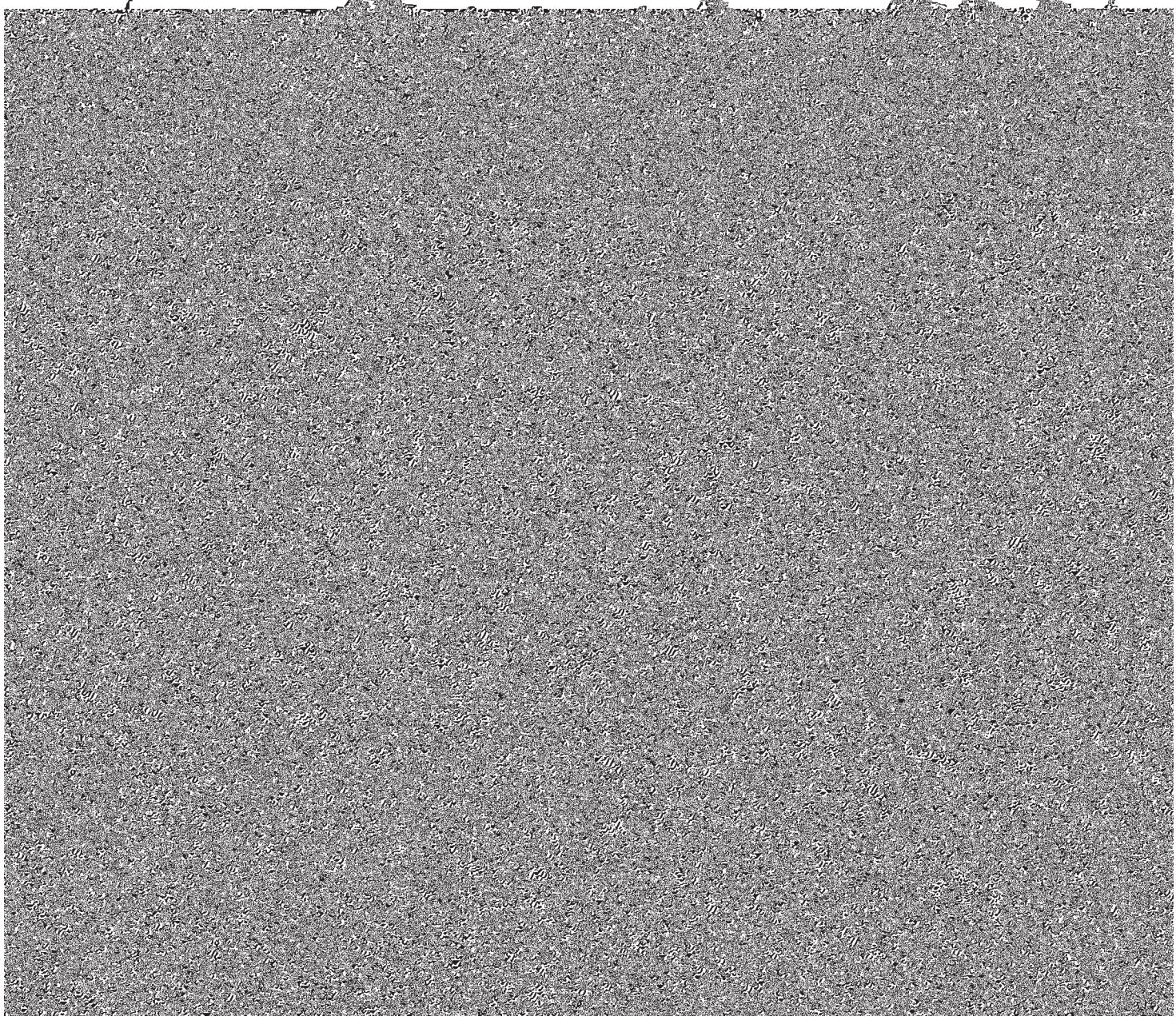
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous

material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

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 a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combina- of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of



divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil.) A numerical designation of acidity and alkalinity in soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Profile, soil. A vertical section of the soil extending through all its horizons and 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 described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0

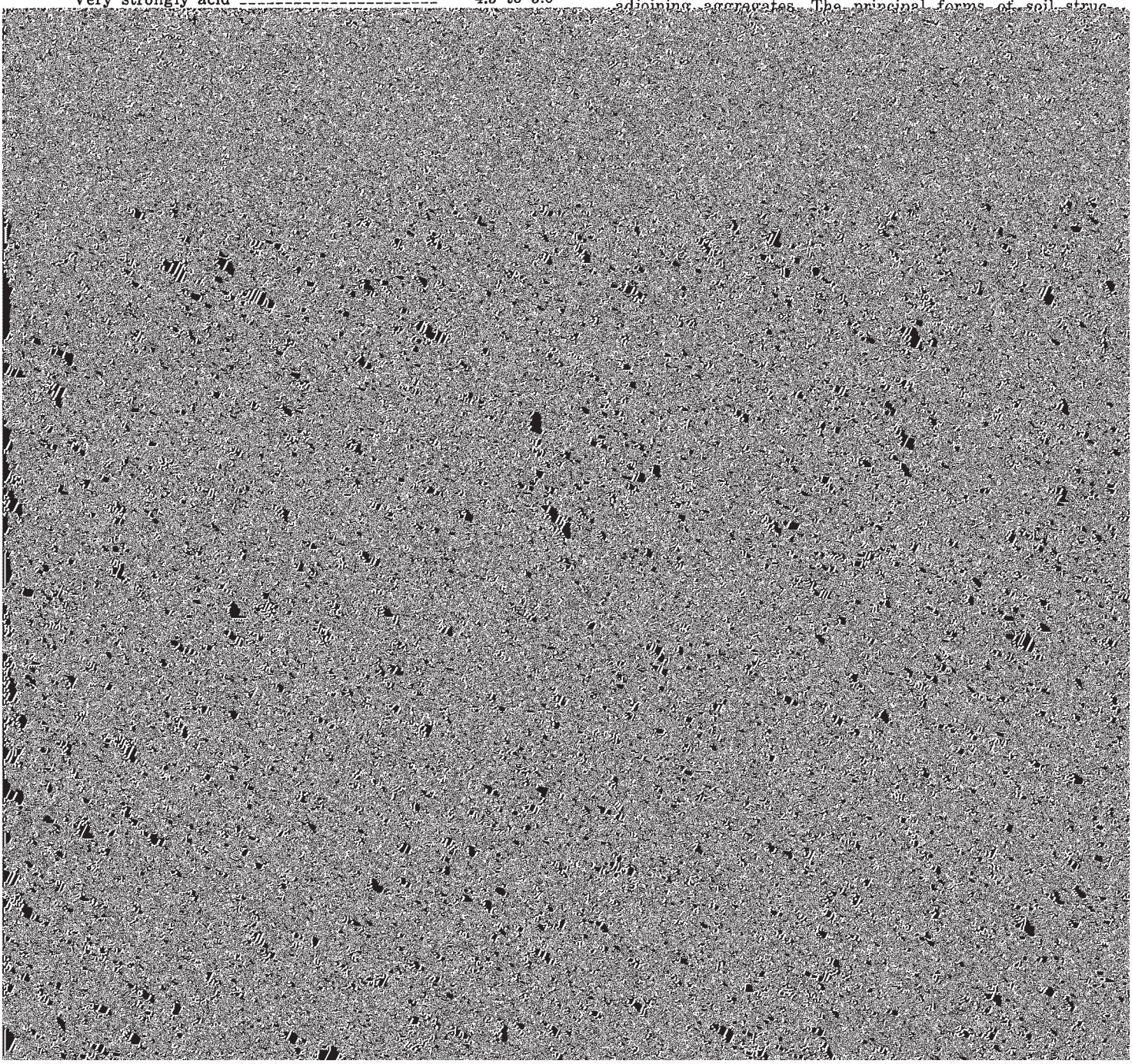
Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

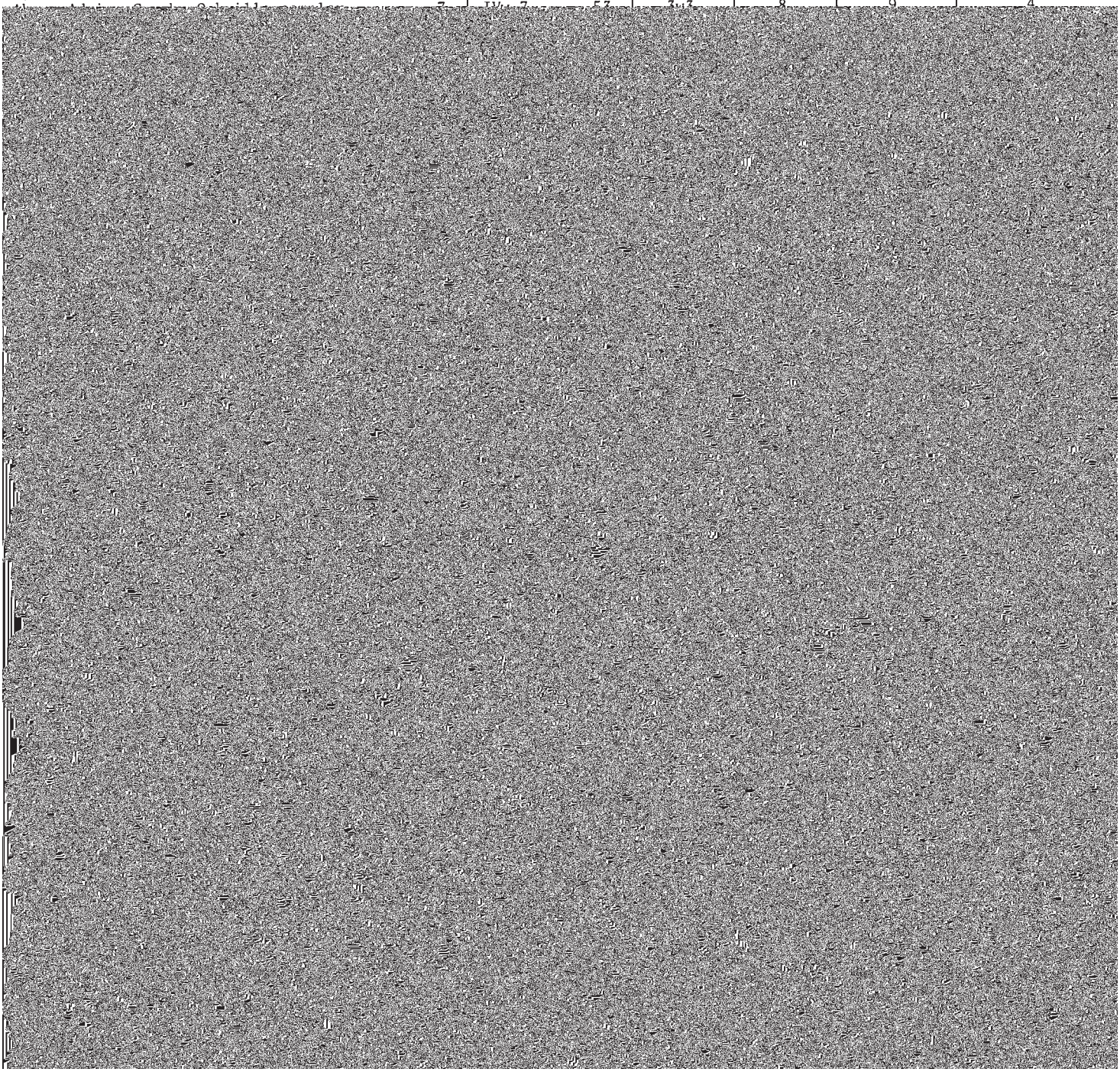
Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil struc-



GUIDE TO MAPPING UNITS

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Wildlife group	Recreation group	Tree and shrub group
			Symbol	Page	Symbol	Number	Number	Number
Ag	Adrian muck	7	IVw-7	53	3w3	8	9	4



Map symbol	Mapping unit	Page	Capability unit		Woodland group	Wildlife group	Recreation group	Tree and shrub group
			Symbol	Page	Symbol	Number	Number	Number
HsD2	Hochheim-Casco-Sisson complex, 12 to 20 percent slopes, eroded	22	IVe-1	53	2r1	1	2	1
HsE	Hochheim-Casco-Sisson complex, 20 to 30 percent slopes	22	VIe-1	54	2r1	1	2	1
HtB	Hochheim-Knowles silt loams, 1 to 6 percent slopes	23	IIe-1	48	2o1	1	2	1
Hu	Houghton muck	23	IIIw-9	52	3w3	8	9	4
JuA	Juneau silt loam, 0 to 3 percent slopes	24	I-2	48	2o1	9	7	1
KlA	Kendall silt loam, 0 to 3 percent slopes	24	IIw-2	49	2o2	6	4	3
KnA	Kewaunee silt loam, 0 to 2 percent slopes	25	IIs-7	51	2c1	2	2	1
KnB	Kewaunee silt loam, 2 to 6 percent slopes	25	IIe-6	49	2c1	2	2	1
KpB2	Kewaunee silty clay loam, 2 to 6 percent slopes, eroded	25	IIe-6	49	2c1	2	5	1
KpC2	Kewaunee silty clay loam, 6 to 12 percent slopes, eroded	26	IIIe-6	51	2c1	2	5	1
KpD2	Kewaunee silty clay loam, 12 to 20 percent slopes, eroded	26	IVe-6	53	2c3	2	5	1
KsC3	Kewaunee silty clay, 6 to 12 percent slopes, severely eroded	26	IVe-6	53	3c1	2	5	1
KsD3	Kewaunee silty clay, 12 to 20 percent slopes, severely eroded	26	VIe-6	55	3c2	2	5	1
KuA	Kibbie silt loam, 0 to 3 percent slopes	27	IIw-2	49	1o2	6	4	3
LmA	Lamartine silt loam, 0 to 3 percent slopes	28	IIw-2	49	2o2	6	4	3
Lo	Loamy land, seeped	28	Vw-16	54	4w2	7	6	3
Ma	Made land	28	VIIIs-10	55	6s1	10	6	---
MbA	Manawa silt loam, 0 to 3 percent slopes	29	IIw-2	49	2c2	6	4	3
Mf	Marsh	29	VIIIw-15	55	6w1	7	6	---
MgA	Martinton silt loam, 0 to 3 percent slopes	30	IIw-2	49	4o1	6	4	3
MkA	Matherton silt loam, 0 to 3 percent slopes	30	IIw-5	50	3o2	6	4	3
Mo	Montgomery silty clay loam	31	IIw-1	49	4w2	7	8	3
MsA	Mosel loam, 0 to 3 percent slopes	32	IIw-2	49	2o2	6	4	3
Mz	Muskego muck	32	IVw-7	53	3w3	8	9	4
Na	Navan loam	33	IIw-1	49	4w2	7	8	3
NnA	Nenno silt loam, 0 to 2 percent slopes	33	IIw-2	49	2o2	6	4	3
NnB	Nenno silt loam, 2 to 6 percent slopes	33	IIw-2	49	2o2	6	4	3
OaB	Oakville loamy fine sand, 0 to 6 percent slopes	34	IVs-3	54	3s1	3	3	2
OaC	Oakville loamy fine sand, 6 to 12 percent slopes	34	VIs-3	55	3s1	3	3	2
Ot	Otter silt loam	35	IIw-1	49	2w1	7	8	3
Pa	Palms muck	35	IIw-8	50	3w3	8	9	4
Ph	Pella silt loam	36	IIw-1	49	3w2	7	8	3
Py	Poygan silty clay loam	36	IIw-1	49	2w1	7	8	3
Ry	Rough broken land	37	VIIe-6	55	6s1	2	6	---
ScA	St. Charles silt loam, 0 to 2 percent slopes	38	I-3	48	1o1	1	2	1
ScB	St. Charles silt loam, 2 to 6 percent slopes	38	IIe-1	48	1o1	1	2	1

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Wildlife group	Recreation group	Tree and shrub group
			Symbol	Page	Symbol	Number	Number	Number
ShA	Saylesville silt loam, 0 to 2 percent slopes	39	IIs-7	51	2c1	2	2	1
ShB	Saylesville silt loam, 2 to 6 percent slopes	39	IIe-6	49	2c1	2	2	1
SkC2	Saylesville silty clay loam, 6 to 12 percent slopes, eroded	39	IIIe-6	51	2c1	2	2	1
Sm	Sebewa silt loam	40	IIw-5	50	4w2	7	8	3
SrA	Sisson very fine sandy loam, 0 to 2 percent slopes	40	I-4	48	1o1	1	1	1
SrB	Sisson very fine sandy loam, 2 to 6 percent slopes	40	IIe-1	48	1o1	1	1	1
SrC2	Sisson very fine sandy loam, 6 to 12 percent slopes, eroded	40	IIIe-1	51	1o1	1	1	1
Sw	Stony land, wet	41	Vw-16	54	4w2	7	8	---
ThA	Theresa silt loam, 0 to 2 percent slopes	41	I-4	48	1o1	1	2	1
ThB	Theresa silt loam, 2 to 6 percent slopes	41	IIe-1	48	1o1	1	2	1
ThC2	Theresa silt loam, 6 to 12 percent slopes, eroded	41	IIIe-1	51	1o1	1	2	1
Wa	Wasepi sandy loam	42	IVw-5	53	3o2	6	4	3
WbA	Waymor silt loam, 0 to 2 percent slopes	43	I-4	48	1o1	1	2	1
WbB	Waymor silt loam, 2 to 6 percent slopes	43	IIe-1	48	1o1	1	2	1
WbC2	Waymor silt loam, 4 to 12 percent slopes, eroded	43	IIIe-1	51	1o1	1	2	1
We	Willette muck	44	IIIw-8	52	3w3	8	9	4
YhA	Yahara very fine sandy loam, 0 to 3 percent slopes	44	IIw-4	49	1o2	6	4	3
ZuA	Zurich silt loam, 0 to 2 percent	45	I-3	48	1o1	1	2	1

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