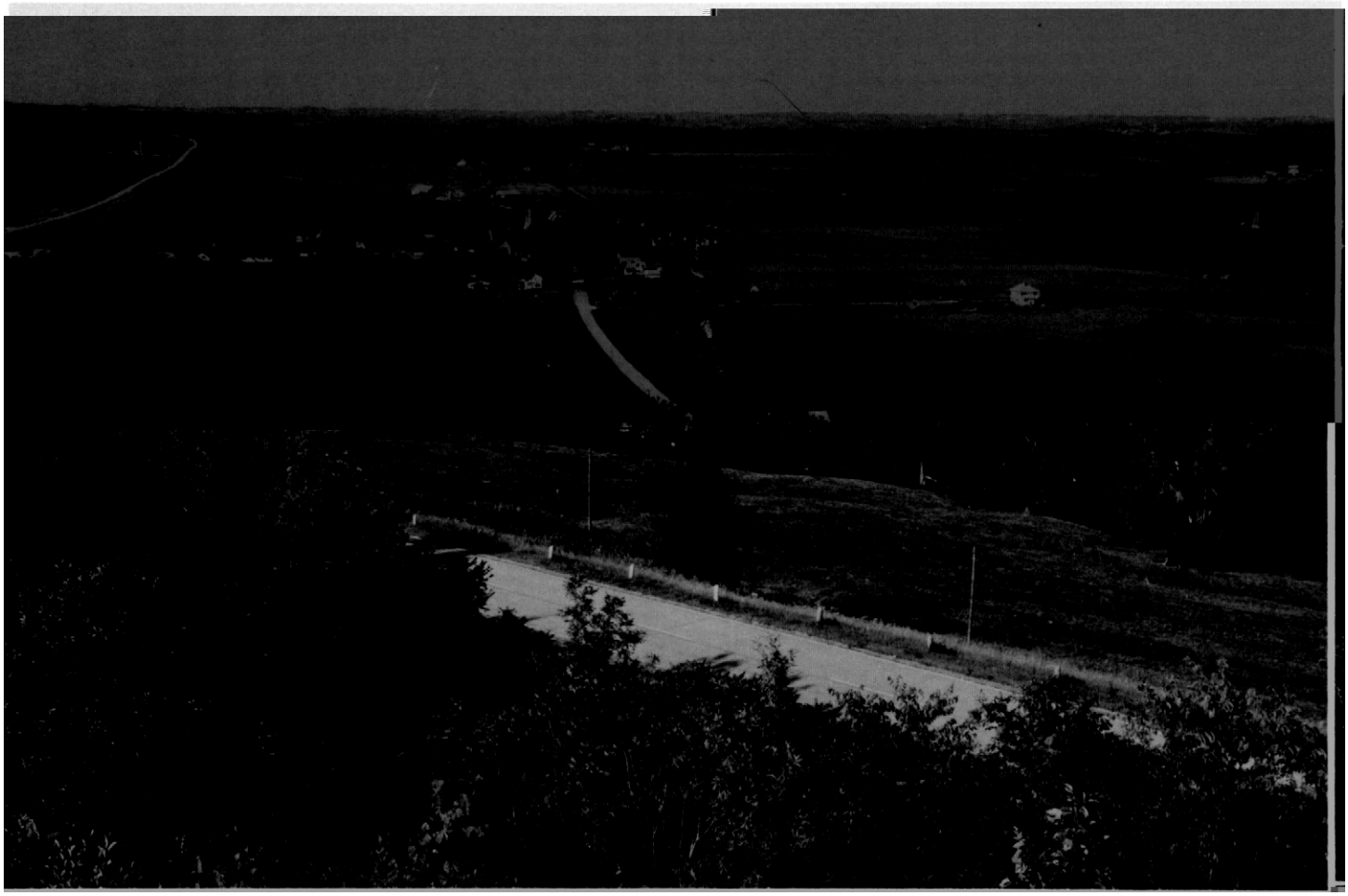
SOIL SURVEY OF

Fayette County, Iowa



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Iowa Agriculture and
Home Economics Experiment Station and
Cooperative Extension Service
Iowa State University and the
Department of Soil Conservation, State of Iowa

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 1962–1972. Soil names and descriptions were approved in 1975. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1975. This survey was made cooperatively by the Soil Conservation Service in cooperation with the Iowa Agriculture and Home Economics Experiment Station and Cooperative Extension Service, Iowa State University and the Department of Soil Conservation, State of Iowa. It is part of the technical assistance furnished to the Fayette County Soil Conservation District. Funds appropriated by Fayette County and the State of Iowa were used to defray part of the cost of this survey.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can 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 Fayette 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

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 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 discussions of the capability units.

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 concerned with suburban development can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and for schools and parks in the section "Engineering."

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 the soils."

Newcomers in Fayette County may be especially interested in the section "General soil map," where broad patterns of soil are described. They may also be interested in the information about the county given in the section "Environmental factors affecting soil use."

Cover: Typical area in Fayette County overlooking the town of Eldorado along the Turkey River in association 6.

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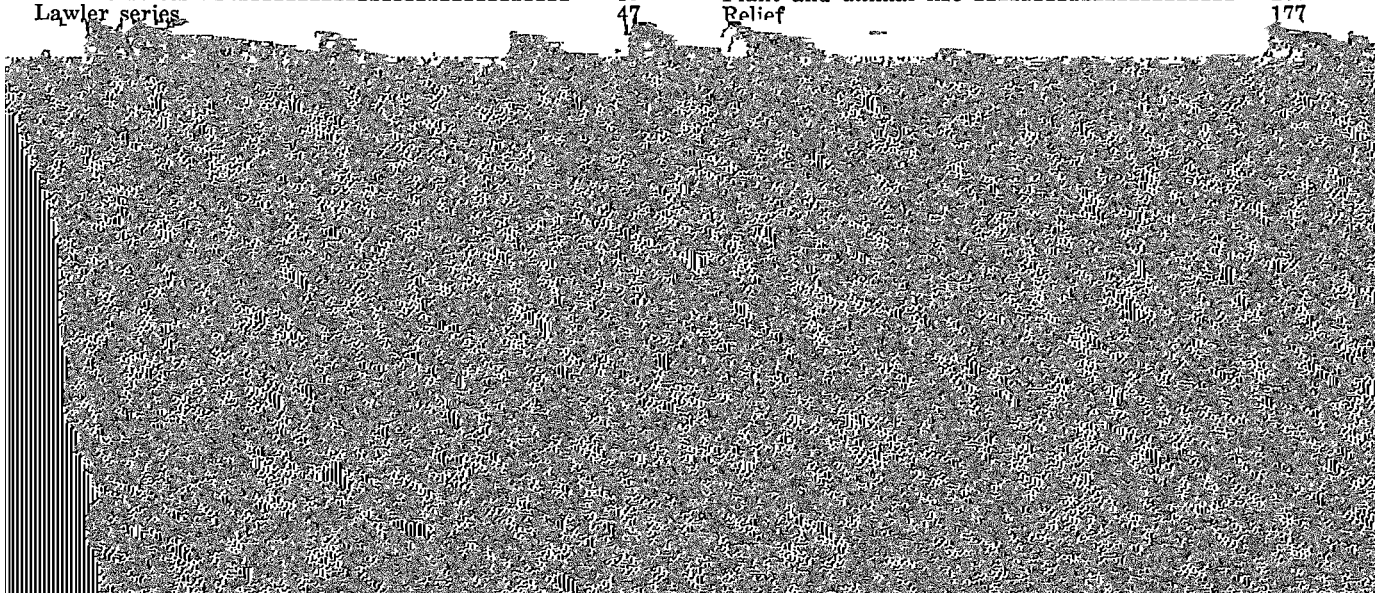

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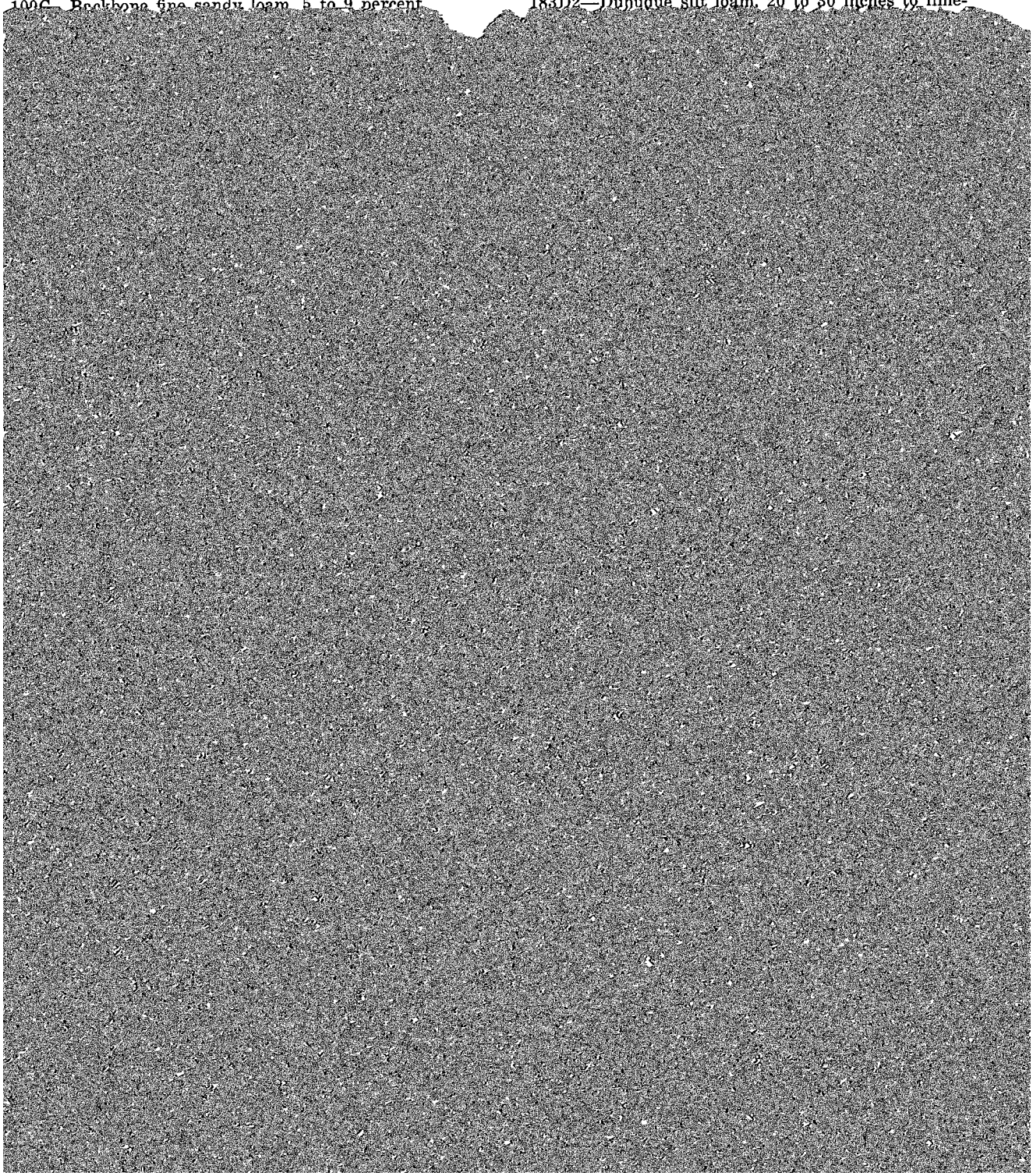

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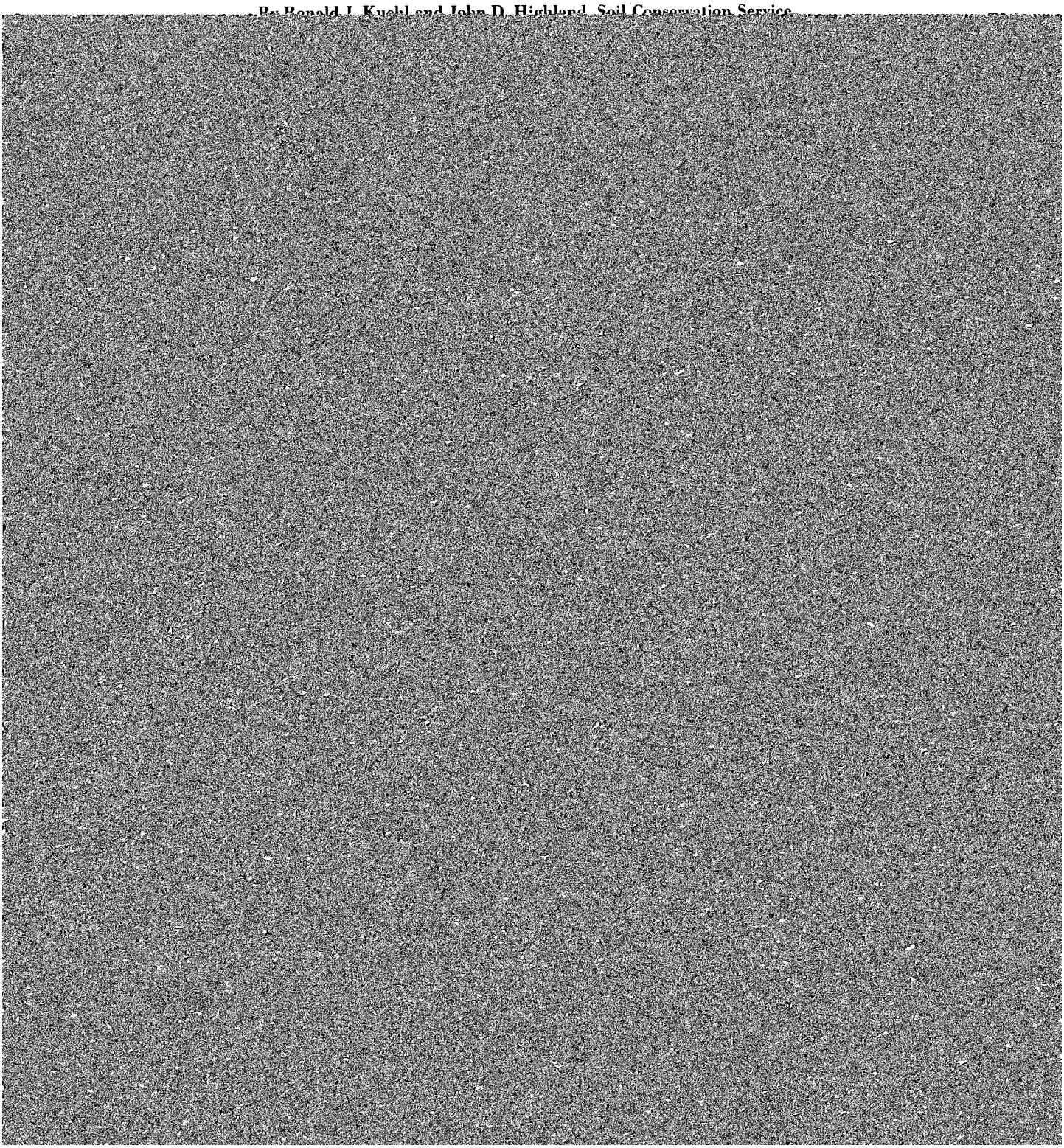
SOIL SURVEY OF FAYETTE COUNTY, IOWA

By Ronald L. Kuehl and John D. Highland, Soil Conservation Service



ping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

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

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. Fayette-Dubuque-Jacwin complex, 14 to 25 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 miscellaneous areas and are given descriptive names. Such a miscellaneous area in Fayette County is Sandy escarpments, 14 to 30 percent slopes.

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 kind 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 kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

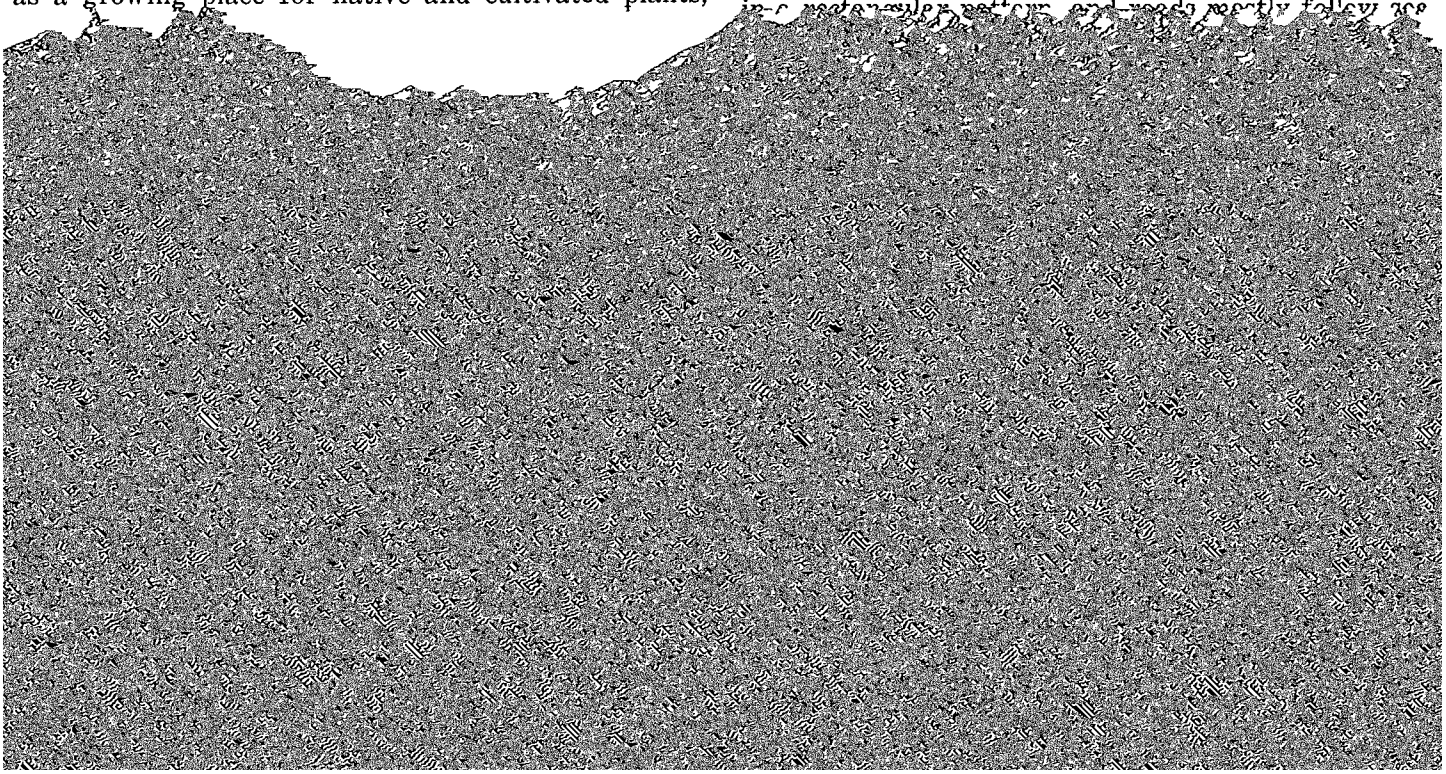
A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a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

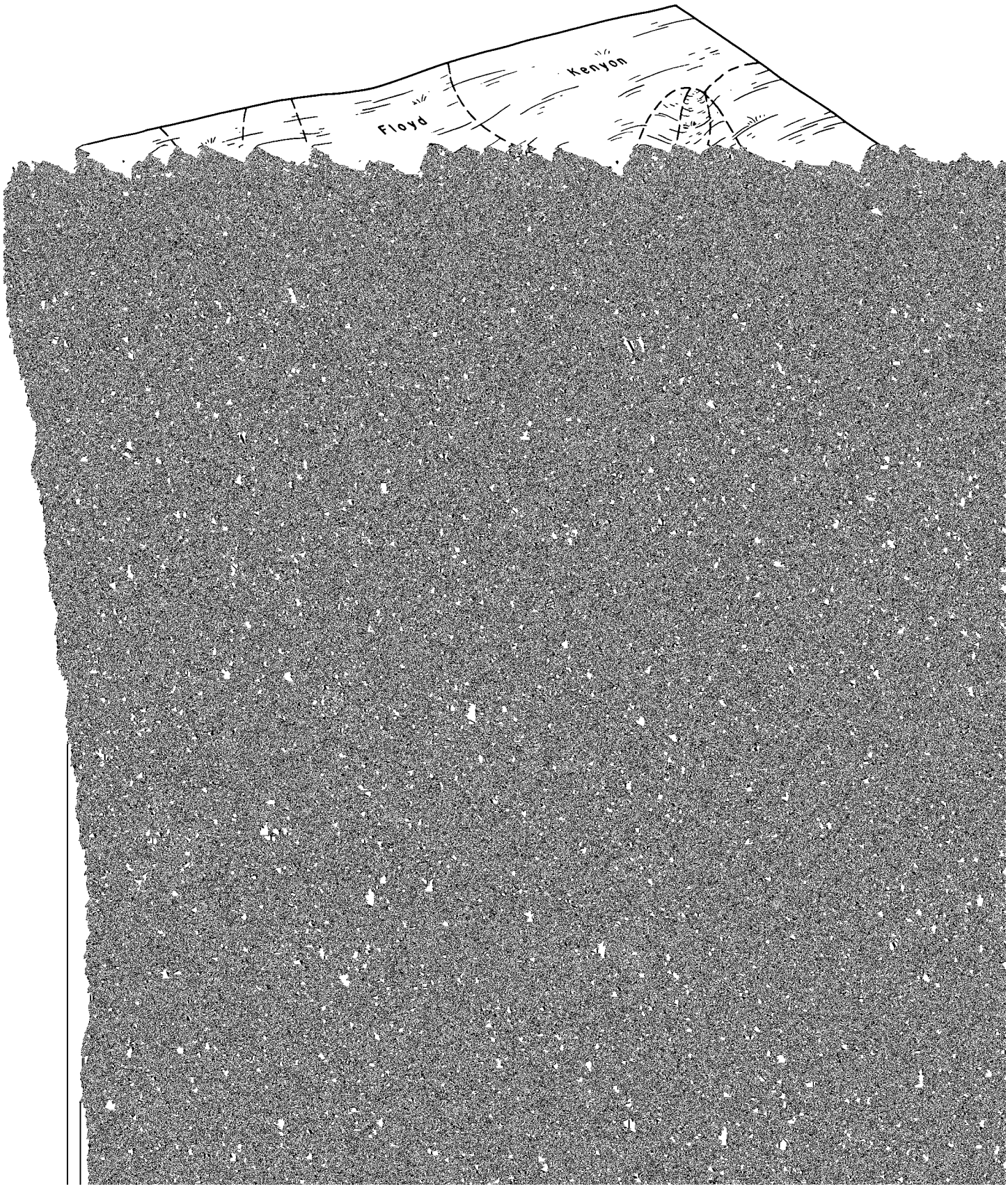
The soil associations in this survey are described on the pages that follow.

1. Kenyon-Clyde-Floyd association

Nearly level to moderately sloping, moderately well drained to poorly drained soils that formed in loamy material and glacial till; on uplands

This association is on uplands characterized mainly by long, gentle slopes, slightly rounded hills, and many low-gradient drainageways through which water moves slowly. The soils formed in loamy material and glacial till (fig. 2). They are nearly level to moderately sloping. In much of this area, stones and boulders are conspicuous features on the landscape in unimproved pasture. Fields and county roads in this association are in a [illegible] pattern and roads mostly follow ar




Floyd
Kenyon

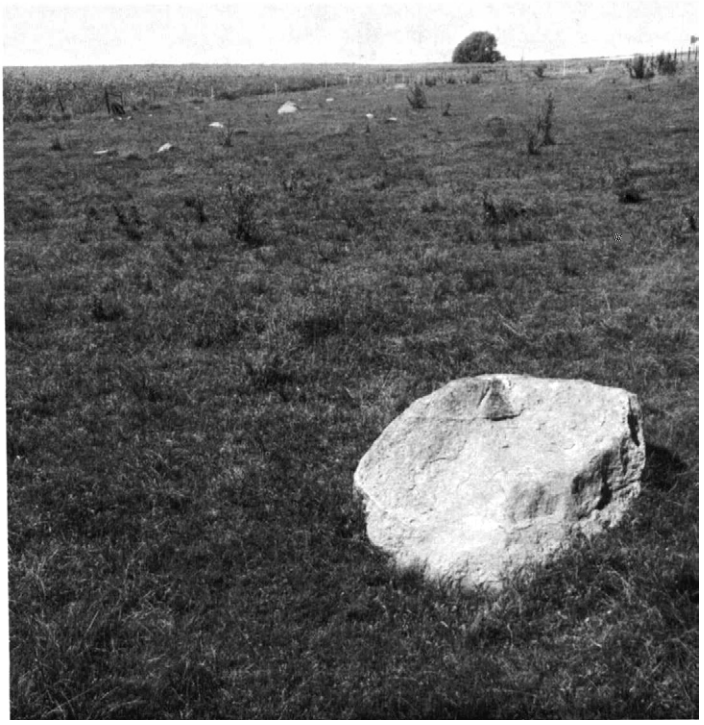


Figure 3.—Typical nontiled upland drainageway in Kenyon-Clyde-Floyd association. Many areas of Clyde soils in the county have been tiled, and the boulders have been removed.

This association is well suited to row crops. Almost all of this association is cultivated. A few areas are in permanent pasture. Although much of this area has been drained, improvement of drainage is still the principal management need. Maintenance of tilth and fertility are also management needs. In places stones or boulders interfere with cultivation and tile drainage.

3. Loamy Alluvial Land-Saude-Flagler association

Nearly level to moderately sloping, somewhat excessively drained to poorly drained soils that formed in loamy and sandy alluvial sediment; on bottom lands and stream benches

The soils on bottom lands and soils on benches form two distinct associations, but they are impractical to separate. This association is characterized by nearly level to moderately sloping soils, but there are a few strongly sloping to steep soils along the bench escarpments. The bottom lands are subject to frequent flooding, but most of the soils on the benches are generally free of flooding, except during very heavy rainfall or in some low areas. As the elevation increases away from the streams, the bench soils are less liable to flooding but in places they receive runoff from the adjacent hillsides. The farms and roads in this association commonly form irregular patterns; the shape of the fields is determined by the boundaries of streams, old stream meanders, and oxbows. Some of the roads parallel the rivers, but the network of roads is sketchy. The farmsteads are usually at higher elevations and are not subject to flooding.

This association makes up about 9 percent of the county. It is about 24 percent Loamy alluvial land, 21 percent Saude soils, 19 percent Flagler soils, 9 percent Lawler soils, 7 percent Marshan soils, and 20 percent minor soils. Minor soils in this association are Burkhardt, Coland, Dickinson, Spillville, and Wapsie soils.

Loamy alluvial land consists of clayey to sandy material that has been deposited by streams. It is frequently flooded and is well drained to poorly drained. Water commonly is ponded in the oxbows and remnants of former stream channels that dissect this land. It is generally nearly level. In places areas are undulating because of depressions or channels and natural levees that form during periods of flooding.

Saude soils are nearly level to moderately sloping and are on benches. The soils are well drained. They have a dark, loamy surface layer. The subsoil is brown and has sand and gravel below a depth of about 2 feet.

Flagler soils are nearly level to moderately sloping and are on benches. The soils are somewhat excessively drained. They have a dark, sandy loam surface layer. The subsoil is sandy loam and loamy sand that has coarse sand and gravel below a depth of about 2 feet.

This association is well suited to poorly suited to row crops. The management needs are control of flooding, improvement of drainage, control of erosion, and maintenance of tilth and fertility. The loamy alluvial land is used mainly for pasture or woodland although some areas that are flooded less frequently are being cropped. The Saude soils are used for cultivated crops, and yields are moderately good in years of normal rainfall. Flagler soils are droughty and yields are low, even if management is good.

4. Fayette-Nordness-Rock outcrop association

Moderately sloping to very steep, well drained and somewhat excessively drained soils that formed in loess overlying limestone bedrock and rock outcrops; on uplands

This association is on uplands characterized by narrow, moderately sloping to strongly sloping ridgetops and strongly sloping to very steep side slopes that are dissected by many side-valley waterways. Nearly all of this association is adjacent to the Turkey and Volga Rivers and their tributaries. The soils formed in loess over limestone bedrock. They are well drained and somewhat excessively drained (fig. 4). Typical of the landscape are narrow, meandering valleys bordered by very steep, irregular side slopes. On the side slopes, between the bottom lands and the highest upland ridges, are outcrops of limestone. The limestone forms steep bluffs 10 to 150 feet or more high.

This association is scenic. Only a few winding roads cross the valleys, and limestone outcrops are in many of the road cuts. Woodland and pasture border the bluffs in most places on the uplands. Scattered trees grow in the drainageways and along the fences, and there are many irregularly shaped timbered areas. A distinctive feature of the landscape is the patches of oak and hickory forest that remain from the native vegetation. Some of these timbered areas are large, ranging from 40 acres to 600 acres in size. The farmsteads are mostly on the ridgetops, although a few are in the small valleys. The fields are commonly small,

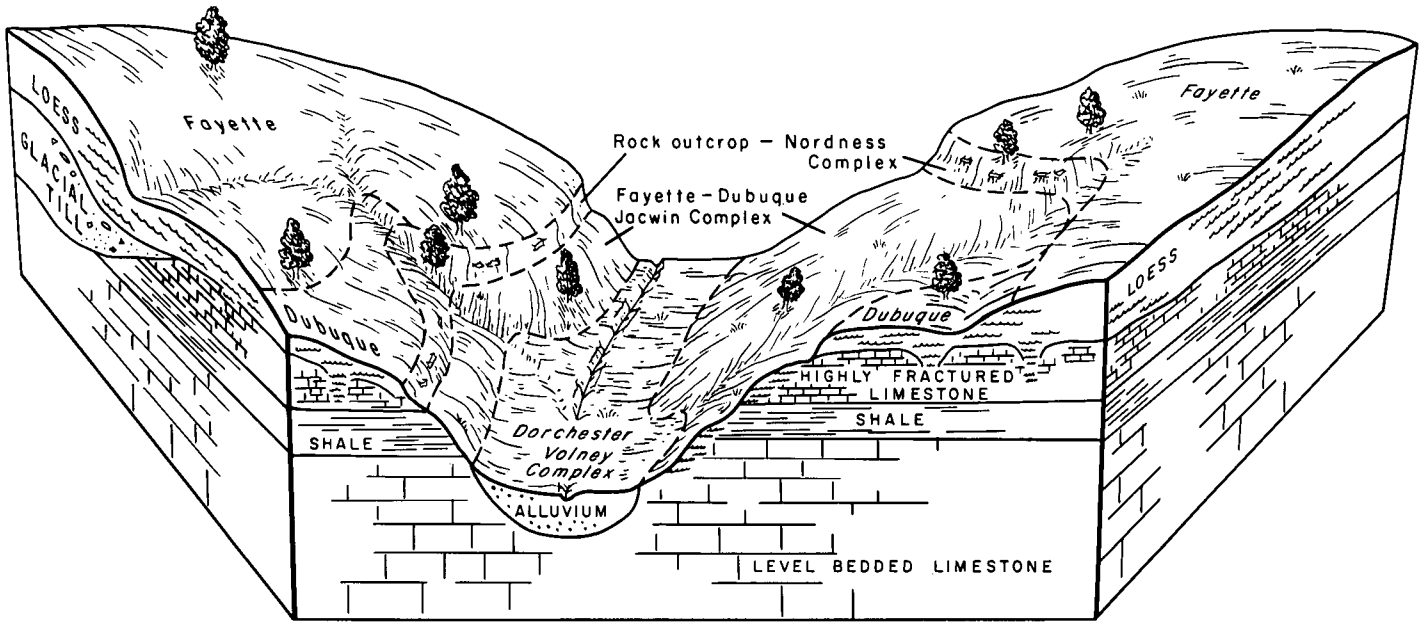


***Figure 4.*—Typical pattern of soils and underlying material in association 4.**

and they vary in shapes. County roads seldom follow the section lines.

This association makes up about 18 percent of the county. It is about 65 percent Fayette soils, 13 percent Nordness soils, 12 percent Rock outcrop, 4 percent Dubuque soils, and 6 percent minor soils. Minor soils in this association are Downs, Jacwin, Chaseburg, Dorchester, Volney, Fayette, and Dubuque soils.

Fayette soils are gently sloping to very steep and are on side slopes on uplands. The soils are well drained. They have a light colored silt loam surface layer where they are cultivated. The subsoil is dark yellowish brown silty clay loam that grades to silt loam as depth increases.

Nordness soils are gently sloping to steep and are on side slopes and escarpments on uplands. The soils are somewhat excessively drained. They have a light colored silt loam to loam surface layer. The subsoil is dark yellowish brown silt loam to silty clay loam. Limestone bedrock is at a depth of 5 to 18 inches.

Rock outcrop is outcrops of limestone bedrock on very steep side slopes and escarpments on uplands. In most places a thin layer of silt loam or loam overlies the limestone bedrock.

About half of this association is used for cultivated crops. The principal management needs are control of erosion and maintenance of tilth and fertility. Erosion is a concern, particularly in cultivated parts of ridgetops and valleys. Many of the soils are suited to row crops in a crop rotation, but farming on the contour

The livestock also use the available native pasture. The size of the average farm ranges from 160 to 200 acres, but the general trend is toward larger farms. Many farm buildings are unoccupied and deteriorating.

5. Downs-Fayette association

Gently sloping to moderately steep well drained soils that formed in loess on uplands

This association is on uplands characterized by gently sloping to moderately sloping narrow ridgetops and strongly sloping to moderately steep side slopes. The soils formed from loess more than 40 inches thick. They are well drained (fig. 5). The side slopes are dissected by many small drainageways, some of which have gullies that cannot be crossed with farm machinery. Scattered trees grow in the drainageways and along the fences in some places, and there are a few, small, irregularly shaped timbered areas in addition to the groves of trees around farmsteads. The farmsteads are mostly on ridgetops, although a few are in the small valleys. The fields are commonly small and have a variety of shapes. County roads often do not follow section lines.

This association makes up about 12 percent of the county. It is 60 percent Downs soils, 30 percent Fayette soils, and 10 percent minor soils. Minor soils in this association are Exette, Otter, and Huntsville soils.

Downs soils are gently sloping to strongly sloping and are on convex side slopes. The soils are well

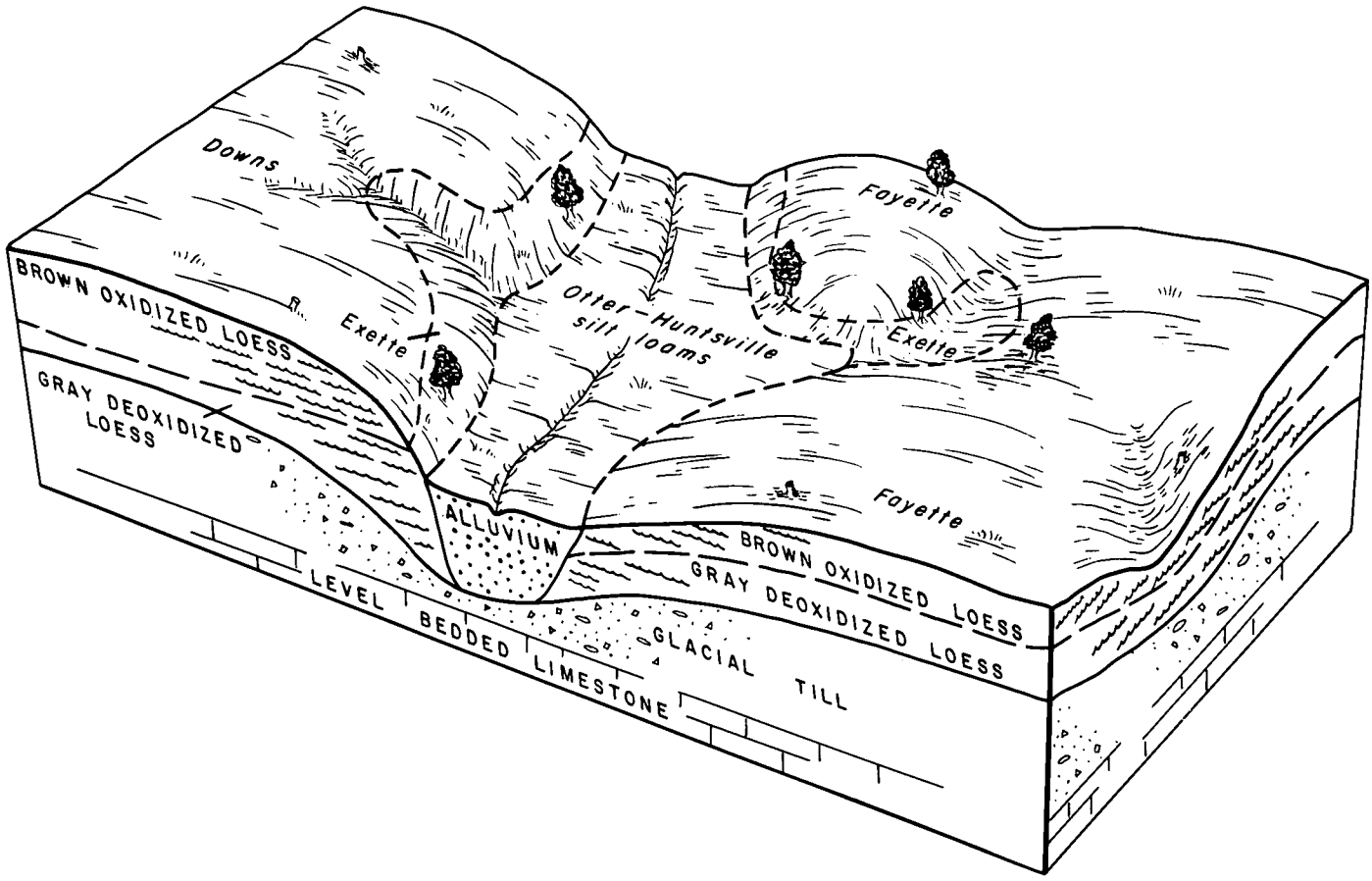


Figure 5.—**Typical pattern of soils and underlying material in association 5.**

Fayette soils are gently sloping to moderately steep and are on convex side slopes. They are usually more sloping than Downs soils. The soils are well drained. They have a light colored silt loam surface layer if cultivated. The subsoil is dark yellowish brown silty clay loam that grades to silt loam as depth increases.

This association is well suited to poorly suited to row crops. The soils are subject to erosion or are too steep for cultivated crops. The principal management needs are control of erosion and maintenance of tilth and fertility. Erosion is a concern, particularly in cultivated parts of ridgetops and valleys. In most areas

6. Dorchester-Saude-Wapsie association

Nearly level to moderately sloping, moderately well drained and well drained soils that formed in silty and loamy alluvial sediment on bottom lands and stream benches

This association is on bottom lands and stream benches characterized by nearly level to moderately sloping areas, but a few strongly sloping to steep areas are along the terrace escarpments. The soils on bottom lands and the soils on the benches form two distinct associations, but they are impractical to separate. The

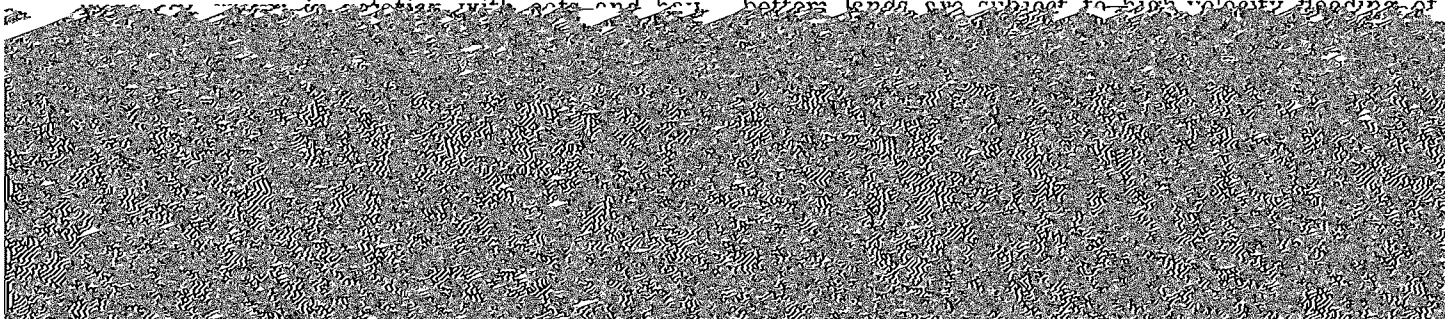


Figure 6.—Grass seeded backslope of tile inlet terrace in Downs Fayette association.

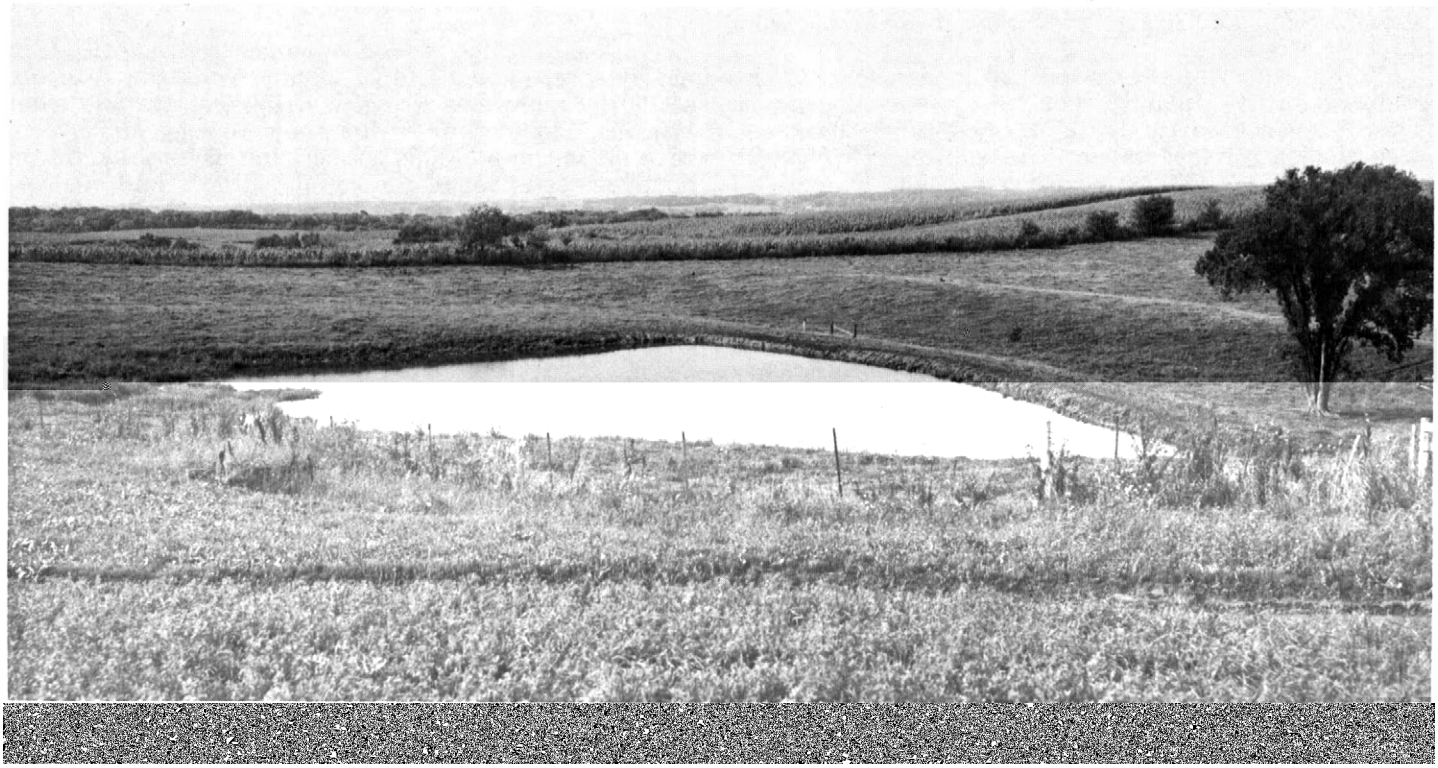


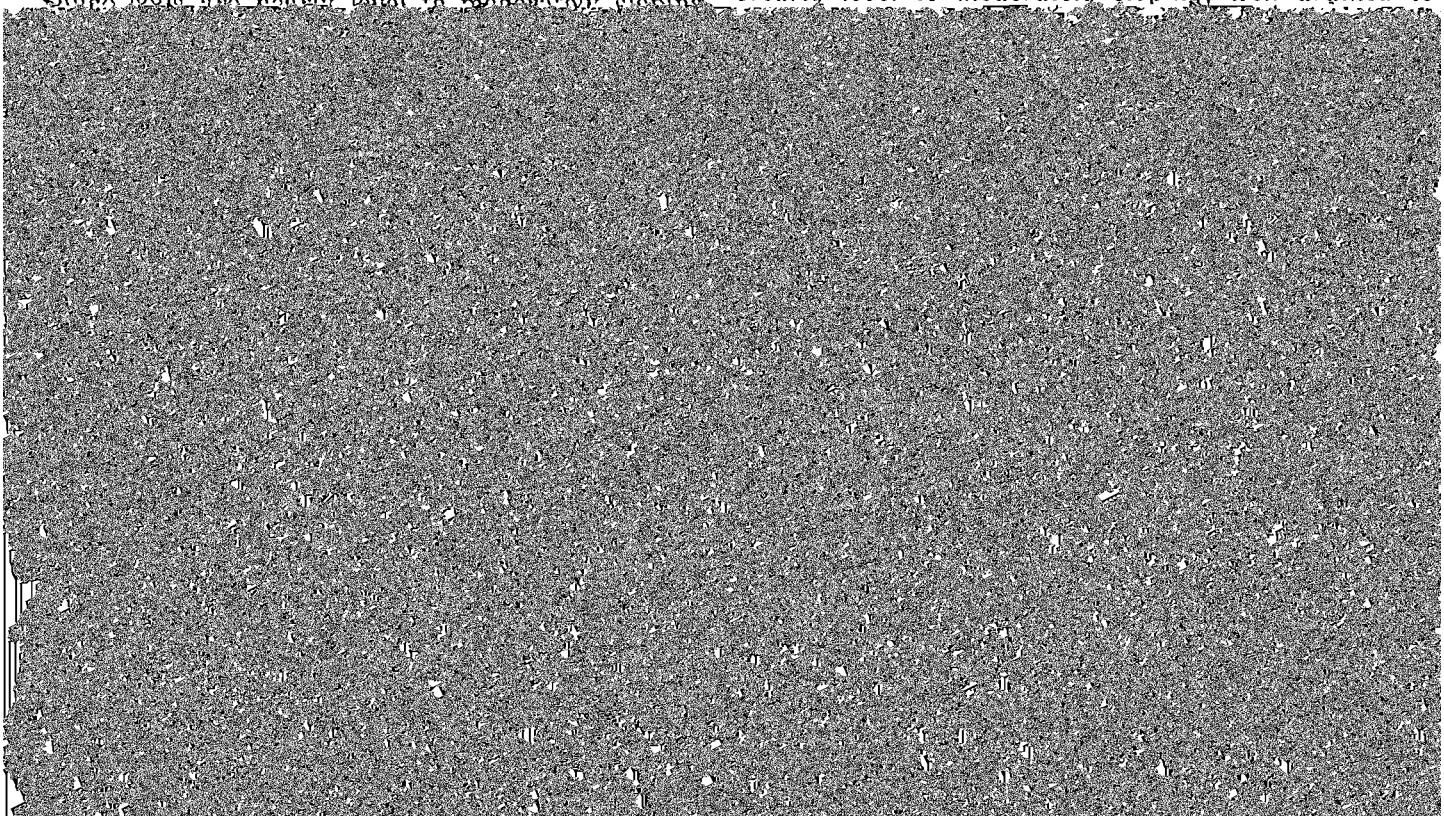
Figure 8.—Typical area along the Volga River. Dorchester soils are in the stream valley, and Nordness soils are in the background.

mildly alkaline. A dark colored silt loam buried soil is below a depth of about 3 feet.

Soude soils are nearly level to moderately sloping

7. Bassett-Schley-Wapsie association

Nearly level to moderately sloping, well drained to



erately thick, moderately dark colored, loamy surface layer over a yellowish brown, mottled, stratified, loam subsoil that contains stones and pebbles.

Wapsie soils are nearly level to moderately sloping and are on benches. The soils are well drained. They have a moderately dark colored, loamy surface layer over yellowish brown loamy subsoil. Sand and gravel are below a depth of about 2 feet.

This association is well suited to poorly suited to crops. Row crops are grown intensively on this association. Yields are moderately good for the Saude and Wapsie soils in years of normal rainfall. The management needs are control of flooding on the bottom lands and maintenance of tilth and fertility on the benches. The bottom lands are flooded nearly [illegible]

by referring to the "Index to mapping units" at the front of this survey.

Backbone series

The Backbone series consists of moderately dark colored, somewhat excessively drained soils. These gently sloping to strongly sloping soils are on ridges and convex side slopes on uplands. Slopes are 2 to 14 percent. These soils formed in moderately coarse textured windblown sediment and the underlying very firm residuum over limestone bedrock. The native vegetation was mixed prairie grasses and deciduous trees.

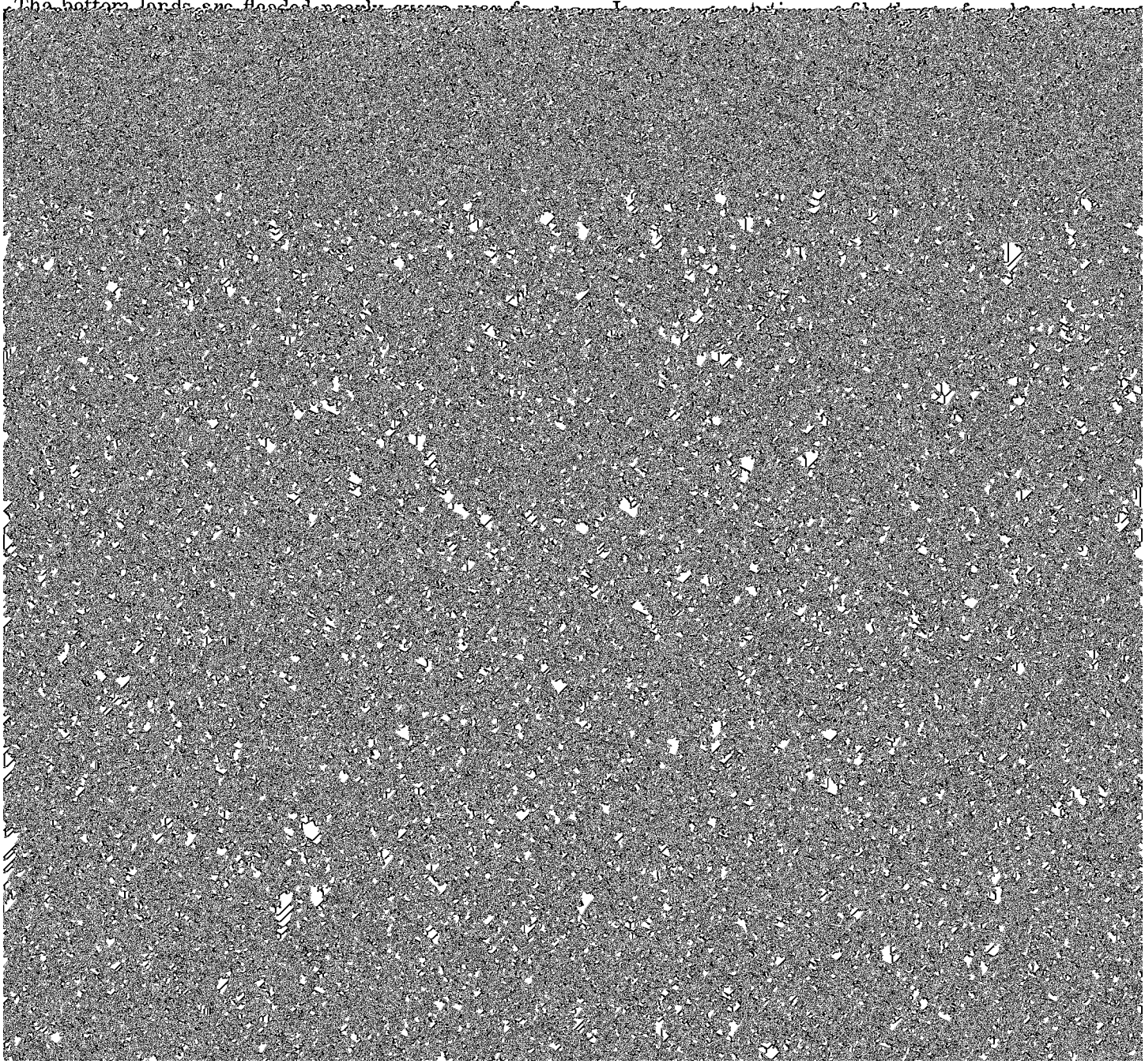


TABLE 1.—*Acreage and proportionate extent of the soils*

Map symbol	Soil name	Acres	Percent	Map symbol	Soil name	Acres	Percent
27B	Terril loam, 2 to 5 percent slopes	930	0.2	163D	Fayette silt loam, 9 to 14 percent slopes	2,565	0.6
41	Sparta loamy fine sand, 0 to 2 percent slopes	350	0.1	163D2	Fayette silt loam, 9 to 14 percent slopes, moderately eroded	12,445	2.7
41B	Sparta loamy fine sand, 2 to 5 percent slopes	1,245	0.3	163D3	Fayette silt loam, 9 to 14 percent slopes, severely eroded	1,855	0.4
41C	Sparta loamy fine sand, 5 to 9 percent slopes	585	0.1	163E	Fayette silt loam, 14 to 18 percent slopes	3,090	0.7
41D	Sparta loamy fine sand, 9 to 14 percent slopes	280	0.1	163E2	Fayette silt loam, 14 to 18 percent slopes, moderately eroded	4,445	1.0
63C	Chelsea loamy fine sand, 2 to 9 percent slopes	365	0.1	163E3	Fayette silt loam, 14 to 18 percent slopes, severely eroded	2,975	0.6
63E	Chelsea loamy fine sand, 14 to 25 percent slopes	490	0.1	163F	Fayette silt loam, 18 to 25 percent slopes	2,750	0.6
83B	Kenyon loam, 2 to 5 percent	75,090	16.1	163F2	Fayette silt loam, 18 to 25 percent slopes, moderately eroded	2,235	0.5

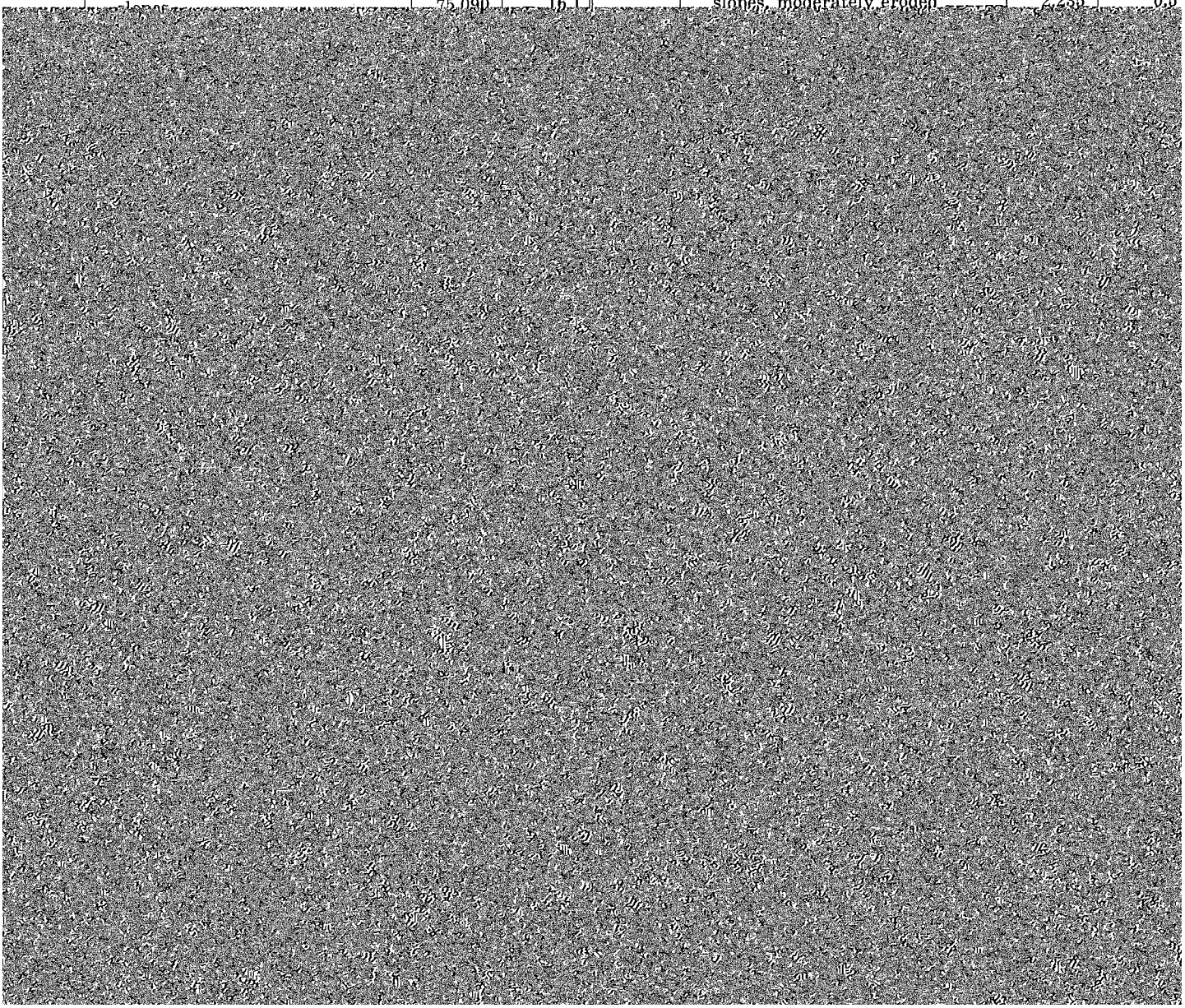


TABLE 1.—*Acreage and proportionate extent of the soils*—Continued

Map symbol	Soil name	Acres	Percent	Map symbol	Soil name	Acres	Percent
214	Rockton loam, 20 to 30 inches to limestone, 0 to 2 percent slopes	955	0.2	444C	Jacwin loam, 5 to 9 percent slopes	675	0.1
214B	Rockton loam, 20 to 30 inches to limestone, 2 to 5 percent slopes	2,575	0.6	444D	Jacwin loam, 9 to 14 percent slopes	225	(1)
214C	Rockton loam, 20 to 30 inches to limestone, 5 to 9 percent slopes	575	0.1	471	Oran loam, 1 to 3 percent slopes	4,200	0.9
				478G	Rock outcrop-Nordness complex, 25 to 60 percent slopes	17,280	3.7
				480C	Orwood silt loam, 5 to 9 percent		

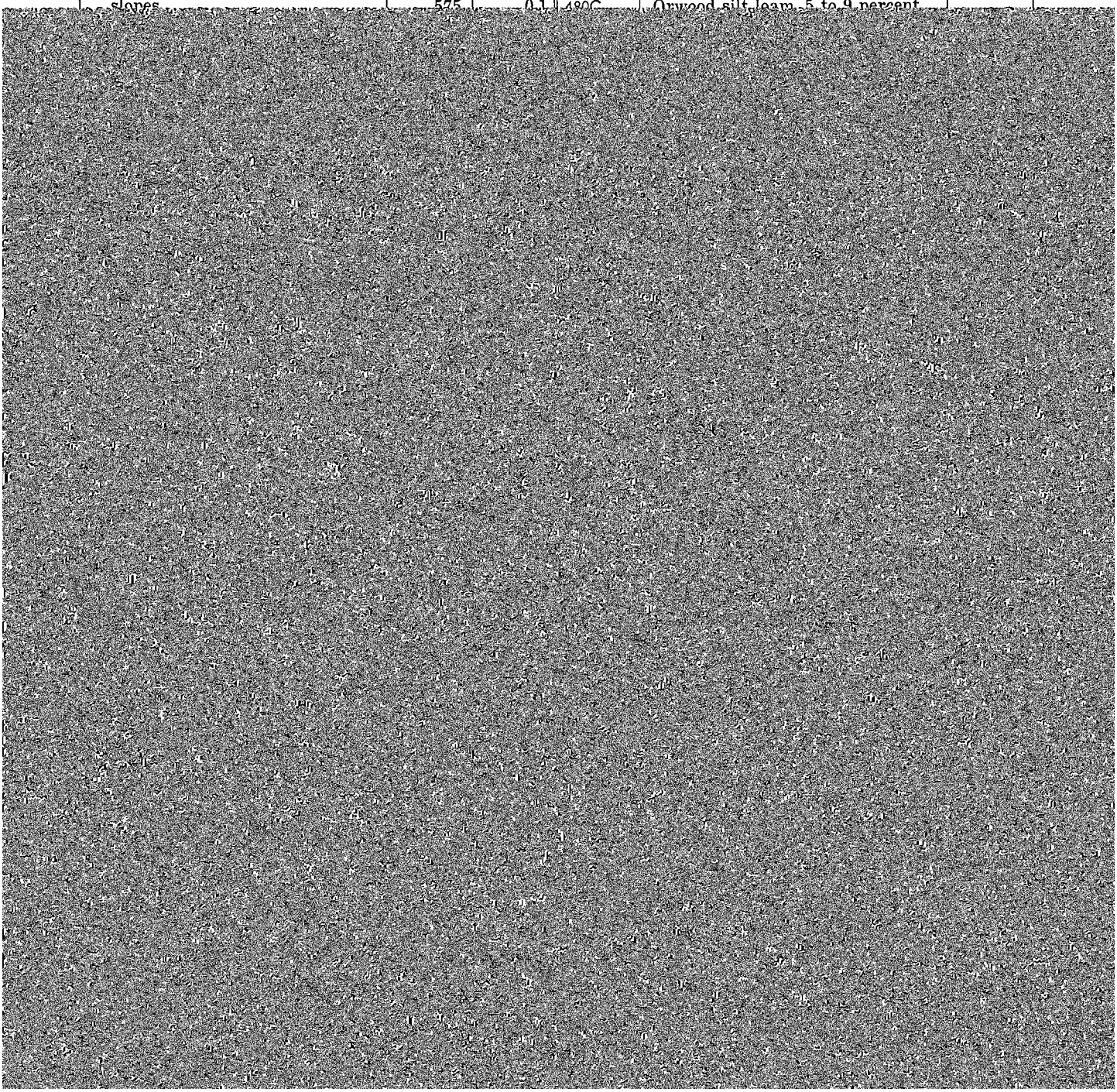


TABLE 1.—*Acreage and proportionate extent of the soils*—Continued

Map symbol	Soil name	Acres	Percent	Map symbol	Soil name	Acres	Percent
777C	Wapsie loam, 5 to 9 percent slopes	480	0.1	784B	Riceville loam, 1 to 4 percent slopes	520	0.1
781B	Lourdes loam, 2 to 5 percent slopes	1,300	0.3	798B	Protivin loam, 1 to 4 percent slopes	2,900	0.6
781C	Lourdes loam, 5 to 9 percent slopes	215	(1)	926	Canoe silt loam, 0 to 2 percent slopes	375	0.1
782	Donnan loam, 0 to 2 percent slopes	220	(1)	977	Richwood silt loam, 0 to 2 percent slopes	215	(1)
782B	Donnan loam, 2 to 5 percent slopes	2,650	0.6	978	Festina silt loam, 0 to 2 percent slopes	460	0.1
782C	Donnan loam, 5 to 9 percent slopes	280	0.1		Limestone quarries, water, sand and gravel pits, borrow areas, made land	1,210	0.3
783B	Cresco loam, 2 to 5 percent slopes	10,575	2.3		Total	465,920	100.0
783C	Cresco loam, 5 to 9 percent slopes	1,215	0.3				

[1] Less than 0.1 percent.

subangular blocky structure; firm; stone line at a depth of 24 inches; thin discontinuous brown (10YR 4/3) clay films; strongly acid; abrupt wavy boundary.

IIB23t—30 to 34 inches; brown (7.5YR 4/4) clay; strong coarse prismatic structure parting to strong medium subangular blocky; very firm; thick continuous yellowish red (5YR 4/6) clay films; many soft black (10YR 2/1) oxide concretions; strongly acid; abrupt wavy boundary.

IIR1—34 to 36 inches; soft limestone weathered along joints and partially fractured; limestone flags with reddish brown (5YR 4/4) and strong brown (7.5YR 5/6) clay residuum interbedded; mildly

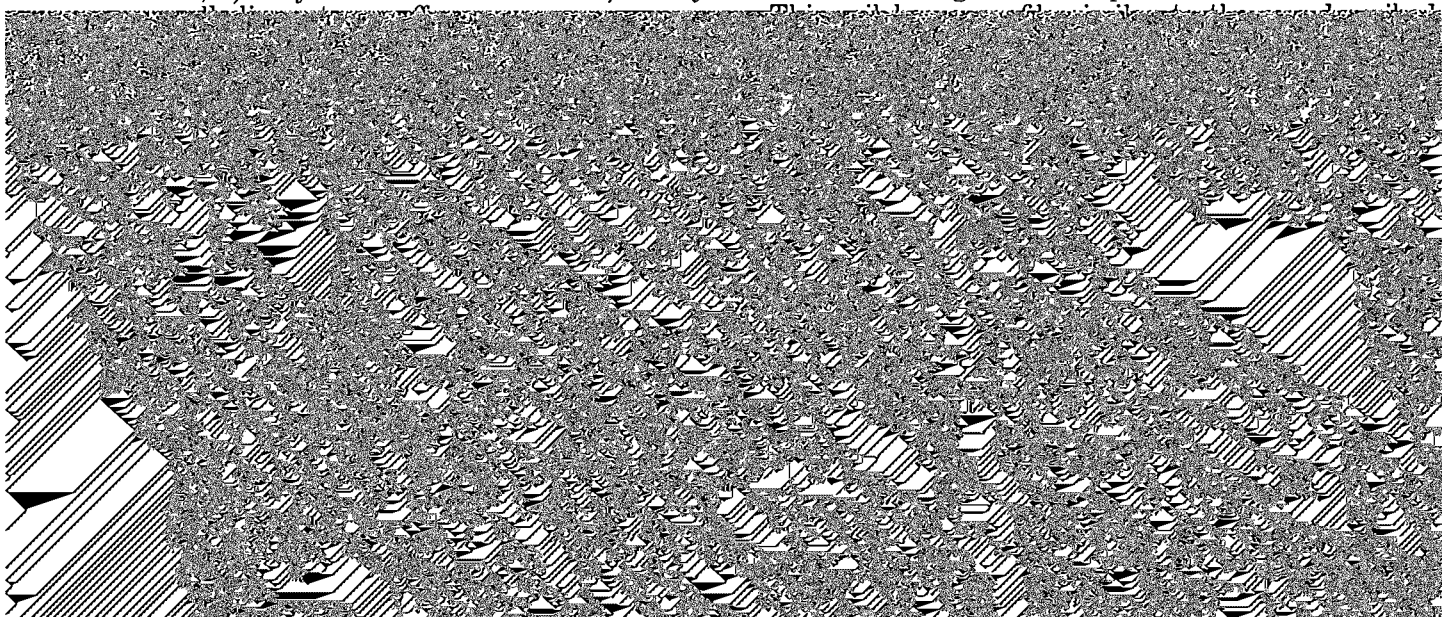
side slopes on uplands and in benchlike areas. Areas are about 10 acres in size and irregular in shape.

This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of soils that have a thicker and darker surface layer and are higher in organic matter and fertility than this Backbone soil.

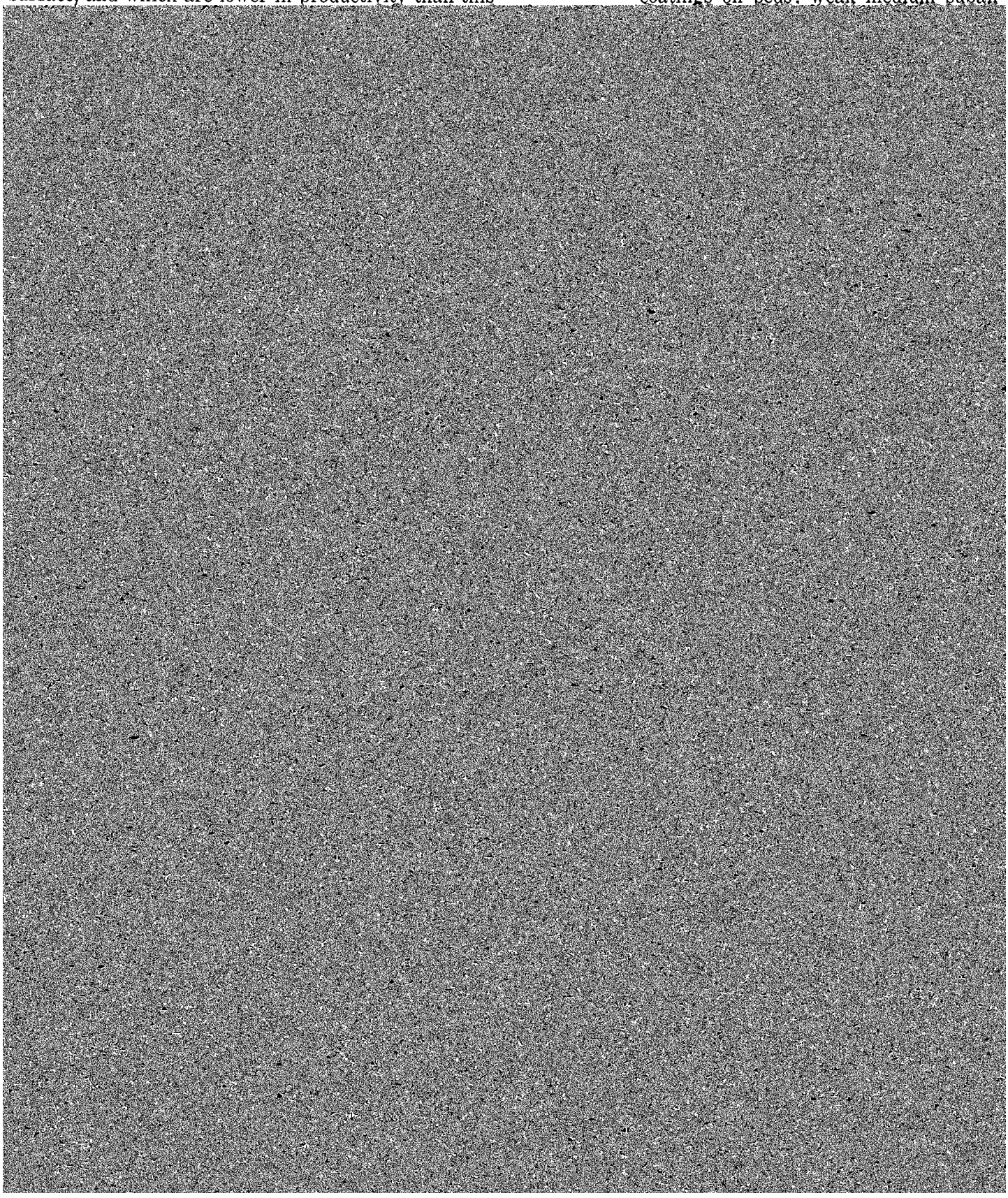
This soil is suited to occasional row crops. It is droughty because of the shallowness to limestone bedrock. Crop yields are low unless rainfall is very timely. This soil is subject to soil blowing and water erosion if cultivated. The organic matter content is very low. Capability unit IIIe–4.

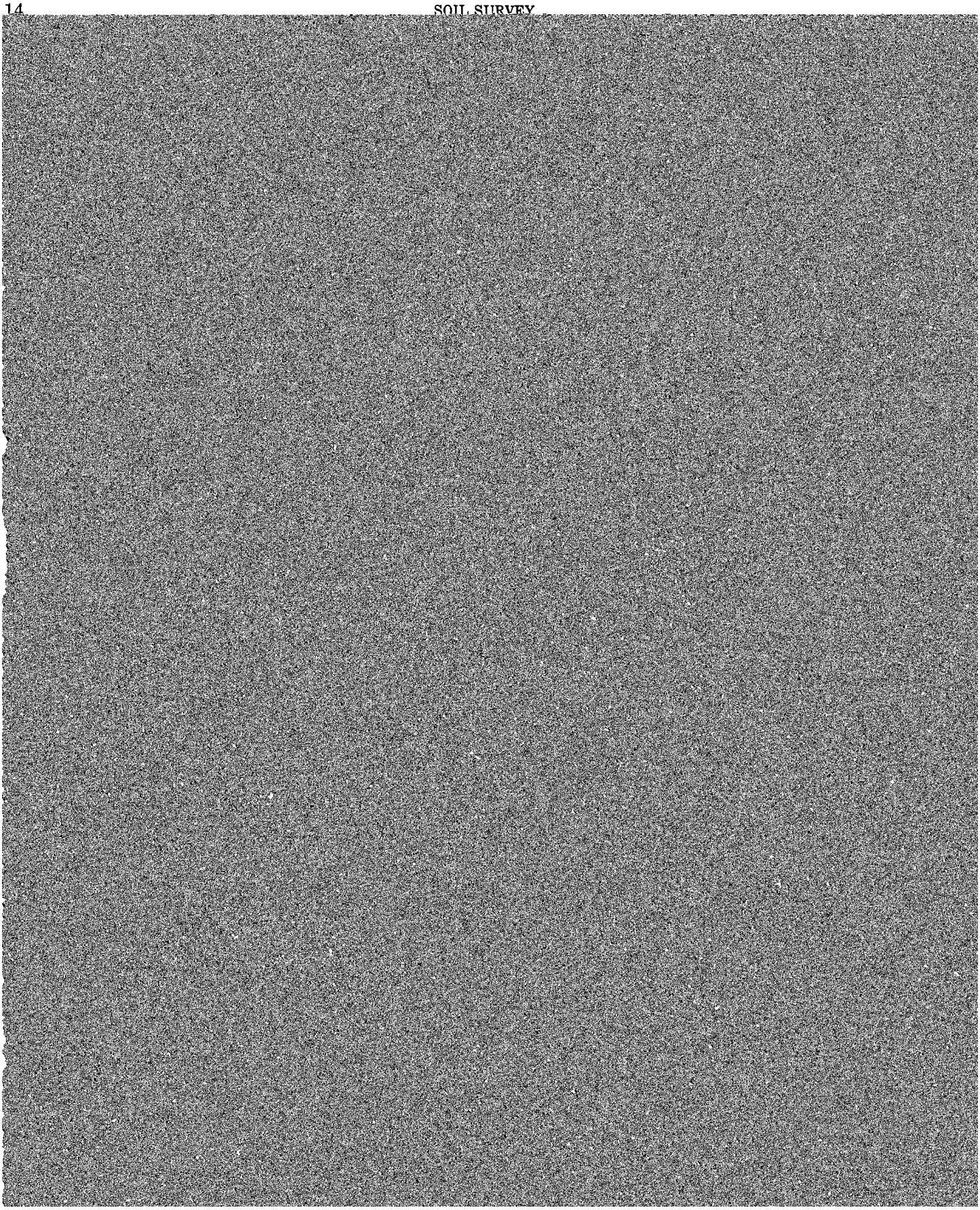
109C—Backbone fine sandy loam, 5 to 9 percent slopes. This moderately sloping soil is on convex ridges and side slopes on uplands. Areas are 5 to 10 acres in size and are elongated in shape.



surface, and which are lower in productivity than this

coatings on peds: weak medium suban-





ture; friable; strongly acid; gradual smooth boundary.

B21t—14 to 21 inches; yellowish brown (10YR 5/4) heavy loam; moderate medium subangular blocky structure; friable; thin discontinuous brown (7.5YR 4/4) clay films; very strongly acid; clear smooth boundary.

B22t—21 to 26 inches; yellowish brown (10YR 5/6) light clay loam; moderate medium subangular blocky structure; friable; thin discontinuous brown (7.5YR 4/4) clay films; very strongly acid; clear smooth boundary.

B3t—26 to 30 inches; yellowish brown (10YR 5/6) sandy clay loam; weak medium subangular blocky structure; friable; thin discontinuous brown (7.5YR 5/4) clay films; very strongly acid; abrupt

on uplands and on stream benches. Areas are about 5 to 10 acres in size and are irregular in shape.

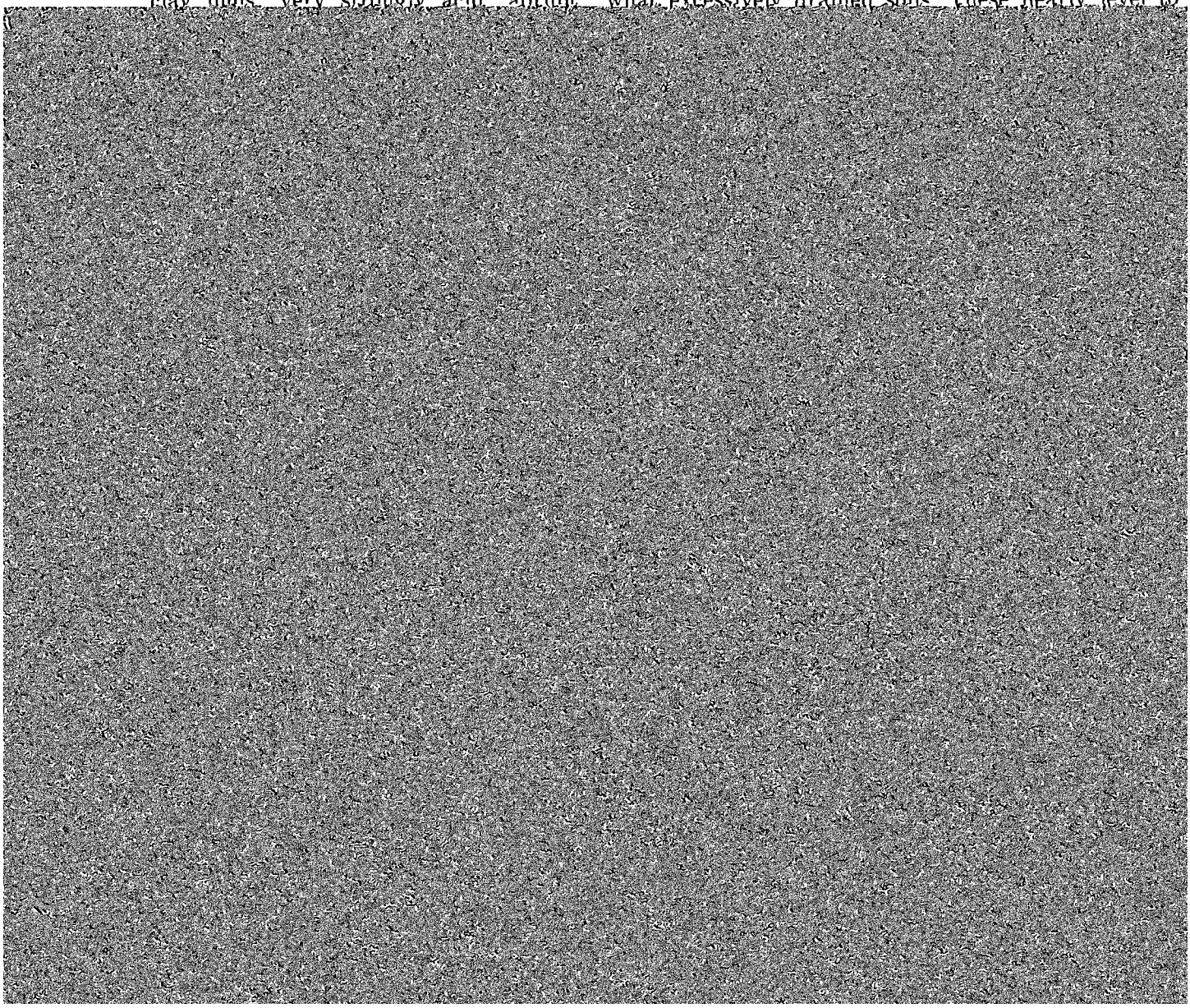
This soil has a profile similar to the one described as representative of the series, but the depth to sand and gravel is less.

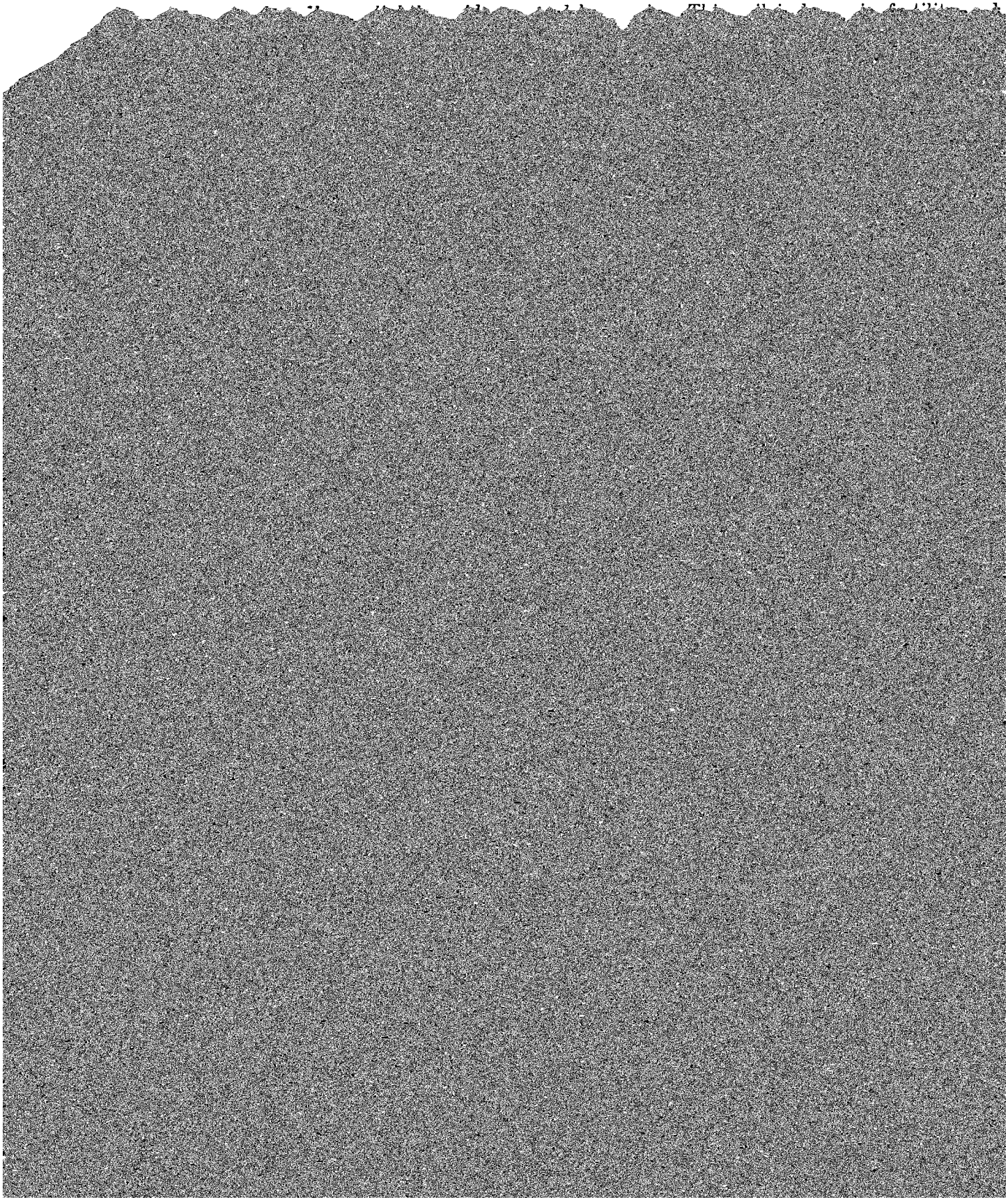
Included with this soil in mapping are a few areas of soils that have steeper slopes and are subject to more erosion than this Bixby soil.

This soil is suited to cultivated crops. It is subject to slight to moderate erosion if cultivated. Because of the coarse textured substratum, droughtiness is a limitation if rainfall is not timely or above normal during the growing season. The organic matter content is very low. Capability unit IIe–2.

Burkhardt series

The Burkhardt series consists of dark colored, somewhat excessively drained soils. These nearly level to





A1—0 to 10 inches; black (N 2/0) silty clay loam; moderate very fine and fine granular structure; friable; neutral; gradual smooth boundary.

A3—10 to 17 inches; black (10YR 2/1) heavy silty clay loam, weak medium subangular blocky structure parting to weak fine granular; friable; neutral; gradual smooth boundary.

B2g—17 to 24 inches; olive gray (5Y 5/2) and olive (5Y 5/3) heavy silty clay loam; gray (5Y 5/1) coatings on peds; few fine prominent yellowish brown (10YR 5/8) mottles; moderate medium and fine subangular blocky structure parting to moderate very fine subangular blocky; friable; neutral; gradual smooth boundary.

B31—24 to 29 inches; mottled yellowish brown (10YR 5/8) and olive (5Y 5/3) heavy silty clay loam; few fine faint light olive gray (5Y 6/2) mottles; weak medium and fine subangular blocky structure; friable; neutral; clear smooth boundary.

IIB32g—29 to 40 inches; mottled greenish gray (5GY 6/1) and yellowish brown (10YR 5/6, 5/8) silty clay; moderate medium and fine prismatic structure parting to strong medium and fine subangular blocky; very firm; mildly alkaline; strong effervescence; gradual smooth boundary.

IIC—40 to 60 inches; mottled greenish gray (5GY 6/1) and yellowish brown (10YR 5/8) silty clay shale; massive; very firm; mildly alkaline; strong effervescence.

The solum is generally more than 36 inches thick, but it ranges from 30 to 50 inches in thickness. The solum is neutral or slightly acid in the most acid part. The soils formed in 24 or 32 inches of moderately fine textured material and in the underlying very firm silty clay shale. Carbonates are present in the lower part of the solum at a depth of 24 to 40 inches. The A horizon is typically silty clay loam but ranges to heavy loam and heavy silt loam that is high in sand. It is 15 to 24 inches thick. The B2 horizon has hue of 5Y or 2.5Y, value of 4 or 5, and chroma of 2 to 6. The B2 and B3 horizons are typically silty clay loam but range to sandy clay loam. In places a thin stratum of sandy loam or loamy sand as much as 8 inches thick is between the moderately fine textured material and the clayey shale. Texture of the shale is silty clay or clay. In some places a small amount of fractured limestone is interbedded with the shale. Reaction of the shale is mildly alkaline.

These Calamine soils do not have the argillic horizon that is typical of the series, but this does not significantly alter their usefulness or behavior.

Calamine soils are associated with the Jacwin, Marlean, Rockton, Winneshiek, and Nordness soils and the Rock Outcrop-Nordness complex. They are not underlain by limestone bedrock as are Rockton, Marlean, Winneshiek, and Nordness soils. They have a grayer upper B horizon and are more poorly drained than Jacwin soils.

551—Calamine silty clay loam, 1 to 3 percent slopes. This nearly level to gently sloping soil is on slightly concave to slightly convex foot slopes on high structural benches on uplands. Areas are 10 to 20 acres in size and are irregular in shape.

Included with this soil in mapping are a few areas of soils in which the depth to clayey shale is 4 feet or more. Also included are areas of soils that have a loam texture above the shale and that commonly contain a sand lens as much as 2 feet thick. These areas may be more difficult to drain.

This soil is poorly suited to cultivated crops. It is subject to wetness caused by seepiness from soils upslope. Water from springs feed many areas. Artificial drainage is needed, but is difficult because the water feeding these areas must be intercepted upslope before it reaches the rooting zone. The organic matter content is high. Capability unit IIIw–2.

Camden series

The Camden series consists of light colored, well drained soils. These nearly level soils are on stream benches. Slopes are 0 to 2 percent. These soils formed in 36 to 45 inches of medium textured silty alluvium and in the underlying stratified outwash. The native vegetation was deciduous trees.

In a representative profile the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil extends to a depth of 55 inches. It is brown, friable silt loam in the upper part; yellowish brown, friable heavy silt loam and light clay loam in the middle part; and brown, friable clay loam and sandy clay loam with sandy loam strata in the lower part. The substratum is dark brown sandy loam and has some gravel and thin strata of sandy clay loam.

Available water capacity is moderate. Permeability is moderate in the upper part of the soil and moderately rapid to rapid in the coarser textured substratum. Available phosphorus is medium, and available potassium is very low. Unless these soils have been limed within the past 5 years, they are acid.

Camden soils are mainly used for cultivated crops. The major limitation for crops is occasional runoff from the adjoining loess-covered uplands. These soils can be somewhat droughty during seasons of below normal rainfall.

Representative profile of Camden silt loam, 0 to 2 percent slopes, in a cultivated field, 520 feet west and 416 feet south of the northeast corner of SW¼SW¼ sec. 34, T. 95 N., R. 7 W.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; few very dark grayish brown (10YR 3/2) coatings on peds, light brownish gray (10YR 6/2) dry; cloddy parting to weak fine and very fine granular structure; friable; slightly acid; abrupt smooth boundary.

A2—8 to 11 inches; brown (10YR 4/3) silt loam; very weak thin platy structure; friable; slightly acid; clear smooth boundary.

B1—11 to 15 inches; brown (10YR 5/3) silt

loam; weak to moderate medium subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21t—15 to 26 inches; yellowish brown (10YR 5/6) heavy silt loam; moderate to strong medium and fine angular blocky and subangular blocky structure; friable; thin discontinuous light gray (10YR 7/1) dry silt coatings on ped faces; thin discontinuous dark brown (10YR 3/3) clay films; slightly acid; clear smooth boundary.

IIB22t—26 to 31 inches; yellowish brown (10YR 5/6) light clay loam; moderate medium and fine angular blocky and subangular

high in sand. They may be more droughty than this Camden soil.

This soil is well suited to cultivated crops. It is subject to runoff and sediment from soils upslope. It is subject to droughtiness when rainfall is below average. The organic matter content is low to very low. Capability unit I–1.

Caneek series

The Caneek series consists of moderately dark colored, somewhat poorly drained to poorly drained soils. These nearly level soils are on flood plains associated with the steep soils that formed in thin loess over limestone on uplands. Slopes are 0 to 2 percent. These

Caneek soils are associated with Dorchester, Ossian, and Huntsville soils, and they formed in parent material similar to that of Dorchester soils. They have a grayer C horizon than the Dorchester soils and are more poorly drained. They are lighter colored in the upper part of the profile than Ossian and Huntsville soils.

490—Caneek silt loam, 0 to 2 percent slopes. This nearly level soil is on bottom lands and low stream benches. Areas are about 10 acres in size and are irregular in shape.

Included with this soil in mapping are a few areas of soils that have 6 to 15 inches of sandy overwash. These areas are lower in productivity than this Caneek soil.

This soil is suited to row crops if well managed. It is subject to numerous floods of short duration during the growing season. Diversion terraces help to protect it from runoff. It has a seasonal high water table, and tile drainage is beneficial. The organic matter content is very low above a depth of 20 to 36 inches and high below this depth. Capability unit IIw–3.

Canoe series

The Canoe series consists of moderately dark colored, somewhat poorly drained soils. These nearly

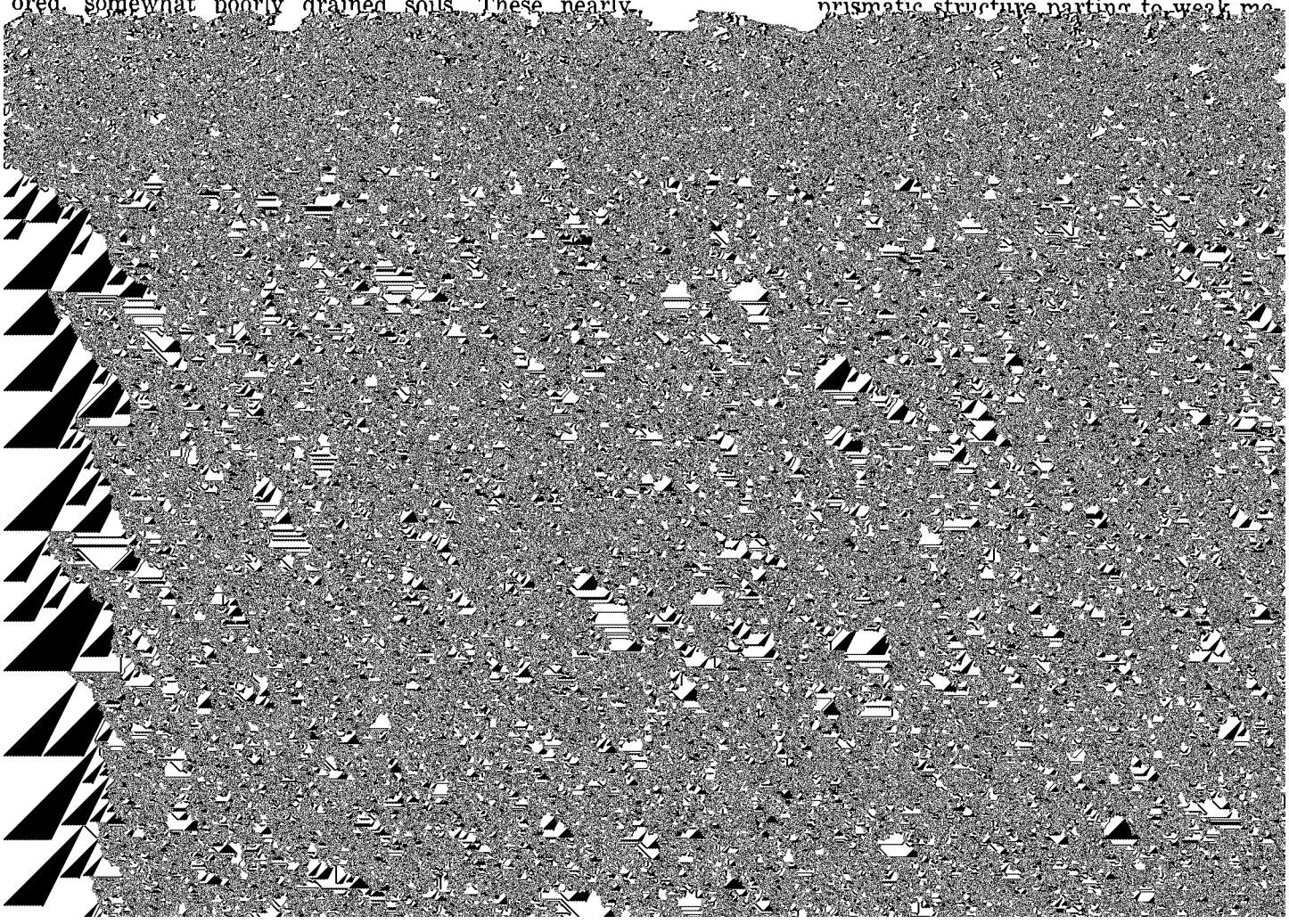
platy structure; friable; medium acid; clear smooth boundary.

B1—12 to 17 inches; grayish brown (10YR 5/2) silt loam; few fine distinct brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

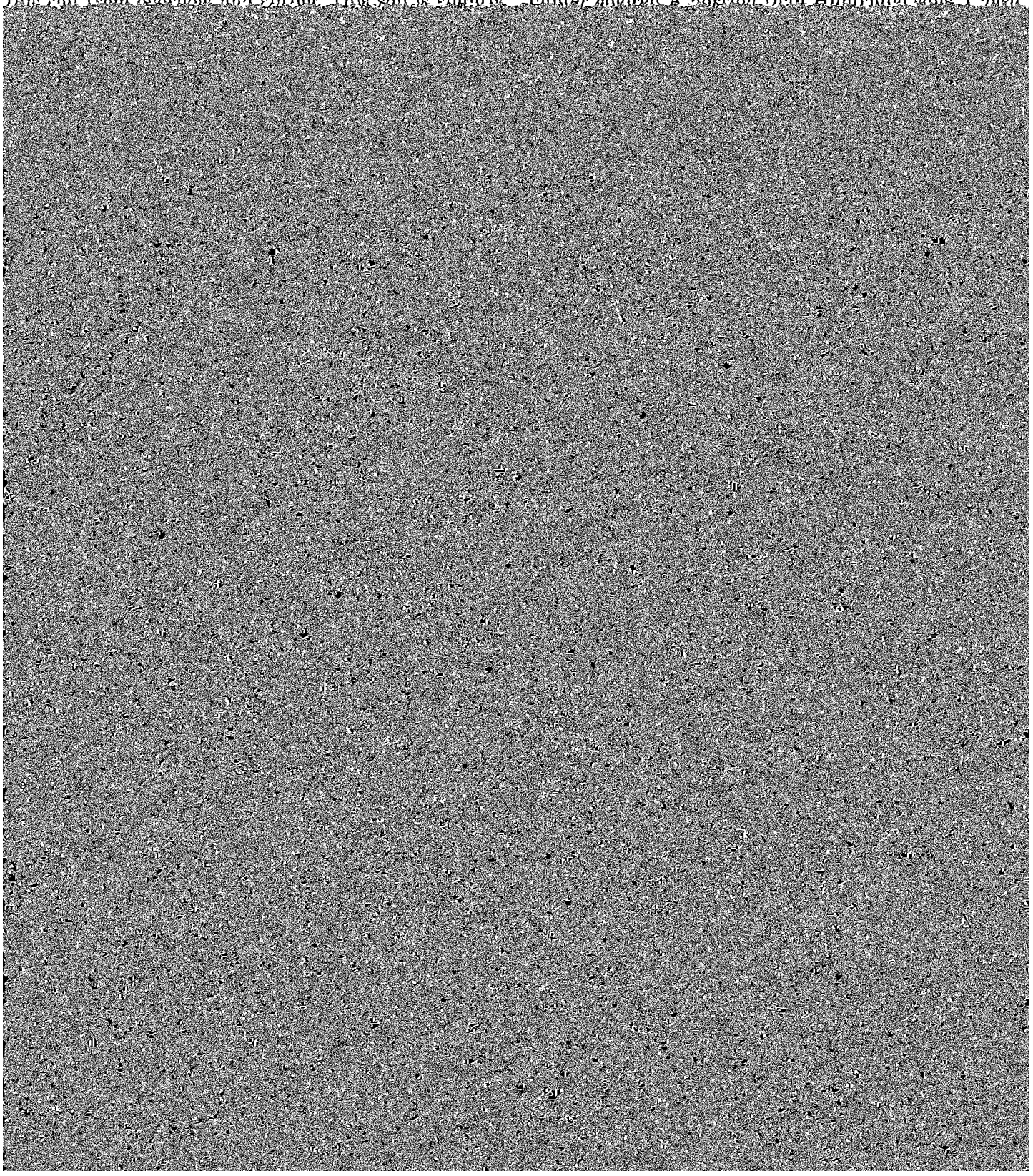
B21—17 to 28 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) silt loam; light brownish gray (10YR 6/2) coatings on peds; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; common soft dark oxide concretions; very strongly acid; clear smooth boundary.

B22—28 to 37 inches; mottled yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) silt loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; very strongly acid; clear smooth boundary.

B3—37 to 48 inches; mottled strong brown (7.5YR 5/6) and light brownish gray (2.5Y 6/2) silt loam; weak medium prismatic structure parting to weak me-



This soil is well suited to cultivated crops. It is subject to runoff from soils upslope. Diversion terraces placed on the adjacent upland slopes help to protect this soil from overflow and silting. This soil is slightly



ent material similar to that of Dorchester soils. They have a thinner, more stratified solum than Downs, Fayette, Dubuque, and Huntsville soils. They have a lighter colored A horizon than Huntsville soils. Chaso

ings; weak medium platy structure parting to weak fine subangular blocky; very friable; slightly acid; clear smooth boundary.

A22—5 to 9 inches; brown (10YR 4/3) fine sand; single grained; loose; slightly acid; clear smooth boundary.

A23—9 to 23 inches; dark yellowish brown (10YR 4/4) fine sand; single grained; loose; few roots; strongly acid; clear smooth boundary.

A24—23 to 45 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; strongly acid; clear smooth boundary.

A&B—45 to 60 inches; light yellowish brown (10YR 6/4) fine sand; single grained; loose; some 1/2- to 1/4-inch thick bands of strong brown (7.5YR 5/6) light sandy loam in the upper part of the horizon that become numerous in lower part; medium acid.

The solum ranges from 4 feet to many feet in thickness. It is medium acid to strongly acid in the most acid part. The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The Ap horizon is dark grayish brown (10YR 4/2) to dark brown (10YR 3/3) or brown (10YR 4/3). The A horizon is typically loamy fine sand but ranges to fine sand. The lamellae in the A&B horizon are 1/4 inch to 2 inches thick and have hue of 7.5YR or 10YR and chroma of 3 to 4. The uppermost lamella is at a depth of 3 to 4 feet.

Chelsea soils are associated with Sparta, Lamont, Backbone, and Fayette soils, and they formed in parent material similar to that of Sparta, Lamont, and Dickinson soils. They have more sand in the upper part of the solum than Lamont and Fayette soils. Chelsea soils have more sand in the upper part of the to 40 inches. These soils are more droughty than this Chelsea soil.

This soil is poorly suited to cultivated crops. It is better suited to woodland or wildlife habitat. It is susceptible to soil blowing, water erosion, and severe droughtiness. Because the slopes are steep, many pasture areas are difficult to renovate with regular farm machinery. The organic matter content is very low. Capability unit VIIs–1.

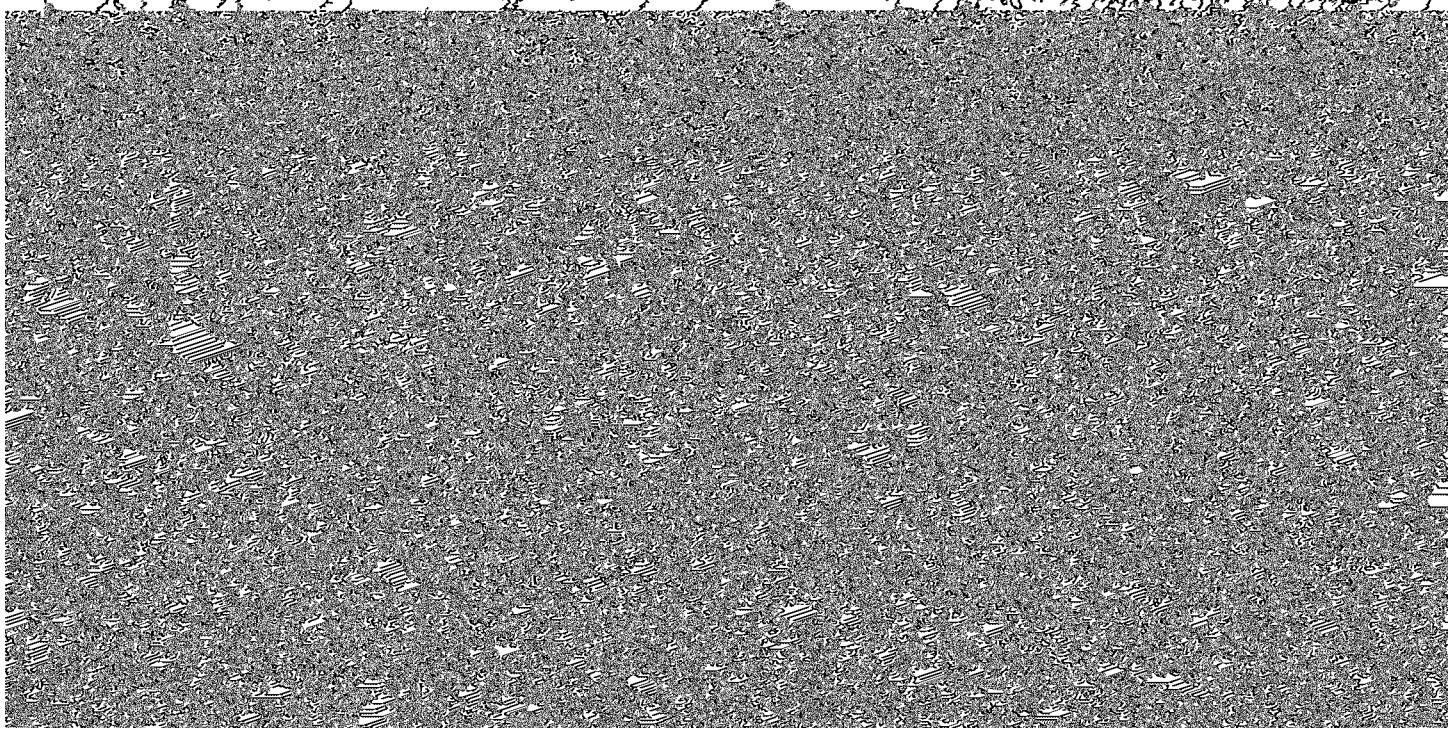
Clyde series

The Clyde series consists of dark colored, poorly drained soils. These nearly level to gently sloping soils are in drainageways and on lower concave positions on the uplands. Slopes are 1 to 3 percent. These soils formed in 30 to 50 inches of moderately fine textured material and in the underlying friable to firm glacial till or stratified valley fill. The native vegetation was prairie grasses and plants that were tolerant to wetness.

In a representative profile the surface layer is black, friable clay loam and silty clay loam high in sand and is about 20 inches thick. The subsoil extends to a depth of 52 inches. It is dark gray, friable silty clay loam in the upper part; gray, friable silty clay loam and mottled gray and olive gray, very friable sandy loam in the middle part; and mottled gray and strong brown, firm heavy loam in the lower part. The substratum is gray, firm heavy loam.

Available water capacity is high and permeability is moderate. Available phosphorus and available potassium are very low. These soils are generally neutral in the surface layer and do not require liming.

These soils are used mainly for cultivated crops. If not artificially drained, they are in permanent pasture or are idle. The major limitation for crops is wetness. Tile drainage is needed in Clyde soils for satisfactory



medium subangular blocky structure; friable; common fine distinct dark brown (7.5YR 4/4) oxide concretions; neutral; clear smooth boundary.

B22tg—24 to 29 inches; gray (5Y 5/1) silty clay

Kenyon soils, which are better drained and more sloping than these soils. This complex is 60 percent Clyde soils and 40 percent Floyd soils. In most places the Clyde soil is in the lowest part of the drainageway, bordered by a band of Floyd soil. These soils are in

Figure 9.—**Typical undrained area of Clyde-Floyd complex in permanent pasture.**

A1—0 to 2 inches; very dark gray (10YR 3/1) loam; weak medium platy structure

IIB22t—24 to 32 inches; yellowish brown (10YR 5/6) heavy loam; brown (10YR 5/3)

inches thick and is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The A2 horizon is 4 to 10 inches thick, but in cultivated areas it may be partially incorporated into the Ap horizon. The IIB horizon is typically loam but ranges to light clay loam or sandy clay loam. It is medium acid to very strongly acid. Calcareous glacial till is at a depth of 60 to 80 inches.

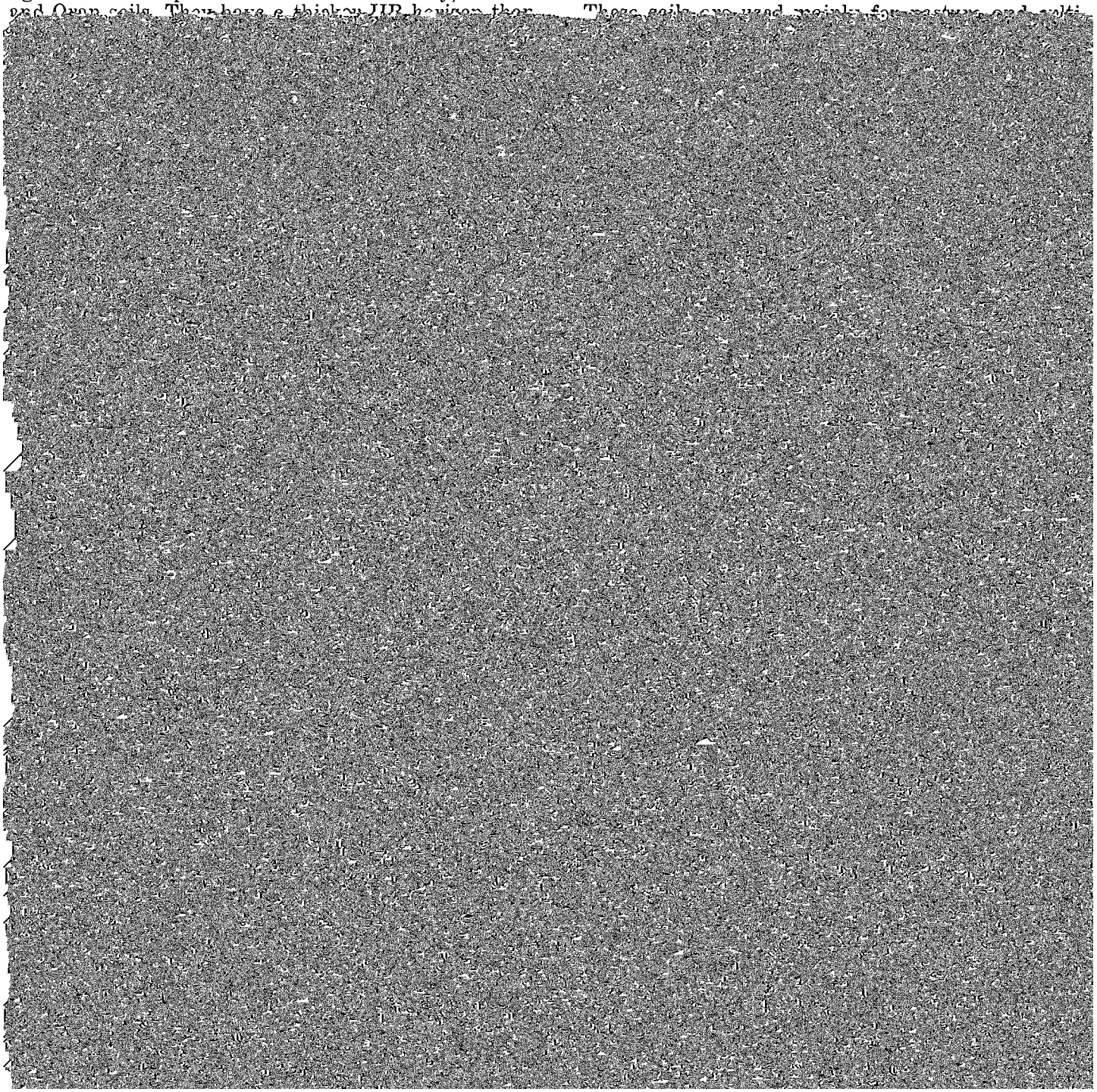
Coggon soils are associated with Bassett, Schley, and Winneshick soils, and they formed in parent material similar to that of Bassett and Oran soils. They have a lighter colored Ap or A1 horizon than Schley, Bassett and Oran soils. They have a thicker IIB horizon than

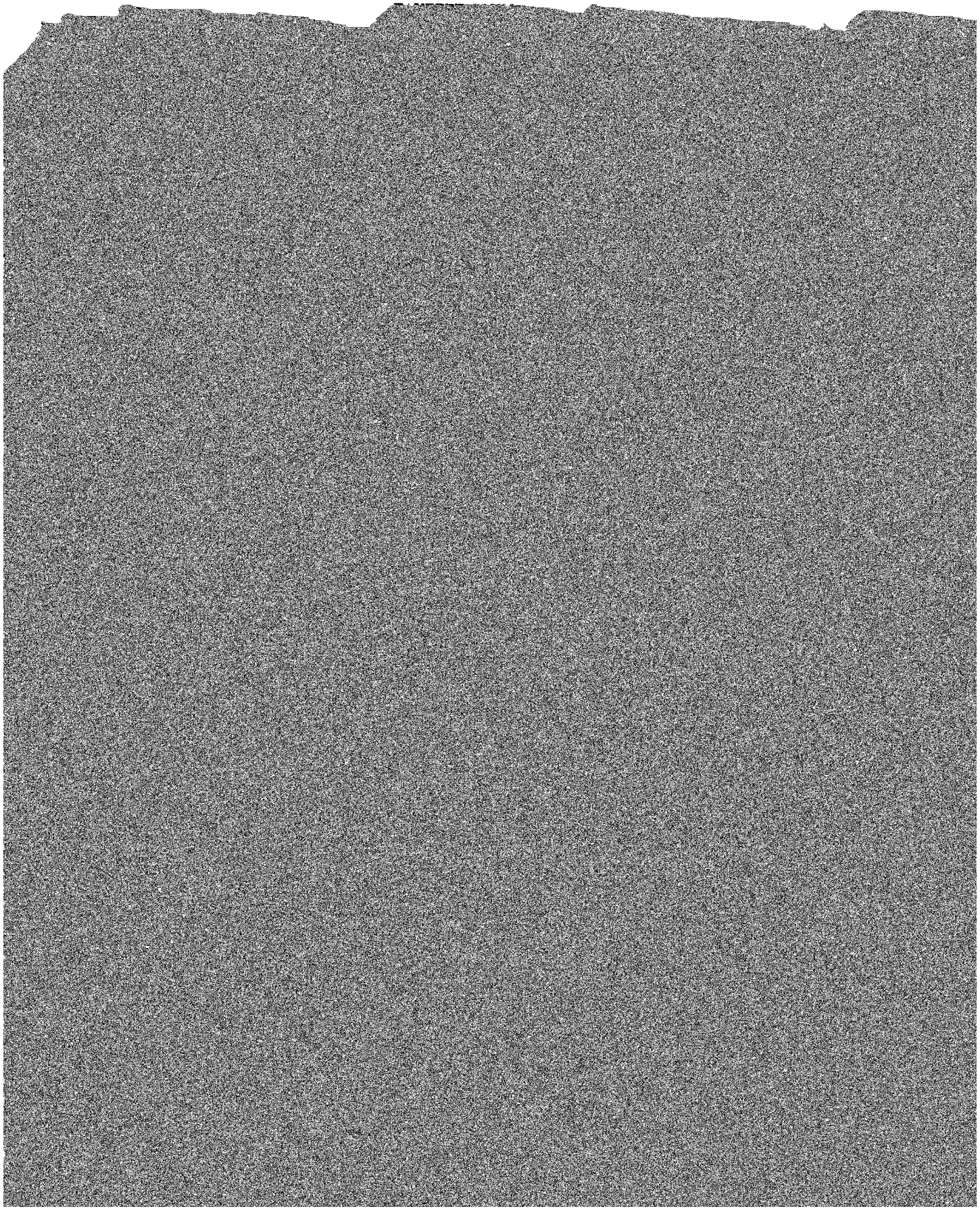
fine textured alluvium. The native vegetation was water-tolerant grasses.

In a representative profile the surface layer is about 49 inches thick. It is black, mottled, friable clay loam and loam. The substratum is gray loamy sand that has some gravel.

Available water capacity is high, and permeability is moderately slow. Available phosphorus is medium, and available potassium is very low. These soils are generally neutral to slightly acid and do not require lime.

These soils are used mainly for pasture and culti-





783B—Cresco loam, 2 to 5 percent slopes. This gently sloping soil is on long, convex ridges and side slopes on uplands. Areas are 40 acres or more in size and are irregular in shape.

This soil has a profile similar to the one described as representative of the series, but the depth to clay loam till is greater.

Included with this soil in mapping are a few small spots of sandy soils that are more droughty than this Cresco soil.

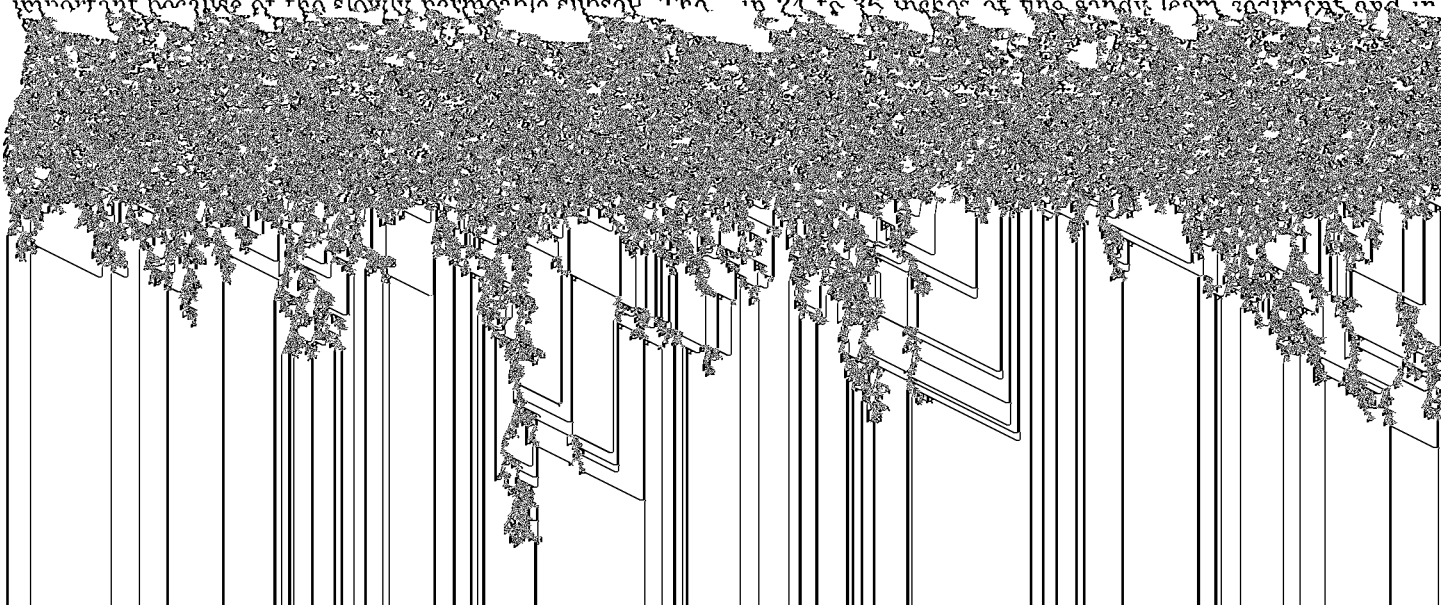
This soil is well suited to corn and soybeans. It is subject to slight erosion if cultivated. Because of the difference in permeability between the loamy material and the underlying very firm glacial till, water accumulates at the contact of these materials, causing a temporary high water table, particularly early in spring. A combination of terracing and tile drainage helps to provide adequate erosion control and drainage. Careful placement and spacing of tile are important because of the slowly permeable subsoil. The organic matter content is moderate to high. Capability unit IIe–1.

783C—Cresco loam, 5 to 9 percent slopes. This moderately sloping soil is on long, convex side slopes on uplands. Areas are 5 to 10 acres in size and are elongated in shape.

This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of moderately eroded soils in which the surface layer is less than 10 inches thick. These areas are lower in fertility than this Cresco soil. Also included are a few sandy areas that are more droughty.

This soil is suited to corn and soybeans. It is subject to moderate or severe erosion if cultivated. Because of the difference in permeability between the loamy material and the underlying very firm glacial till, water accumulates at the contact of these materials, causing a temporary high water table, particularly early in spring. A combination of terracing and tile drainage helps to provide adequate erosion control and drainage. Careful placement and spacing of tile are important because of the slowly permeable subsoil. The



sediment; and it is rapid in the underlying coarse textured substratum of some soils but moderately slow in the till substratum of other soils. Available phosphorus and available potassium are very low. Unless these soils have been limed within the past 5 years, they are generally acid in the surface layer.

The Dickinson soils are used mainly for cultivated crops. The major limitations for crops are erosion and droughtiness. Conservation practices that control runoff and reduce moisture losses, such as minimum tillage that leaves residue on the surface, are beneficial.

Representative profile of Dickinson fine sandy loam, 2 to 5 percent slopes, in a cultivated field, 81 feet east and 171 feet south of the northwest corner of the NE¼NE¼ sec. 7, T. 91 N., R. 9 W.:

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

A12—8 to 13 inches; very dark brown (10YR 2/2) fine sandy loam; moderate medium and fine granular structure; friable; medium acid; gradual smooth boundary.

A3—13 to 20 inches; very dark grayish brown (10YR 3/2) sandy loam; weak medium subangular blocky structure parting to moderate fine granular; friable; medium acid; clear smooth boundary.

B2—20 to 30 inches; brown (10YR 4/3) light sandy loam; dark brown (10YR 3/3) coatings on peds; weak medium subangular blocky structure; very friable; medium acid; gradual smooth boundary.

B3—30 to 35 inches; brown (10YR 4/3) loamy sand; weak medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.

C—35 to 60 inches; dark yellowish brown (10YR 4/4) fine sand; single grained; loose; medium acid.

The solum is 24 to 40 inches thick. It is slightly acid to strongly acid in the most acid part. The soils formed in 24 to 36 inches of fine sandy loam sediment and in

This soil has a profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that have a loamy sand surface layer and are more droughty than this Dickinson soil.

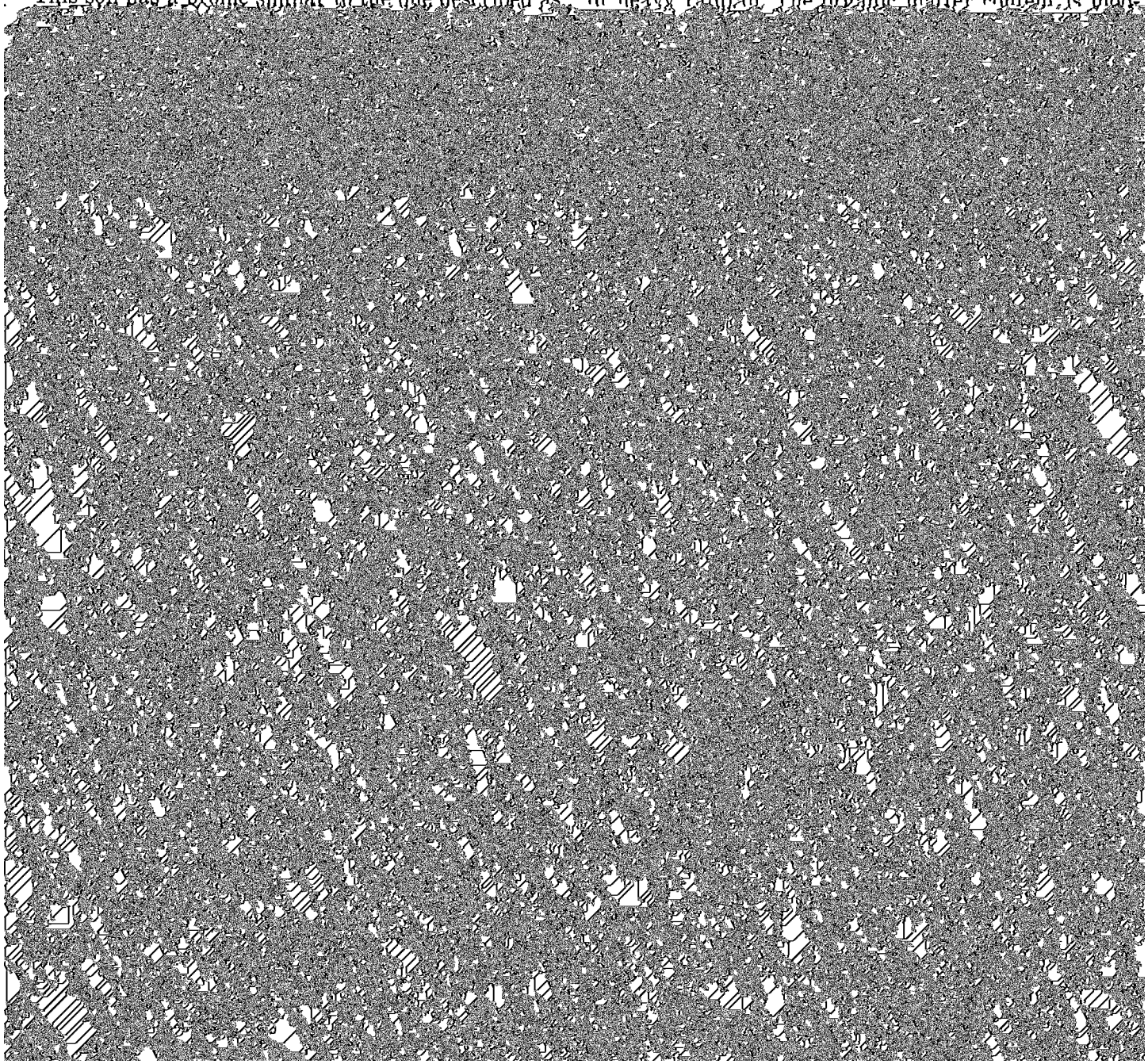
This soil is suited to cultivated crops, and yields can be good if rainfall is normal and timely. The soil is subject to droughtiness and slight soil blowing and water erosion. The organic matter content is moderately low. Capability unit IIIe–3.

175C—Dickinson fine sandy loam, 5 to 9 percent slopes. This moderately sloping soil is on convex ridges and side slopes on uplands. Areas are about 5 acres in size and rounded in shape.

This soil has a profile similar to the one described as representative of the series, but loam glacial till is at a depth of more than 40 inches.

Included with this soil in mapping are small areas of soils in which the surface layer is thinner and lighter colored than in this Dickinson soil. These soils are lower in organic matter content and fertility. Also included are small areas of soils where the depth to glacial till is more than 50 inches.

This soil is suited to row crops, and yields can be good if rainfall is normal and timely. The soil is subject to droughtiness during periods of below normal rainfall and to soil blowing and water erosion if cultivated. It is seepy at times in spring or after periods of heavy rainfall. The organic matter content is mod-



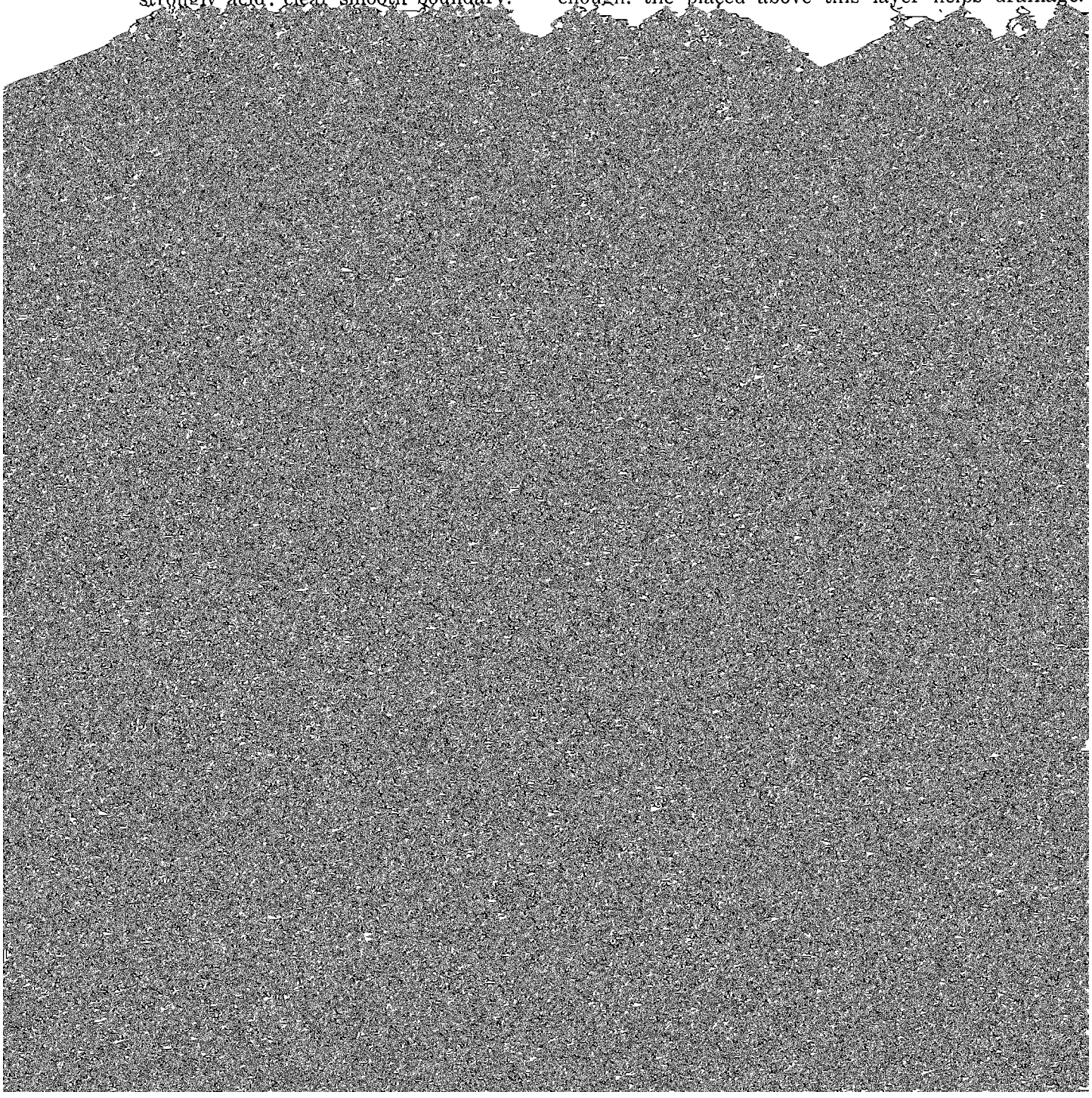
ular structure; friable; neutral; abrupt smooth boundary.

B1—8 to 13 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21—13 to 18 inches; dark yellowish brown (10YR 4/4) heavy loam; brown (10YR 4/3) coatings on peds; moderate medium subangular blocky structure; friable; strongly acid; clear smooth boundary.

of soils that have a sandy loam surface layer, have a high infiltration rate, and are very seepy in wet seasons.

This soil is suited to row crops. Most areas are cultivated, and use of this soil is commonly determined by the use of the surrounding soils. This soil is subject to wetness. Tile systems may not drain all areas satisfactorily. Careful placement of tile is very important because of the very slow permeability of the underlying subsoil. If the clayey subsoil is deep enough, tile placed above this layer helps drainage.



water table and seepy areas on the side slopes. If loamy materials above the clay subsoil are thick enough to provide adequate cover for tile, this soil should be tiled across the slopes to intercept the seepage. The organic matter content is very low. Capability unit IIIe–1.

Dorchester series

The Dorchester series consists of stratified, light colored and moderately dark colored, moderately well drained soils. These nearly level soils are on stream bottom lands associated with soils formed in thin loess over limestone on uplands. They are also in a complex with Volney soils along narrow upland drainageways. Slopes are 0 to 2 percent. These soils formed in 30 to 45 inches of recently deposited, mildly alkaline, stratified, silty alluvium over a dark medium textured buried soil. Because these soils are young, vegetation has not influenced the development of the profile.

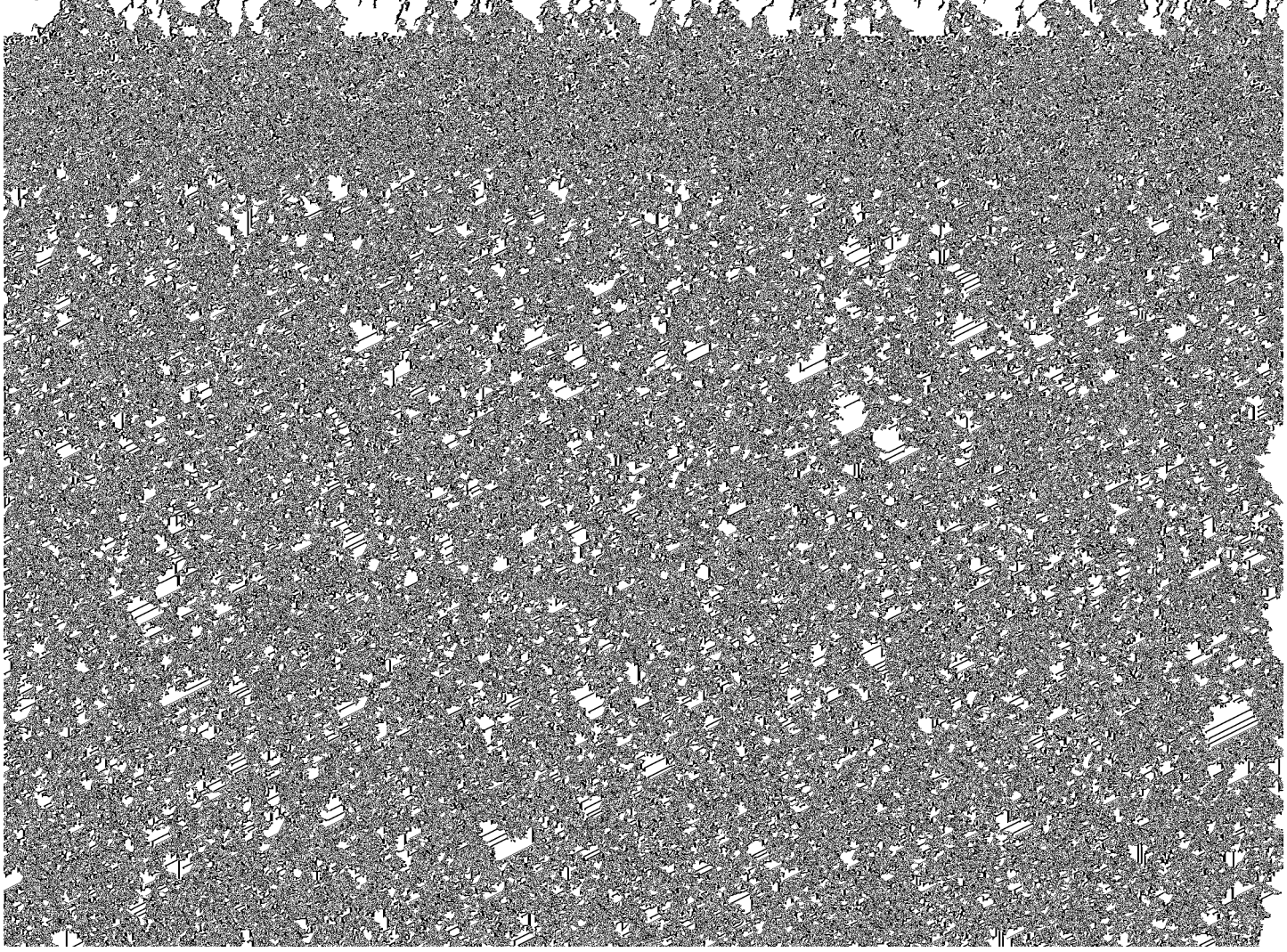
In a representative profile the recently deposited material extends to a depth of 38 inches. It is dark grayish brown, friable, calcareous silt loam with thin strata of very dark grayish brown, dark brown, and yellowish brown friable calcareous silt loam. A black alkaline. The IIAb horizon is typically silt loam but ranges from loam to light silty clay loam. It is black (10YR 2/1) or very dark brown (10YR 2/2) and is mildly alkaline or neutral.

Dorchester soils are associated with Caneek, Ossian, Volney, and Spillville soils, and they formed in parent material similar to that of Caneek soils. They have a browner C horizon and are better drained than Caneek soils. They have a lighter colored solum and are more stratified than Ossian and Spillville soils. Dorchester soils are more stratified than Volney soils and do not have the coarse limestone fragments of Volney soils.

158—Dorchester silt loam, 0 to 2 percent slopes. This nearly level soil is on stream bottom lands associated with loess-covered uplands in the eastern part of the county. Areas are 20 to 40 acres in size and are irregular in shape.

Included with this soil in mapping are small areas of soils that have 6 to 15 inches of sandy overwash. Also included are a few areas of neutral soils where the surface layer does not have an excess of lime. These soils are less productive than this Dorchester soil.

This soil is well suited to intensive row crops. It is subject to flooding. Young plants on this soil can be covered by sediment if not protected from overflow



cent by volume in the surface layer to as much as 75 percent by volume in the lower part of the solum. These limestone fragments are numerous enough to make cultivation of this soil difficult. The soils are in such close association that it is impractical to map them separately.

Runoff from the sloping soils upslope deposits new sediment on the soils of this complex. This material generally contains limestone fragments. Some areas of these soils are slightly wet because of seepage from the soils upslope. Wetness is not a limitation, however, and tile drainage is not needed.

Most of this complex is in permanent pasture. It is poorly suited to cultivated crops. The small, elongated areas of this complex are difficult to reach with farm machinery, and because of their small size they generally remain in permanent pasture or woodland. Capability unit VIs–1.

Downs series

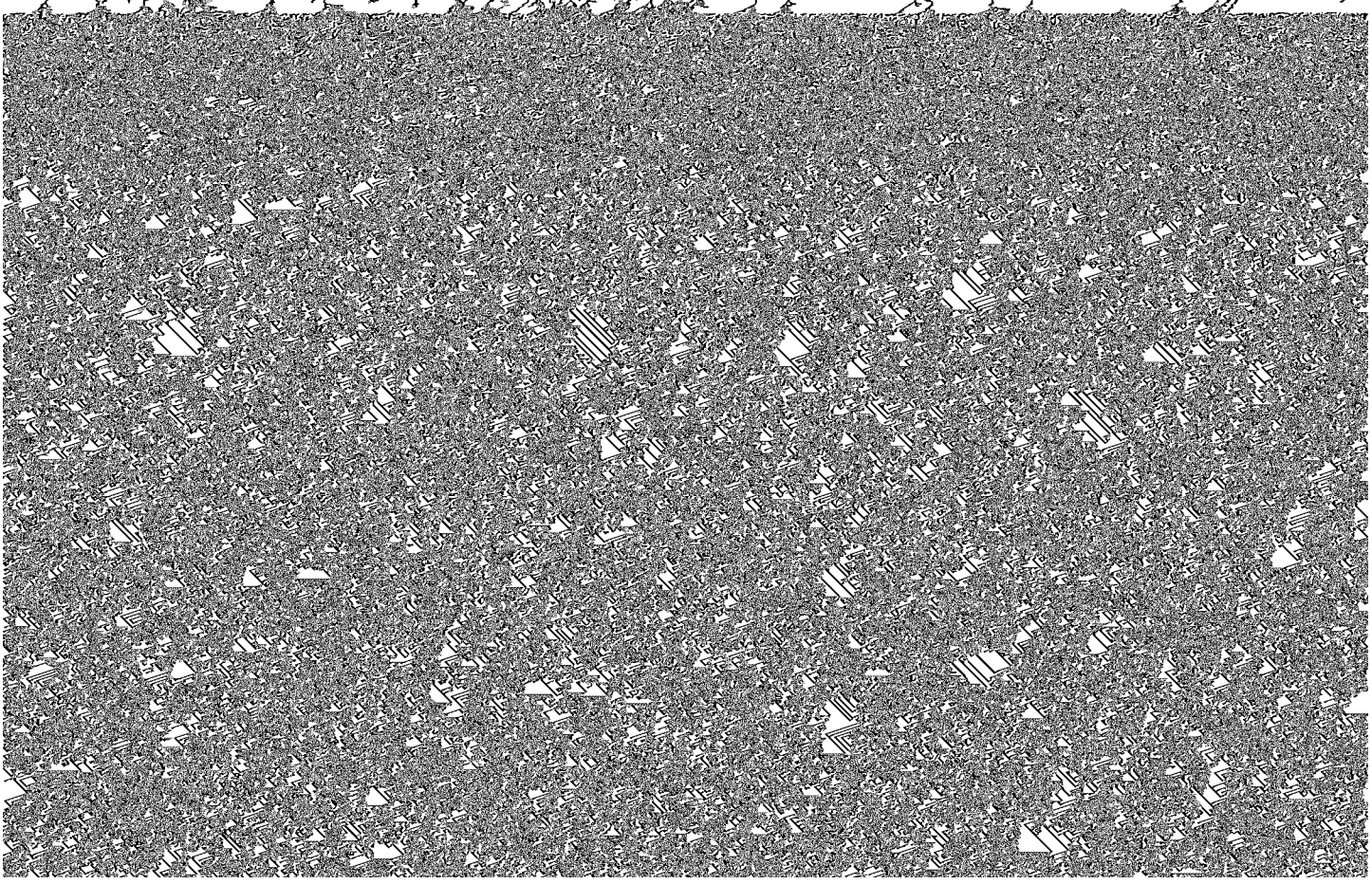
The Downs series consists of moderately dark colored, well drained soils. These gently sloping to moderately steep soils are on ridges and side slopes on uplands. Slopes are 2 to 18 percent. These soils formed in loess more than 40 inches thick. The native vegetation was prairie grasses and deciduous trees.

In a representative profile the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is—

B21t—19 to 24 inches; yellowish brown (10YR 5/4) light silty clay loam; brown (10YR 4/3) coatings on peds; moderate fine subangular blocky structure; friable; few thin discontinuous dark brown (10YR 3/3) clay films; discontinuous light gray (10YR 7/1), dry, silt coatings on ped faces; medium acid; clear smooth boundary.

B22t—24 to 30 inches; yellowish brown (10YR 5/4) light silty clay loam; brown (10YR 5/3) coatings on peds; weak medium subangular blocky structure; friable; few thin discontinuous dark brown (7.5YR 3/2) clay films; thin discontinuous light gray (10YR 7/1), dry silt coatings on ped faces; medium acid; clear smooth boundary.

B31t—30 to 44 inches; yellowish brown (10YR 5/4) silt loam; weak coarse prismatic structure parting to weak medium and fine subangular blocky; friable; few thin discontinuous dark brown (7.5YR 3/2) clay films; thin discontinuous light gray (10YR 7/1), dry, silt coatings on ped faces; medium acid; clear smooth



the long, uniform slopes. The organic matter content is moderately low. Capability unit IIe–1.

162C—Downs silt loam, 5 to 9 percent slopes. This moderately sloping soil is on convex ridges and side slopes on uplands. Areas are several miles long and are irregular in shape.

This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of soils that have a darker, thicker surface layer and have a slightly higher organic matter content than this Downs soil.

This soil is suited to cultivated crops. It is subject to moderate or severe erosion if cultivated. Terraced areas can be used more frequently for row crops without excess soil loss than unterraced areas. The organic matter content is moderately low. Capability unit IIIe–1.

162C2—Downs silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping soil is on convex ridges and side slopes on uplands. Areas extend for several miles and are irregular in shape.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored. In some places the surface layer has been mixed with material from the subsoil. This soil has lower organic matter content than the uneroded Downs soils. It generally has good tilth but will puddle and become cloddy if worked when wet.

Included with this soil in mapping are a few areas of severely eroded soils that have a surface layer of brown or yellowish brown heavy silt loam and have lower fertility and poorer tilth than this Downs soil.

This soil is suited to cultivated crops. It is subject to severe erosion if cultivated. Terraced areas can be used more frequently for row crops without excessive soil loss than can unterraced areas. The organic matter content is moderately low to low. Capability unit IIIe–1.

162D—Downs silt loam, 9 to 14 percent slopes. This strongly sloping soil is on convex side slopes on uplands. Areas are about 5 to 10 acres in size and are irregular in shape.

This Downs soil is suited to cultivated crops grown occasionally in rotation with hay crops. It is subject to severe erosion if cultivated. Most areas of this soil are in permanent pasture or woodland. The organic matter content is moderately low. Capability unit IIIe–2.

162D2—Downs silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping soil is on convex side slopes on uplands. Areas are about 10 to 20 acres in size and are elongated in shape.

This soil has a profile similar to the one described as representative of the series, but the surface layer is lighter colored. The soil has a dark grayish brown plow layer because some of the subsoil has been mixed with the surface layer. It has lower organic matter content than uneroded Downs soils. It generally has good tilth but will puddle and become cloddy if worked when wet. This soil has a lower clay content, and the depth to the maximum content of clay is less.

Included with this soil in mapping are a few areas of severely eroded soils where the surface layer is brown or yellowish brown heavy silt loam. These soils have lower fertility and poorer tilth than this Downs soil.

This soil is suited to occasional row crops in rotation with meadow. It is subject to severe erosion if cultivated. The organic matter content is low. Capability unit IIIe–2.

162E2—Downs silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep soil is on convex side slopes on uplands. Areas are about 5 to 10 acres in size and are elongated in shape.

This soil has a profile similar to the one described as representative of the series, but the surface layer is lighter colored. This soil has a dark grayish brown surface layer. Erosion has removed part of the surface and subsurface layers. The plow layer is lower in fertility and organic matter than the uneroded Downs soils. This soil has a lower clay content, and the depth to the maximum content of clay is less.

Included with this soil in mapping are a few areas of severely eroded soils that have a brown or yellowish brown heavy silt loam surface layer. These soils are lower in fertility and have poorer tilth than this Downs soil. There are also a few areas which are in woodland or permanent pasture and are not eroded.

This soil is suited to cultivated crops grown occasionally in a rotation with hay crops. It is subject to severe erosion if cultivated. It generally has good tilth but will puddle and become cloddy if worked when wet. The organic matter content is low. Capability unit IVe–1.

Dubuque series

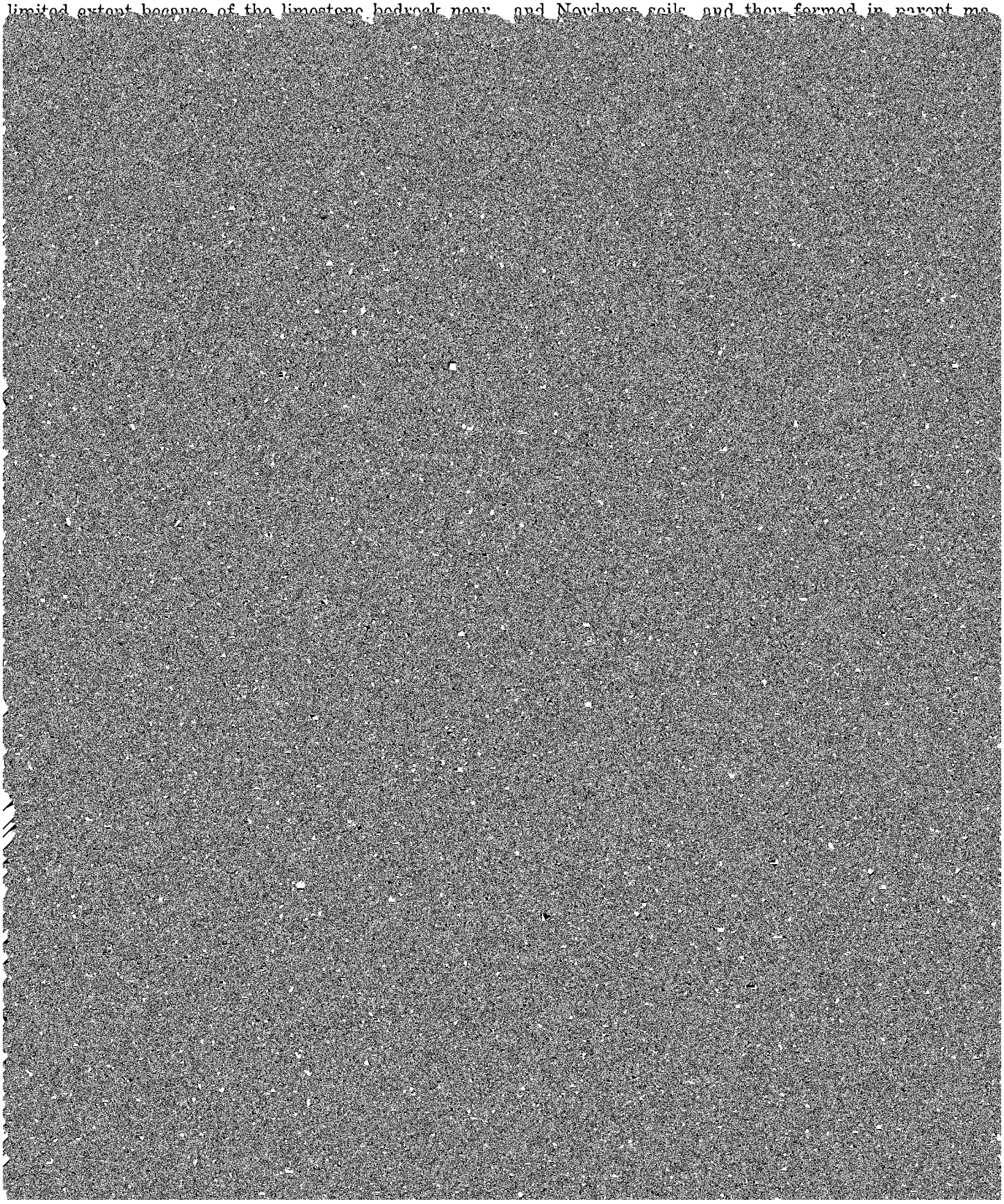
The Dubuque series consists of light colored, well drained soils. These moderately sloping to steep soils are on ridges and side slopes on uplands. Slopes are 5 to 25 percent. These soils formed in loess 20 to 30 inches thick and in a thin layer of residuum weathered from the underlying limestone bedrock. The native vegetation was deciduous trees.

In a representative profile the surface layer is very dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is brown, friable silt loam about 7 inches thick. The subsoil extends to a depth of 25 inches. It is yellowish brown, friable silt loam and light silty clay loam and strong brown, very firm clay. Limestone bedrock is at a depth of 25 inches. It is soft and fragmented in the upper 3 inches and hard and fractured below.

Available water capacity is low. Permeability is moderate in the loess and very rapid in the limestone bedrock. It is slow in the clayey residuum between the loess and limestone, but commonly the residuum is not a continuous layer. Available phosphorus is medium, and available potassium is very low. Unless these soils have been limed within the past 5 years, they are generally acid in the surface layer.

The less sloping Dubuque soils are used mainly for cultivated crops and pasture. The more sloping soils are used for pasture and woodland. The major limitations for crops are erosion and shallowness to limestone bedrock. The soils are subject to erosion, and any soil loss through erosion decreases the depth to limestone and affects the use of these soils. The roots of some crops grown on these soils develop to only a

limited extent because of the limestone bedrock near and Newdoss soils and they formed in parent ma-



this soil. It is suitable for permanent pasture, trees, or wildlife habitat. The organic matter content is very low. Capability unit VIe–1.

183E2—Dubuque silt loam, 20 to 30 [illegible]

soils are in permanent pasture. The major limitation for crops is erosion.

Representative profile of Exette silt loam, 9 to 14

Above a depth of 30 inches, the profile is at least 20 percent mottles that have chroma of 2. The grayness in the profile is a relict feature and not an indication of present drainage.

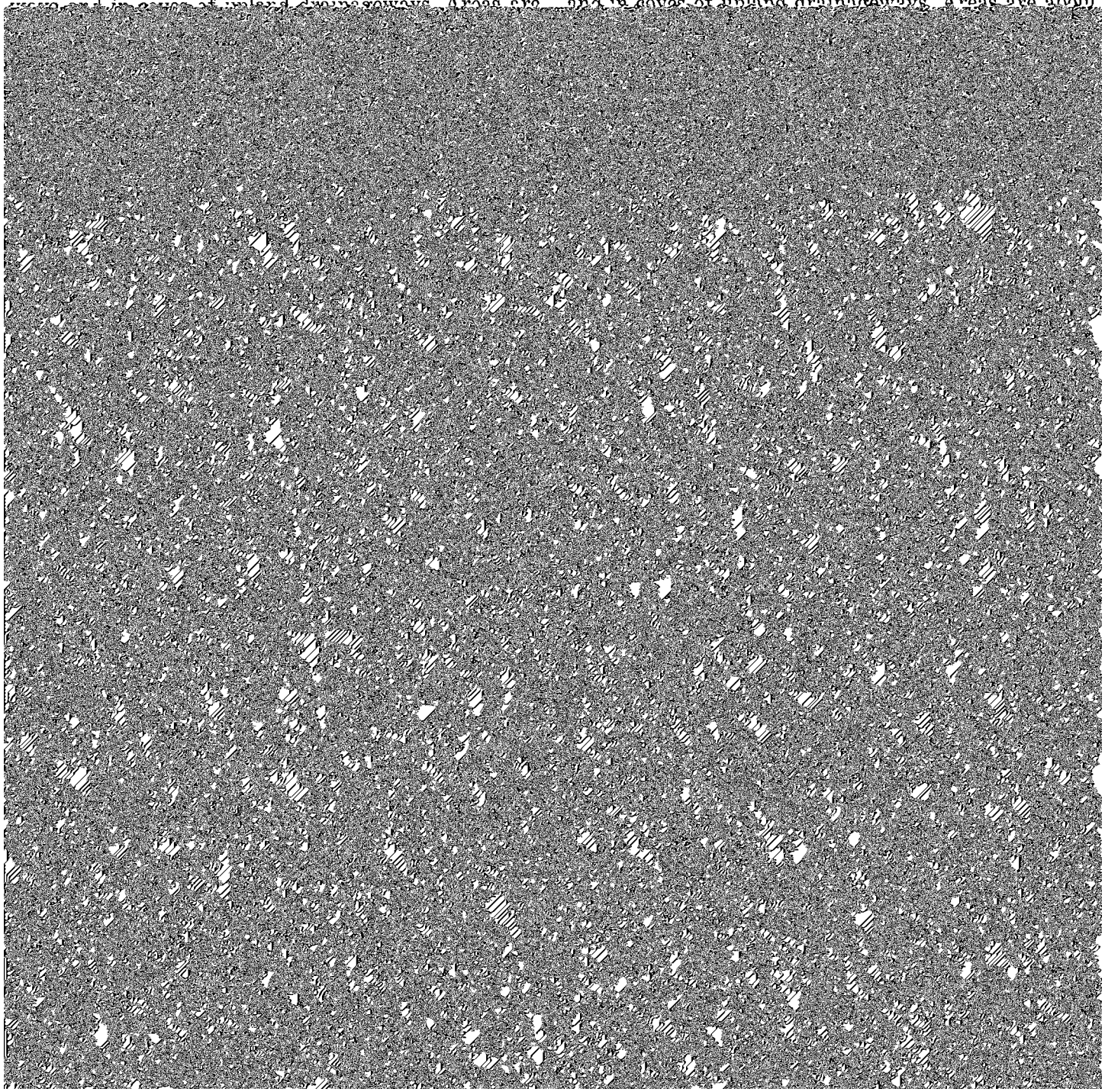
Exette soils are associated with the Fayette and Downs soils. They have grayer B and C horizons than those soils. Exette soils have a thinner A horizon than Downs soils.

763D2—Exette silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping soil is on convex side slopes that are dissected by many small waterways and in coves of upland drainageways. Areas are

of soils in which the grayish brown subsoil is on the surface. These areas are very low in organic matter content, are low in available phosphorus, and have very poor tilth.

This soil is poorly suited to cultivated crops. It is better suited to hay and permanent pasture than to most other uses. The organic matter content is very low. Capability unit VIe–1.

763F2—Exette silt loam, 18 to 25 percent slopes, moderately eroded. This steep soil is on convex side slopes that are dissected by many small waterways and in coves of upland drainageways. Areas are about



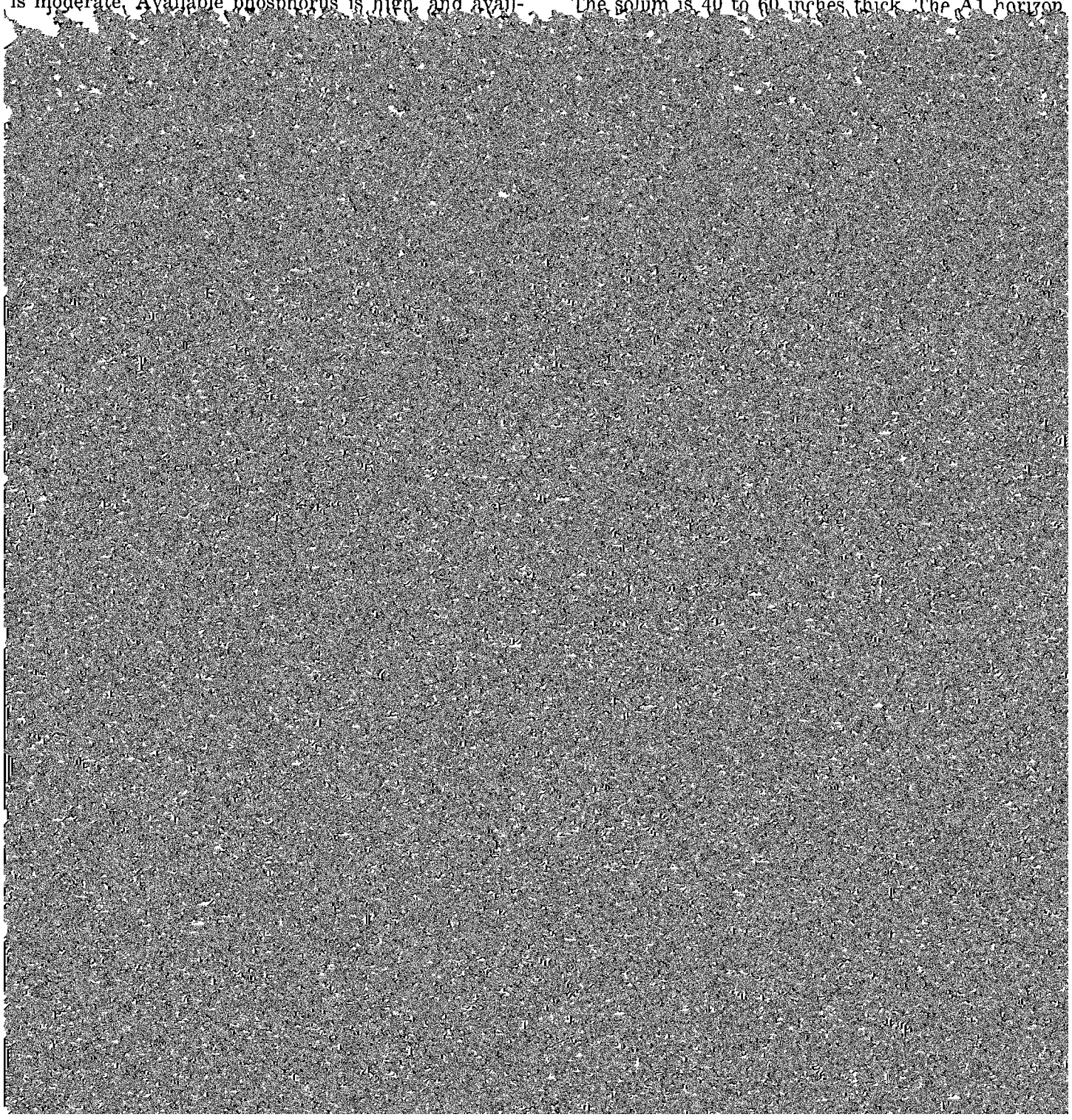
loam about 8 inches thick. The subsoil extends to a depth of 47 inches; it is brown light silty clay loam in the upper part, brown and dark yellowish brown medium silty clay loam in the middle part, and yellowish brown light silty clay loam in the lower part. The substratum is yellowish brown, friable silt loam that has a few grayish mottles.

Available water capacity is high, and permeability is moderate. Available phosphorus is high, and avail-

black (10YR 3/1) oxide concretions; strongly acid; gradual smooth boundary.

C—47 to 73 inches; yellowish brown (10YR 5/4) silt loam; few fine faint grayish brown (10YR 5/2) mottles; massive; some distinct vertical cleavage; friable; few dark brown (10YR 3/3) oxide concretions; strongly acid.

The solum is 40 to 60 inches thick. The A1 horizon



fertility and have poorer tilth than this Fayette soil. They become cloddy if worked when wet. They puddle during intense rains, causing more than normal runoff and retarding growth.

This soil is suited to row crops and alfalfa. More fertilizer is needed to obtain the same yield on this soil than on uneroded Fayette soils. This soil is subject to erosion if cultivated. Most areas are suitable for terracing because of the uniform length and shape of slopes. (fig. 10). The organic matter content is very low. Capability unit IIIe–1.

163D—Fayette silt loam, 9 to 14 percent slopes. This strongly sloping soil is on convex side slopes. Areas are 10 to 20 acres in size and are elongated in shape.

Included with this soil in mapping are a few small areas of moderately eroded soils. The surface layer of these soils is dark grayish brown or brown and they are lower in organic matter content and fertility than this Fayette soil.

out excess soil loss if conservation is practiced. The organic matter content is very low. Capability unit IIIe–2.

163D3—Fayette silt loam, 9 to 14 percent slopes, severely eroded. This strongly sloping soil is on short convex side slopes on uplands. The slopes are dissected by many waterways. Areas are about 10 to 20 acres in size and are elongated in shape.

This soil has a profile similar to the one described as representative of the series, but it is severely eroded and the subsurface layer and part of the subsoil has been incorporated into the surface layer. The present surface layer is lower in fertility and organic matter content and higher in clay than that of less eroded Fayette soils. The plow layer is mainly brown silt loam but is silty clay loam in some areas. It becomes cloddy if worked when wet. It puddles during intense rains, causing more than normal runoff, poor seed emergence, and retarded plant growth.

a depth of less than 40 inches tend to be slightly droughty.

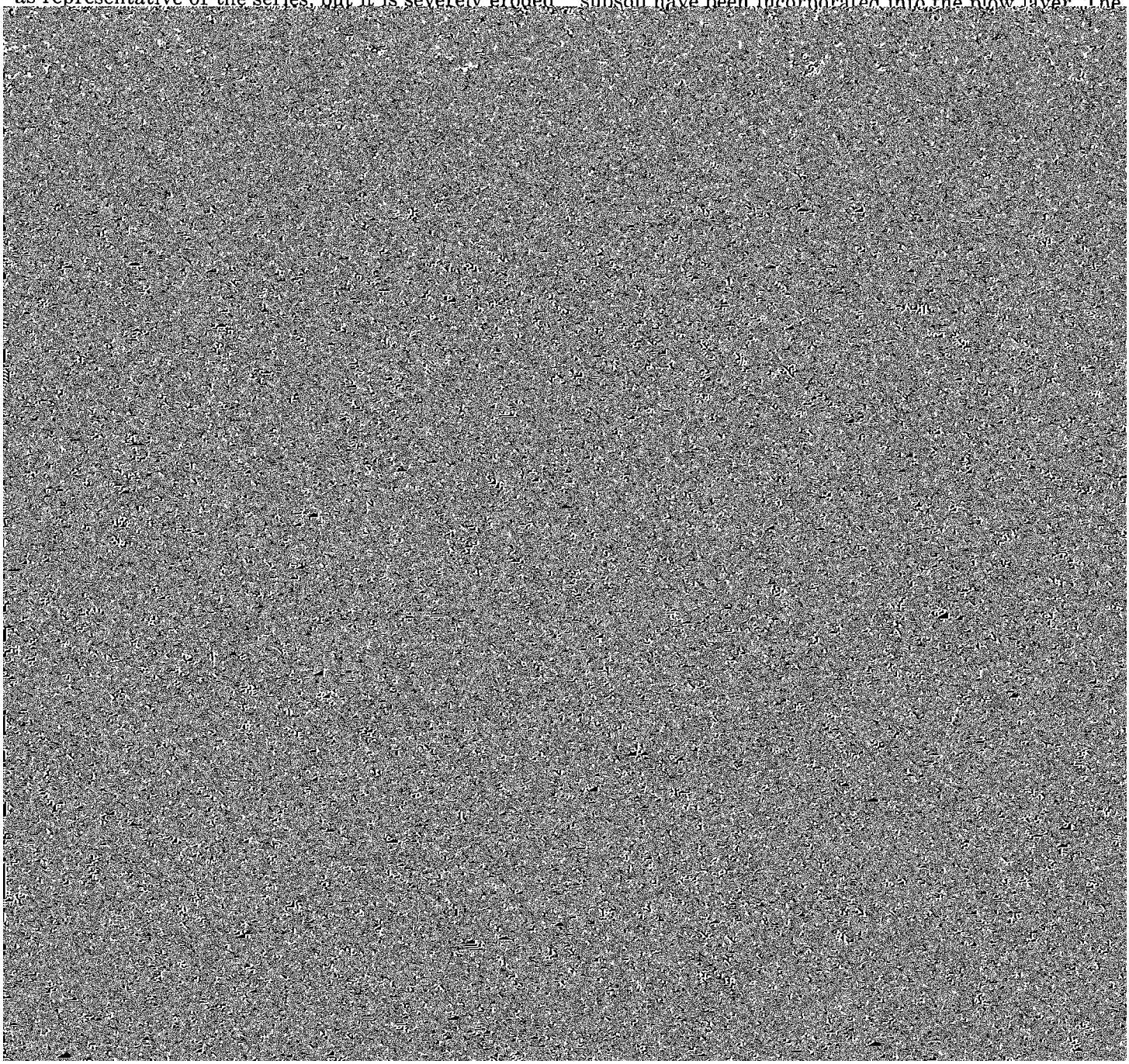
This soil is poorly suited to cultivated crops. It is subject to severe erosion if cultivated. It can be used occasionally for row crops in rotation with meadow. The organic matter content is very low. Capability unit IVe–1.

163E3—Fayette silt loam, 14 to 18 percent slopes, severely eroded. This moderately steep soil is on short, convex side slopes on uplands. The slopes have been dissected by many waterways. Areas are about 5 to 10 acres in size and are elongated in shape.

This soil has a profile similar to the one described as representative of the series, but it is severely eroded subject to severe erosion if cultivated. Farm machinery cannot be used in some places because of the steepness of slope. This soil is suitable for permanent pasture, trees, or wildlife habitat. The organic matter content is very low. Capability unit VIe–1.

163F3—Fayette silt loam, 18 to 25 percent slopes, severely eroded. This steep soil is on short convex side slopes on uplands. The slopes have been dissected by many waterways. Areas are about 5 to 10 acres in size and are elongated in shape.

This soil has a profile similar to the one described as representative of the series, but the surface layer is lighter in color. The subsurface layer and part of the subsoil have been incorporated into the plow layer. The



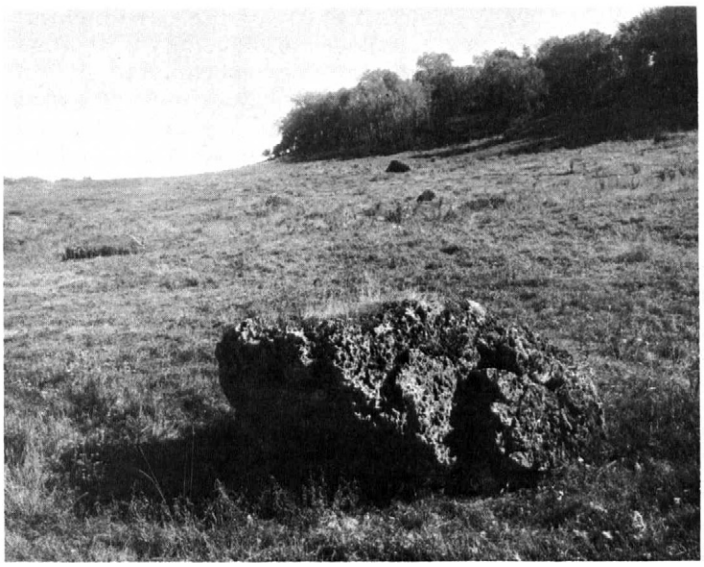


Figure 11.—Limestone boulders in an area of Fayette-Dubuque-Jacwin soils.

very slowly permeable and cause seepy areas. Springs develop in some areas, providing sources of water.

In a representative profile the surface layer is very dark gray, friable silt loam about 8 inches thick. The subsurface layer is brown and dark grayish brown, friable silt loam about 6 inches thick. The subsoil extends to a depth of 48 inches. It is dark yellowish brown and yellowish brown, friable silt loam. The substratum is yellowish brown, friable silt loam.

Available water capacity is high, and permeability is moderate. Available phosphorus is low, and available potassium is very low. Unless these soils have been limed within the past 5 years, they are generally acid in the surface layer.

Festina soils are used mainly for cultivated crops. The major limitation for crops is occasional local runoff from the adjoining loess-covered soils upslope.

Representative profile of Festina silt loam, 0 to 2 percent slopes, in a cultivated field, 327 feet south and 123 feet east of northeast corner of NW¼NW¼ sec. 19, T. 95 N., R. 7 W.:

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam; cloddy parting to weak fine granular structure; friable; neutral; abrupt smooth boundary.

A2—8 to 14 inches; brown (10YR 4/3) silt loam; dark grayish brown (10YR 4/2) coatings; weak medium and thin platy structure; friable; slightly acid; gradual smooth boundary.

grayish brown (10YR 3/2). The A2 horizon is generally 4 to 12 inches thick, but in some places it may be partly incorporated into the Ap horizon. The B horizon is brown (10YR 4/3) to yellowish brown (10YR 5/4). It is medium silt loam to light silty clay loam.

Festina soils are associated with Richwood, Canoe, and Ossian soils. They formed in parent material similar to that of Richwood, Canoe, and Ossian soils. They have a thinner A horizon than Richwood soils. They have a thinner A horizon and a browner upper part of the B horizon than Ossian soils. Festina soils are browner in the upper part of the B horizon and are better drained than Canoe soils.

978—Festina silt loam, 0 to 2 percent slopes. This nearly level soil is on stream benches. Areas are about 10 acres in size and are irregular in shape.

Included with this soil in mapping are areas of soils that have a thinner and lighter colored surface layer and are lower in organic matter content and fertility than this Festina soil.

This soil is well suited to cultivated crops. It receives runoff and sediment from soils upslope. Diversion terraces upslope protect this soil from local runoff. The organic matter content is moderately low. Capability unit I–1.

Flagler series

The Flagler series consists of dark colored, somewhat excessively drained soils. These nearly level to moderately sloping soils are on alluvial benches along streams and on outwash areas on uplands. Slopes are 0 to 9 percent. These soils formed in 24 to 32 inches of stratified moderately coarse textured alluvium and in the underlying gravelly loamy sand and sand. The native vegetation was prairie grasses.

In a representative profile the surface layer is very dark brown, very dark grayish brown, and dark brown sandy loam about 20 inches thick. The subsoil extends to a depth of 33 inches. It is dark yellowish brown gravelly sandy loam in the upper part and brown gravelly loamy sand in the lower part. The substratum is yellowish brown coarse sand with some gravel.

Available water capacity is low. Permeability is moderately rapid in the upper part of the soil and very rapid in the coarse textured substratum. Available phosphorus and available potassium are very low. Unless limed within the past 5 years, these soils are generally acid in the surface layer.

The Flagler soils are used mainly for cultivated crops and pasture. The major limitations for crops are droughtiness and erosion in the more sloping areas.

Representative profile of Flagler sandy loam, 0 to 2 percent slopes, in a cultivated field, 420 feet south and 258 feet west of northeast corner of SE¼NE¼ sec.

moderate fine granular structure; very friable; few small gravel; medium acid; clear smooth boundary.

A3—14 to 20 inches; dark brown (10YR 3/3) sandy loam; weak medium subangular blocky structure; very friable; common 2-millimeter gravel; medium acid; gradual smooth boundary.

IIB2—20 to 28 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam; weak coarse subangular blocky structure; very friable; medium acid; clear smooth boundary.

IIB3t—28 to 33 inches; brown (7.5YR 4/4) gravelly loamy sand; weak coarse subangular blocky structure; very friable; some clay bridging between sand grains; medium acid; clear smooth boundary.

IIC—33 to 60 inches; yellowish brown (10YR 5/6) coarse sand; some gravel; single grained; loose; medium acid.

The solum is 24 to 40 inches thick. Coarse textured material is at a depth of 20 to 36 inches. Carbonates are absent above a depth of 60 inches. The A1 or Ap horizon is black (10YR 2/1) to very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). It is sandy loam or fine sandy loam. The A horizon is 10 to 24 inches thick. The B2 horizon is brown (10YR 4/3) to dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6). The IIC horizon is loamy sand with some gravel to sand or gravelly sand. It is medium acid to neutral.

Flagler soils are associated with the Saude, Kenyon, and Burkhardt soils. They formed in parent material similar to that of Burkhardt soils. They have less clay and more sand in the A horizon and upper part of the B horizon than Saude and Kenyon soils. Flagler soils have more clay and less sand in the upper part of the solum than Burkhardt soils.

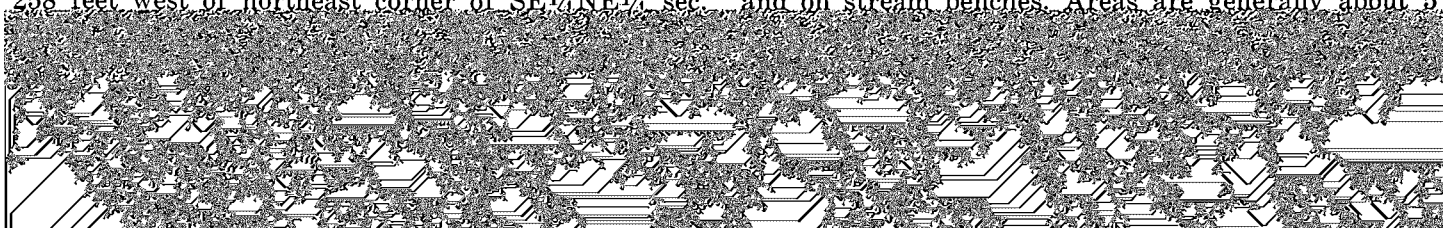
284—Flagler sandy loam, 0 to 2 percent slopes. This nearly level soil is on benches along streams. Areas are commonly 20 to 40 acres in size and are irregular in shape.

This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of soils in which the depth to coarse textured material is more than 36 inches. These soils are less droughty than this Flagler soil.

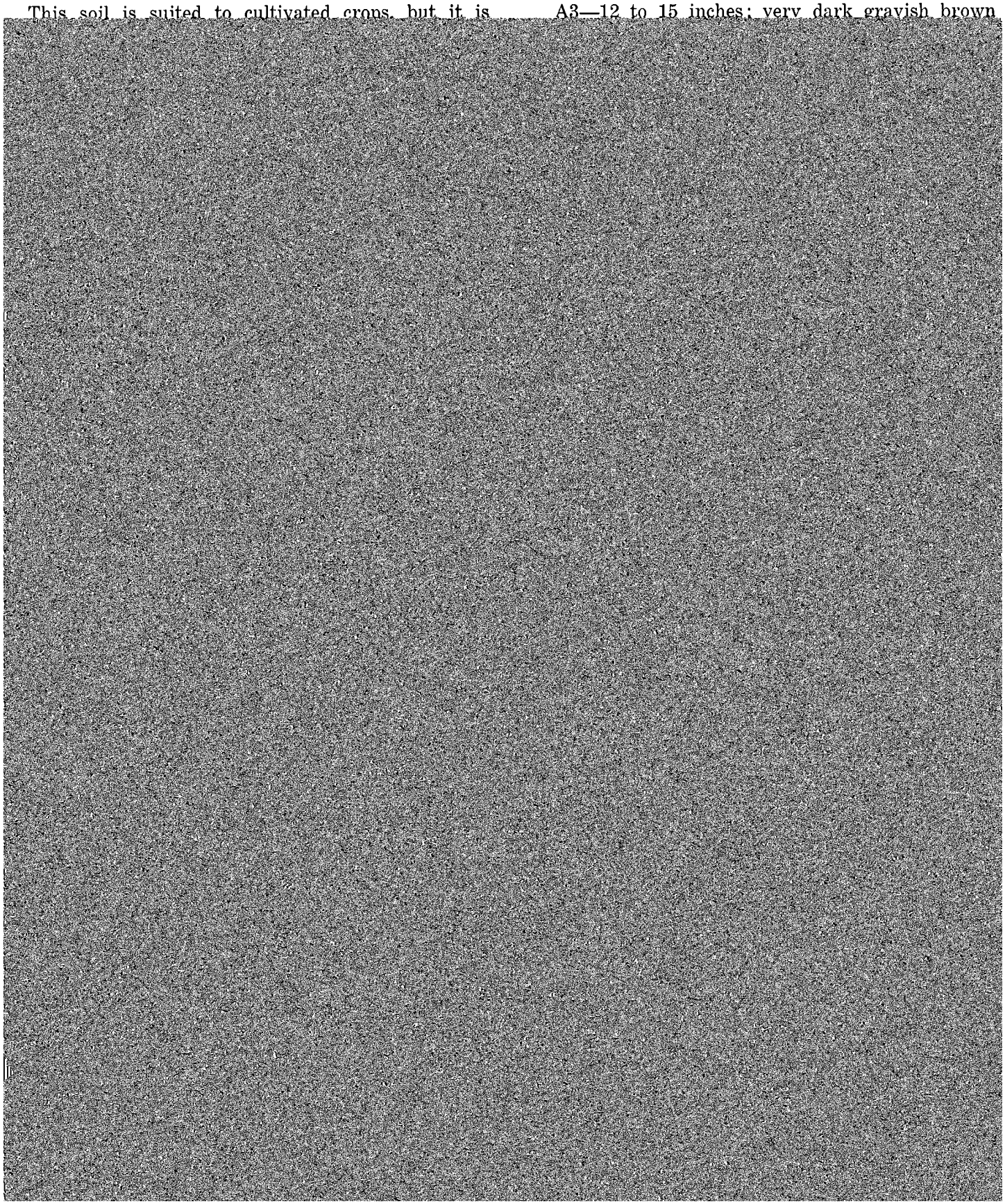
This soil is suited to cultivated crops. It is subject to little runoff, but drainage is somewhat excessive. In most years, crop yields are depressed because of lack of moisture. The organic matter content is moderate. Capability unit IIIs–1.

284B—Flagler sandy loam, 2 to 5 percent slopes. This gently sloping soil is on outwash areas on uplands and on stream benches. Areas are generally about 5



This soil is suited to cultivated crops, but it is

A3—12 to 15 inches; very dark grayish brown



movement of water is needed. The organic matter content is high. Capability unit IIw–1.

Goss series

The Goss series consists of light colored, well drained to somewhat excessively drained soils. These strongly sloping to moderately steep soils are on ridges and side slopes on uplands. Slopes are 9 to 18 percent. These soils formed in 8 to 18 inches of loamy material and in the underlying residuum that was weathered from cherty limestone. The native vegetation was deciduous trees.

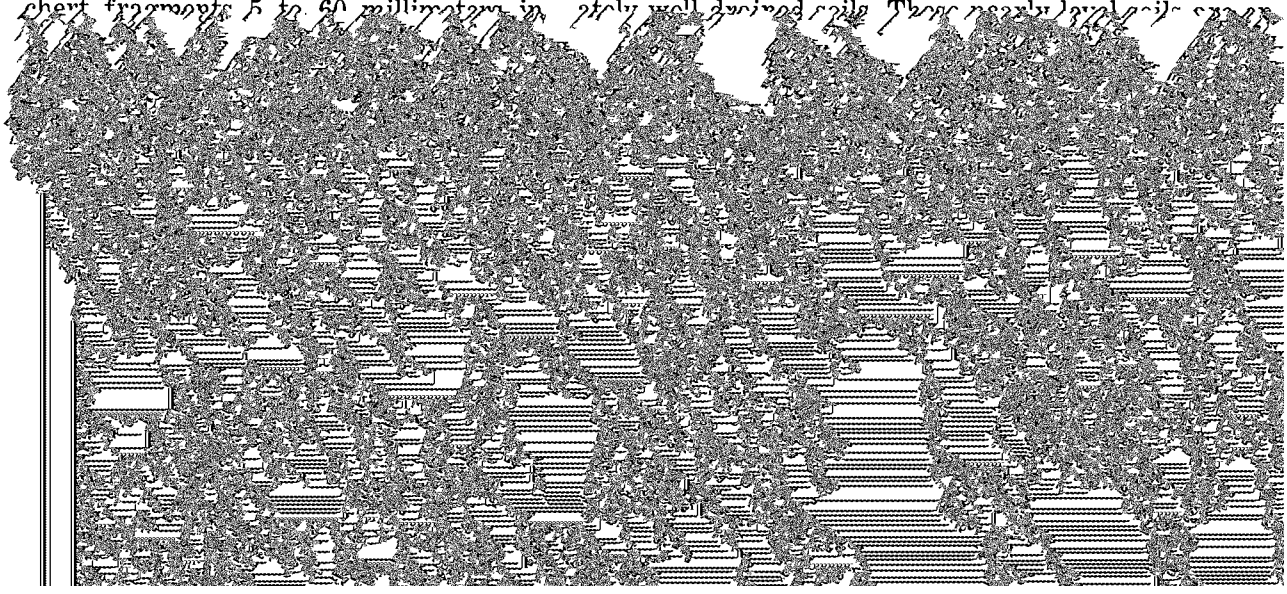
In a representative profile the surface layer is dark grayish brown, friable loam that is about 10 percent chert fragments and is about 6 inches thick. The subsurface layer is brown, friable cherty loam about 3 inches thick. The subsoil extends to a depth of 63 inches. It is dark yellowish brown, friable cherty loam in the upper part; red, firm cherty clay in the middle part; and dark red, firm cherty clay in the lower part. The substratum is red, firm cherty clay.

Available water capacity is low. Permeability is moderate in the loamy material and moderately rapid in the clayey residuum that has coarse chert fragments. Available phosphorus and available potassium are very low. Unless these soils have been limed within the past 5 years, they are generally acid in the surface layer.

Goss soils are used mainly for permanent pasture, although a few areas are cultivated with the adjoining soils. A major limitation for crops is the coarse chert fragments, which make cultivation very difficult. Erosion is also a major limitation.

Representative profile of Goss loam, 9 to 18 percent slopes, in a cultivated field, 592 feet east and 6 feet north of southwest corner of NE¼NW¼ sec. 21, T. 93 N., R. 7 W.:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam; few very dark grayish brown (10YR 3/2) coatings; weak fine subangular blocky structure parting to weak fine granular; friable; about 10 percent chert fragments 5 to 60 millimeters in



films; medium acid; gradual smooth boundary.

IIB22—32 to 63 inches; dark red (10YR 3/6) cherty clay; moderate fine and very fine subangular and angular blocky structure; firm; about 60 percent chert fragments 5 to 80 millimeters in diameter; strongly acid; gradual smooth boundary.

IIC—63 to 70 inches; red (2.5YR 4/6) cherty clay; massive; firm; about 80 percent chert fragments 5 to 80 millimeters in diameter; medium acid.

The solum is 60 to 80 inches thick. The soils formed in 8 to 18 inches of loamy material and the underlying residuum weathered from cherty limestone. The A horizon is typically loam but ranges to silt loam high in sand and sandy loam. The A horizon is 10 to 30 percent chert fragments. The IIB horizon has hue of 10R to 7.5YR. The IIB and IIC horizons are 45 to 80 percent chert fragments.

Goss soils are associated with Marlean, Nordness, and Winneshiek soils. They formed in several feet of residuum weathered from cherty limestone, whereas Marlean, Nordness, and Winneshiek soils have a thin layer of limestone residuum.

215E—Goss loam, 9 to 18 percent slopes. This strongly sloping to moderately steep soil is on ridges and side slopes on uplands. Areas are about 5 to 10 acres in size and are elongated in shape.

Included with this soil in mapping are areas of soils where many coarse chert fragments are on the surface and cultivation is very difficult.

This soil is poorly suited to cultivated crops. It is subject to erosion, and cultivation is very difficult because of chert fragments that work up to the surface layer. Some areas of this soil have been cultivated, but most are now in pasture. Yields are generally low unless rainfall is above normal and timely. The organic matter content is very low. Capability unit VIs–1.

Hanlon series

The Hanlon series consists of dark colored, moder-

west and 726 feet south of the northeast corner of the NW¼ sec. 29, T. 93 N., R. 8 W.:

A11—0 to 18 inches; very dark brown (10YR 2/2) fine sandy loam; very weak fine subangular blocky structure; very friable; neutral; gradual smooth boundary.

A12—18 to 47 inches; very dark brown (10YR 2/2) light sandy loam; very weak fine subangular blocky structure; very friable; neutral; gradual smooth boundary.

A3—47 to 53 inches; very dark brown (10YR 2/2) sandy loam; very weak medium subangular blocky structure; friable; neutral; gradual smooth boundary.

B—53 to 65 inches; very dark grayish brown (10YR 3/2) heavy sandy loam; very weak medium and coarse subangular blocky structure; friable; neutral; gradual smooth boundary.

C—65 to 72 inches; dark yellowish brown (10YR 3/4) loamy sand; single grained; loose; neutral.

The solum is 40 to 72 inches thick. It is neutral or slightly acid. The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2) but in places ranges to very dark grayish brown (10YR 3/2). It is typically fine sandy loam but ranges to sandy loam. It is 40 to 60 inches thick. The B horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. It is commonly sandy loam but in places is fine sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 to 4. It is heavy sandy loam to loamy sand.

Hanlon soils are associated with Spillville, Dorchester, and Coland soils. They formed in parent material similar to that of Spillville soils. They have more sand and less clay throughout the solum than Spillville, Coland, and Dorchester soils. Hanlon soils do not have carbonates, whereas Dorchester soils do.

536—Hanlon fine sandy loam, 0 to 2 percent slopes. This nearly level soil is on flood plains and natural levees along rivers and large streams. Areas are 5 to 12 acres in size and are irregular in shape.

Included with this soil in mapping are small areas of soils that have a loamy sand surface layer and are more droughty and less productive than this Hanlon soil. Also included are areas of soils in which the dark surface layer is less than 36 inches thick. These soils dark brown, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 7 inches thick. The subsoil extends to a depth of 31 inches. It is brown, friable loam in the upper part; mottled grayish brown and brown, friable loam in the middle part; and mixed brown and strong brown loamy sand in the lower part. The substratum is mixed yellowish brown and light yellowish brown medium and coarse sand.

Available water capacity is moderate. Permeability is moderate in the upper part of the soil and rapid in the coarse textured substratum. Available phosphorus is low, and available potassium is very low. Unless these soils have been limed within the past 5 years, they are generally acid in the surface layer.

Hayfield soils are used mainly for cultivated crops. The major limitation for crops is slight wetness. Tile drainage is needed in some years to improve timeliness of field operations. Because of the coarse textured substratum, these soils can also be droughty if rainfall is not timely.

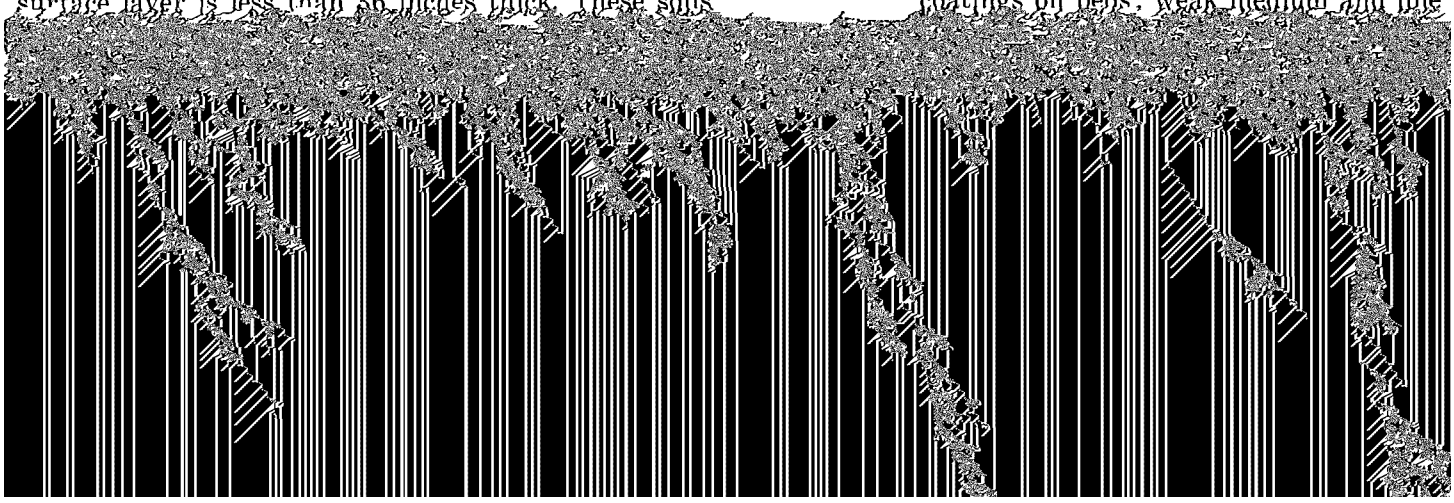
Representative profile of Hayfield loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes, in permanent pasture, at edge of wooded area 417 feet south and 237 feet east of the northwest corner of the NW¼NW¼ sec. 32, T. 91 N., R. 10 W.:

A1—0 to 8 inches; very dark brown (10YR 2/2) loam; black (10YR 2/1) coatings on peds; weak to moderate fine granular structure; friable; medium acid; clear smooth boundary.

A21—8 to 12 inches; dark grayish brown (10YR 4/2) loam; very dark grayish brown (10YR 3/2) and few very dark brown (10YR 2/2) coatings on peds; weak fine subangular blocky structure; friable; few fine faint brown (7.5YR 4/4) mottles; medium acid; clear smooth boundary.

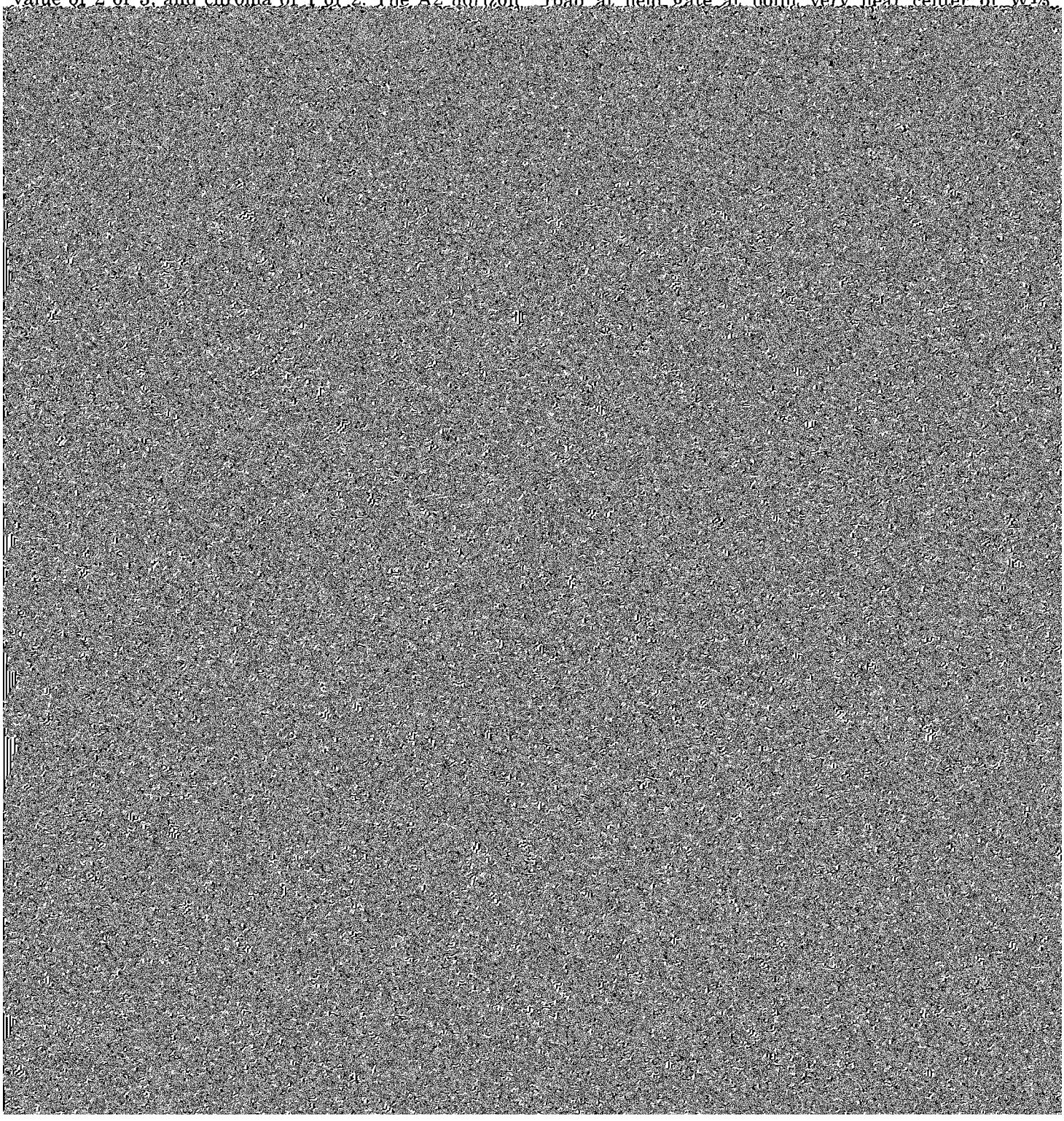
A22—12 to 15 inches; dark grayish brown (10YR 4/2) loam; weak medium and fine subangular blocky structure; friable; few fine faint brown (7.5YR 4/4) mottles; medium acid; clear smooth boundary.

B1—15 to 20 inches; brown (10YR 4/3) loam; some dark grayish brown (10YR 4/2) coatings on peds; weak medium and fine



(10YR 6/4) medium and coarse sand; single grained; loose; about 5 percent 2-millimeter gravel; medium acid.

The solum is 24 to 50 inches thick. Contrasting material is at a depth of about 24 to 40 inches. Carbonates are at a depth of less than 60 inches. The A1 or Ap horizon is 6 to 10 inches thick and has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The A2 horizon



been limed within the past 5 years, they are generally acid in the surface layer.

Huntsville soils are used mainly for cultivated crops. The major limitation for crops is runoff from soils upslope during periods of intense rainfall.

Representative profile of Huntsville silt loam, 0 to 2 percent slopes, in a cultivated field, 180 feet east of road at field gate at point very near center of W½

inches thick. These soils are lower in organic matter content than this Huntsville soil.

This soil is well suited to intensive row crops. It is subject to seasonal flooding. The organic matter content is high. Capability unit I–3.

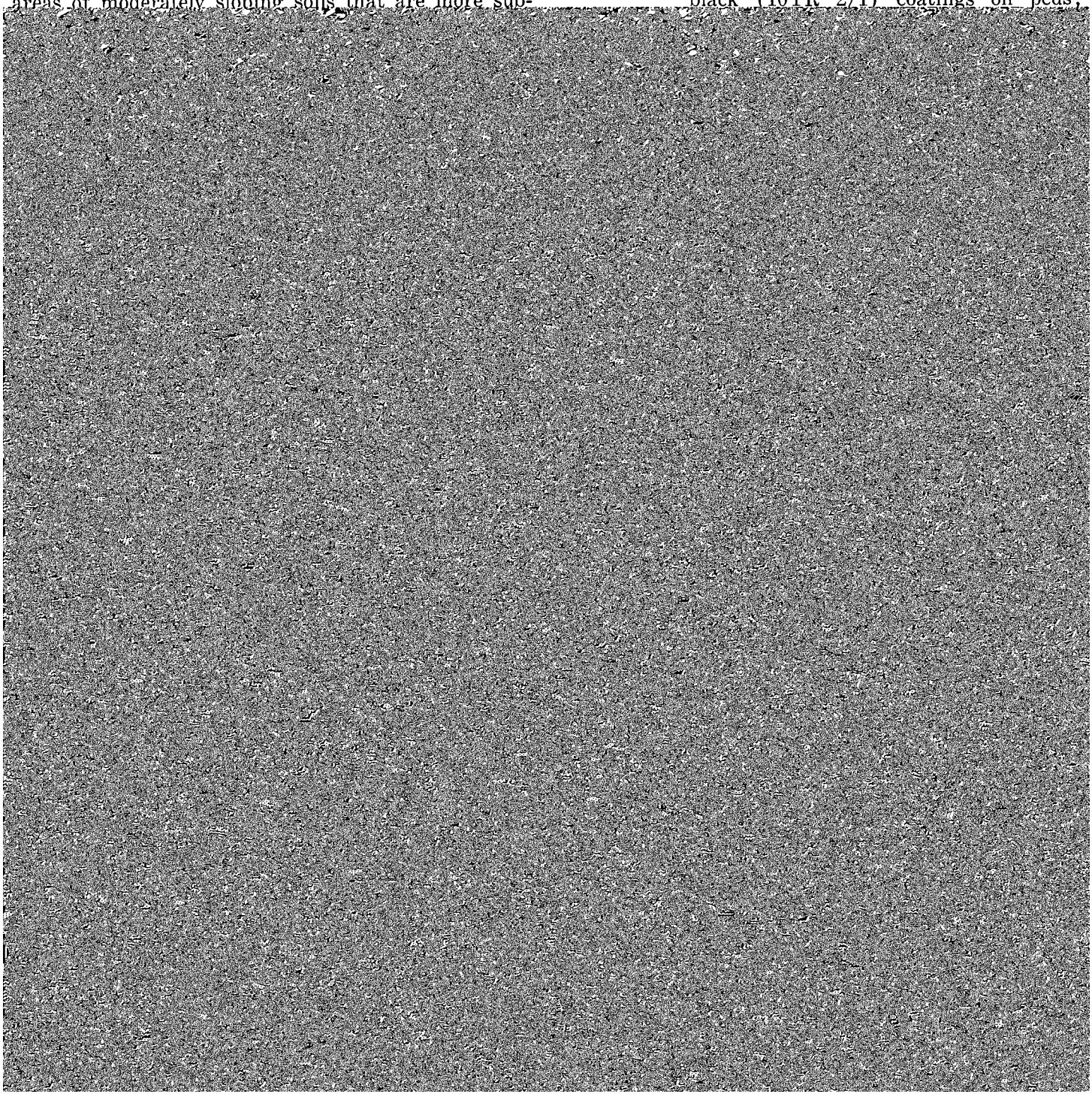
98B—Huntsville silt loam, 2 to 5 percent slopes. This gently sloping soil is on foot slopes, in upland drainageways, or on alluvial fans. Areas are about 5 to 10 acres in size and are elongated in shape.

Included with this soil in mapping are a few small areas of moderately sloping soils that are more sub-

ture; friable; neutral; clear smooth boundary.

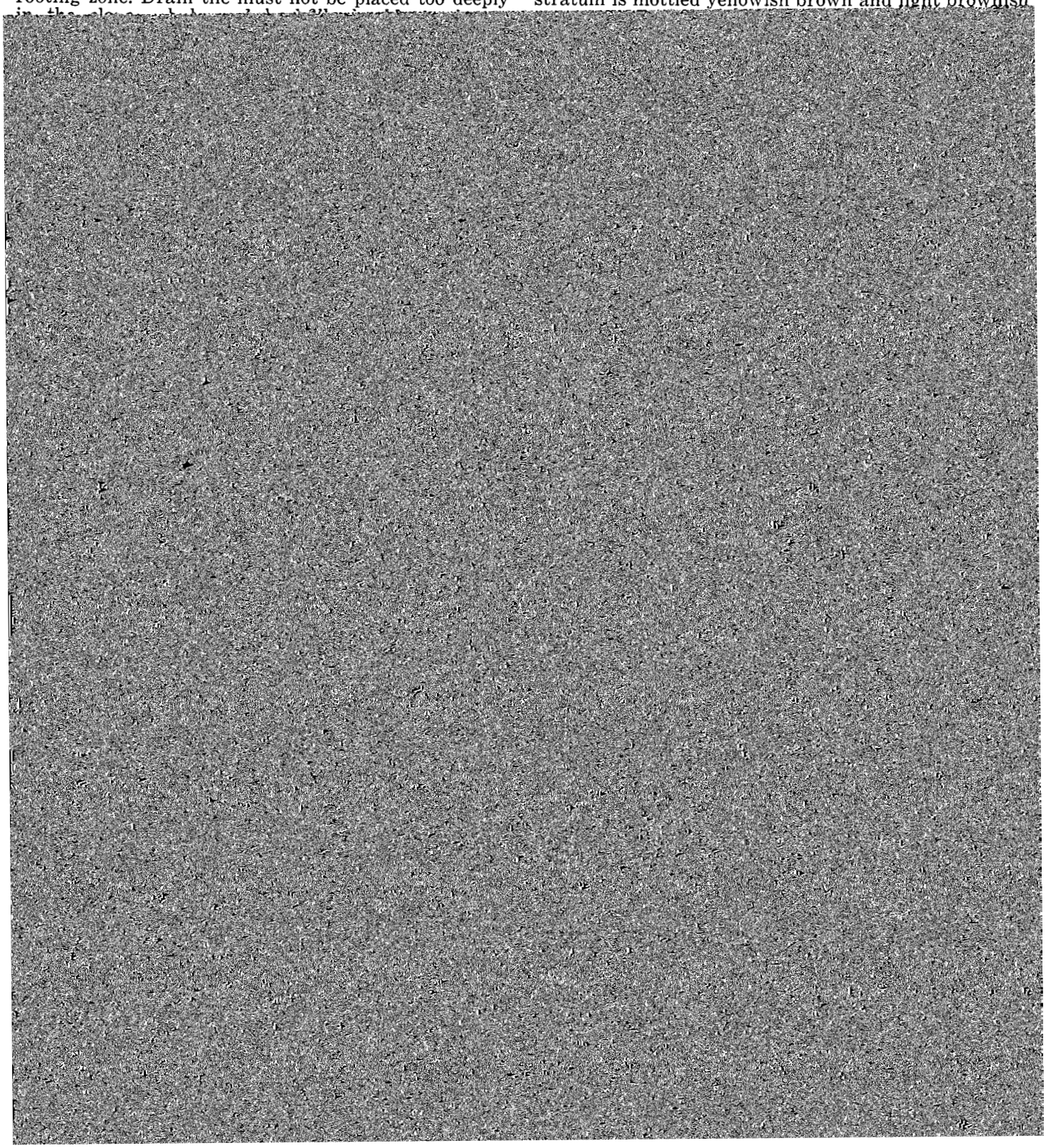
A3—10 to 16 inches; very dark grayish brown (10YR 3/2) heavy loam; black (10YR 2/1) coatings on peds; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; neutral; clear smooth boundary.

B2—16 to 24 inches; dark grayish brown (10YR 4/2) light clay loam; discontinuous black (10YR 2/1) coatings on peds;



crops. It is subject to erosion if cultivated; however, wetness is the major limitation. Artificial drainage is difficult because the water that keeps this soil wet must be intercepted upslope before it seeps into the rooting zone. Drain tile must not be placed too deeply

inches. It is brown, friable loam in the upper part; yellowish brown, firm heavy loam in the middle part; and mottled yellowish brown, strong brown, and light brownish gray, firm loam in the lower part. The substratum is mottled yellowish brown and light brownish



IIB3—39 to 52 inches; mottled yellowish brown (10YR 5/6), strong brown (7.5YR 5/6), and light brownish gray (10YR 6/2) loam; moderate medium prismatic structure; firm; medium acid; abrupt smooth boundary.

IIC—52 to 60 inches; mottled yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) loam; massive; firm; mildly alkaline; strong effervescence.

The solum is 45 to 60 inches thick. The soils formed in about 14 to 21 inches of loamy material and in the underlying glacial till. Carbonates are at a depth of 45 to 65 inches. The A1 horizon is 8 to 16 inches thick and is black (10YR 2/1) to very dark grayish brown (10YR 3/2). It is typically loam but ranges to silt loam that is high in sand. The IIB horizon is typically heavy loam but ranges to light clay loam or sandy clay loam. It is medium acid to strongly acid.

Kenyon soils are associated with Floyd, Clyde, Schley, and Ostrander soils. They formed in parent material similar to that of Readlyn, Tripoli, Bassett, and Oran soils. They have a thicker A horizon than Bassett soils. Kenyon soils are browner in the upper part of the B horizon than Oran, Schley, Readlyn, Tripoli, Floyd, and Clyde soils and are better drained than those soils. They are shallower to firm till and grayish mottles than Ostrander soils.

83B—Kenyon loam, 2 to 5 percent slopes. This gently sloping soil is on ridgetops and long, convex side slopes on uplands. Areas are several miles long and are irregular in shape.

This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that have a sandy surface layer. These soils are more droughty than this Kenyon soil. Also included are a few patches of moderately eroded soils that are lower in fertility.

This soil is well suited to corn and soybeans. It is subject to slight erosion if cultivated. Because of the differences in permeability of the loamy material and the underlying glacial till at a depth of about 1½ feet, water tends to accumulate at this contact, causing a temporary water table, particularly early in spring. The organic matter content is high. Capability unit IIe–1.

83C—Kenyon loam, 5 to 9 percent slopes. This moderately sloping soil is on short, convex side slopes on uplands. Areas are about 5 to 10 acres in size and are elongated in shape.

This soil has a profile similar to the one described as representative of the series, but the dark surface layer is not so thick.

Included with this soil in mapping are a few areas of sandy soils that are droughty and less productive than this Kenyon soil.

This soil is suited to corn and soybeans if properly managed. It is subject to moderate or severe erosion if cultivated. Contour farming and terracing help to control erosion. In a wet season, field work is delayed slightly. Because of the difficulty in providing adequate erosion control and drainage, a combination of terracing and tile drainage is needed. The organic matter content is moderate. Capability unit IIIe–1.

83C2—Kenyon loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping soil is on short, convex side slopes on uplands. Areas are about 5 to 10 acres in size and are elongated in shape.

This soil has a profile similar to the one described as representative of the series, but the dark surface layer is thinner, and some of the subsoil has been mixed into the plow layer. This soil has stones and pebbles on the surface that interfere with farming. It is lower in organic matter content and fertility than the slightly eroded Kenyon soils.

Included with this soil in mapping are areas of severely eroded soils that have little or no topsoil left and are lower in organic matter content and fertility than this Kenyon soil and areas of sandy soils that are more droughty and lower in fertility than this Kenyon soil.

This soil is suited to corn and soybeans if properly managed. It is subject to severe erosion if cultivated. Contour farming and terracing help to control erosion. In wet seasons, field work is delayed slightly. Because of the difficulty in providing adequate erosion control and drainage, a combination of terracing and tile drainage is needed. The organic matter content is moderately low. Capability unit IIIe–1.

Lamont series

The Lamont series consists of light colored, well drained to somewhat excessively drained soils. These nearly level to strongly sloping soils are on stream terraces, convex ridges, and side slopes on uplands. Slopes are 1 to 14 percent. These soils formed in moderately coarse textured wind-deposited sediment and the underlying coarse textured, gravel-free sediment. The native vegetation was deciduous trees.

In a representative profile the surface layer is very dark gray, friable fine sandy loam about 2 inches thick. The subsurface layer is brown and dark grayish brown, friable fine sandy loam about 6 inches thick. The subsoil extends to a depth of 30 inches. It is yellowish brown, very friable fine sandy loam in the upper part; yellowish brown, friable fine sandy loam and heavy fine sandy loam in the middle part; and yellowish brown, friable heavy sandy loam in the lower part. The substratum is light yellowish brown, brownish yellow, and yellowish brown fine sand that has thin brown sandy clay loam bands.

Available water capacity is low. Permeability is moderately rapid in the coarse textured sediments and rapid in the underlying coarse textured substratum. Available phosphorus is low, and available potassium is very low. Unless these soils have been limed within the past 5 years, they are generally acid in the surface layer.

The less sloping Lamont soils are used mainly for cultivated crops. The more sloping areas are in pasture and woodland. The major limitations for crops are erosion and droughtiness.

Representative profile of Lamont fine sandy loam, 1 to 5 percent slopes, in a wooded area, 173 feet north and 380 feet west of southeast corner of NW¼NE¼ sec. 30, T. 93 N., R. 8 W.:

A1—0 to 2 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry;

weak fine subangular blocky structure parting to weak fine granular; friable; neutral; abrupt smooth boundary.

A21—2 to 5 inches; brown (10YR 5/3) and some dark grayish brown (10YR 4/2) fine sandy loam; weak medium and thin platy structure; friable; slightly acid; gradual smooth boundary.

A22—5 to 8 inches; brown (10YR 5/3) fine sandy loam; weak medium platy structure; friable; strongly acid; gradual smooth boundary.

B1—8 to 12 inches; yellowish brown (10YR 5/4) fine sandy loam; weak medium and fine subangular blocky structure; very friable; medium acid; clear smooth boundary.

B21—12 to 17 inches; yellowish brown (10YR 5/4) fine sandy loam; moderate medium subangular blocky structure; friable; medium acid; clear smooth boundary.

B22t—17 to 22 inches; yellowish brown (10YR 5/4) heavy fine sandy loam; moderate medium subangular blocky structure; friable; few thin discontinuous brown (10YR 3/3) clay flows around sand grains; strongly acid; clear smooth boundary.

ent material similar to that of Dickinson and Sparta soils. They have less sand in the A horizon and upper part of the B horizon than Chelsea and Sparta soils. They are not underlain by limestone bedrock at a depth of less than 40 inches as are Backbone soils. Lamont soils have more sand and less clay in the solum than Coggon soils. They have a thinner, lighter colored A horizon than Dickinson soils.

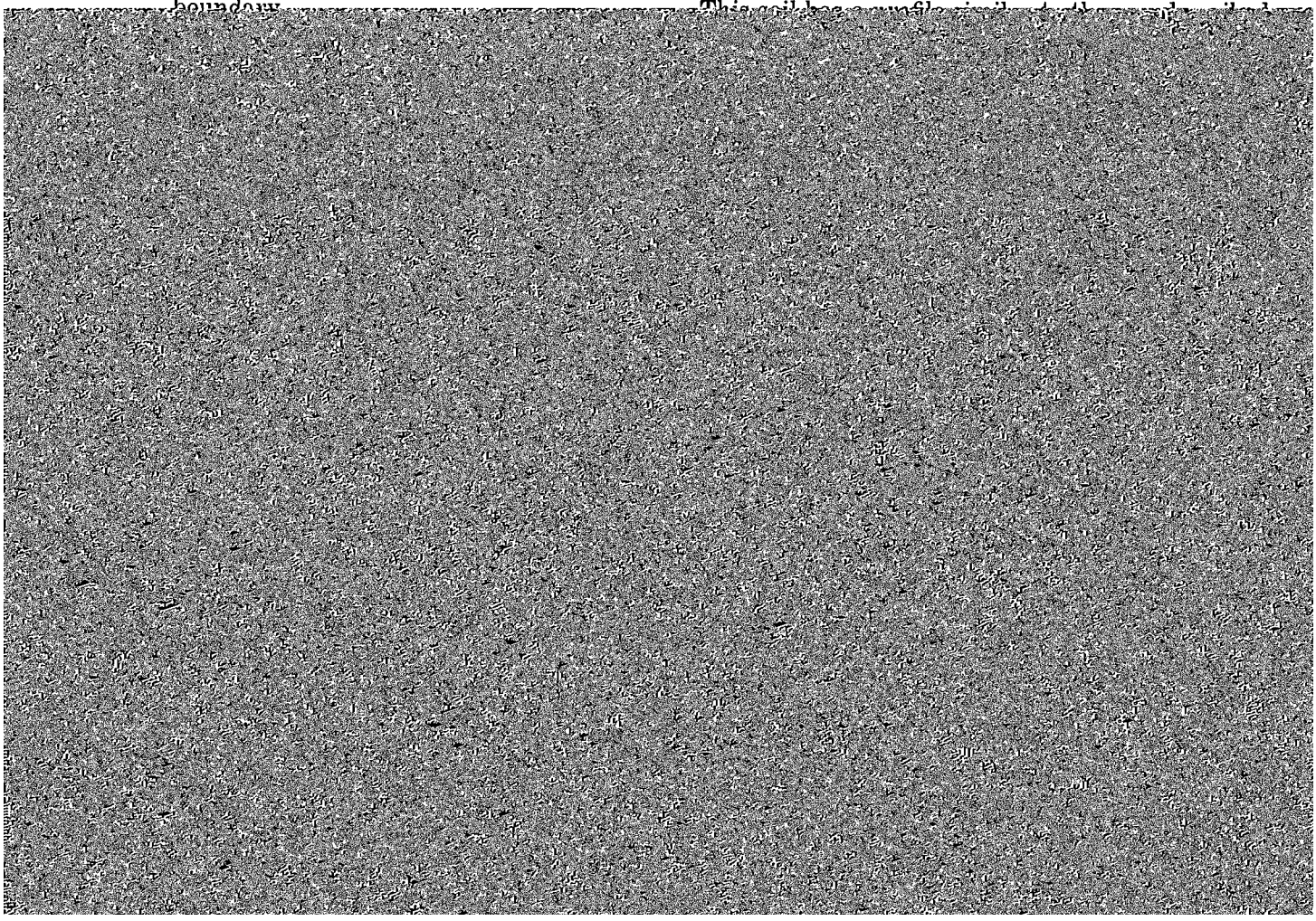
110B—Lamont fine sandy loam, 1 to 5 percent slopes. This nearly level to gently sloping soil is on uplands and on stream benches. Areas are about 10 acres in size and are irregular in shape.

This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of soils that have gravel at a depth of more than 2 feet and in places are more droughty than this Lamont soil.

This soil is suited to cultivated crops but it is droughty unless rainfall is very timely. It is also subject to soil blowing and water erosion if cultivated. The organic matter content is very low. Capability unit IIIe–3.

110C—Lamont fine sandy loam, 5 to 14 percent slopes. This moderately sloping to strongly sloping soil is on ridges and side slopes on stream benches on uplands. Areas are about 5 to 10 acres in size and are irregular in shape.



age is beneficial in some years. If rainfall is not timely these soils can be droughty because of the coarse textured substratum.

Representative profile of Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes, in a cultivated field, 24 feet south and 650 feet west of northeast corner of SW¼SW¼ sec. 29, T. 93 N., R. 10 W.:

Ap—0 to 8 inches; black (10YR 2/1) loam; cloddy parting to weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 16 inches; black (10YR 2/1) loam; weak fine granular structure; friable; medium acid; clear smooth boundary.

A3—16 to 20 inches; very dark grayish brown (10YR 3/2) loam; weak fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

B2—20 to 26 inches; dark grayish brown (2.5Y 4/2) heavy loam; moderate medium subangular blocky structure; friable; medium acid; gradual smooth boundary.

B3—26 to 30 inches; mottled yellowish brown (10YR 5/6), grayish brown (2.5Y 5/2), and light olive brown (2.5Y 5/6) sandy clay loam; very weak coarse subangular blocky structure; friable; medium acid; clear smooth boundary.

IIC1—30 to 44 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) medium and coarse sand; single grained; loose; few small pebbles about ½ inch in diameter; medium acid; gradual smooth boundary.

IIC2—44 to 60 inches; mottled strong brown (7.5YR 5/6), light brownish gray (2.5Y 6/2), and yellowish brown (10YR 5/6) coarse and medium sand; single grained; loose; few small pebbles about ½ inch in diameter; slightly acid.

Thickness of the solum and depth to coarse textured material are generally 24 to 40 inches. The A horizon is loam or silt loam that is high in sand. The A1 horizon is gray in the B horizon as Marshan soils and have better drainage.

225—Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes. This nearly level soil is on stream benches and in outwash areas on uplands. Areas are 10 to 20 acres in size and are irregular in shape.

This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of sandy soils that are droughty and less productive than this Lawler soil.

This soil is well suited to row crops, and good yields can be expected if rainfall is timely. It is subject to wetness or droughtiness during the growing season, depending on the rainfall. It is somewhat poorly drained and benefits from tile drainage during wet seasons. Tile placement is difficult because of the loose, water-bearing sand and gravel. The organic matter content is high. Capability unit IIs–2.

226—Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes. This nearly level soil is on stream benches and in outwash areas on uplands. Areas are 5 to 10 acres in size and are irregular in shape.

This soil has a profile similar to the one described as representative of the series, but sand and gravel are at a depth of 32 to 40 inches.

Included with this soil in mapping are a few areas of soils that have a silt loam surface layer.

This soil is well suited to row crops and can be used intensively for corn and soybeans. It is subject to wetness and will benefit from tile drainage during wet seasons. Tile placement is difficult in places because of the loose, water-bearing sand and gravel at a depth of about 3 feet. The organic matter content is high. Capability unit I–2.

Loamy alluvial land

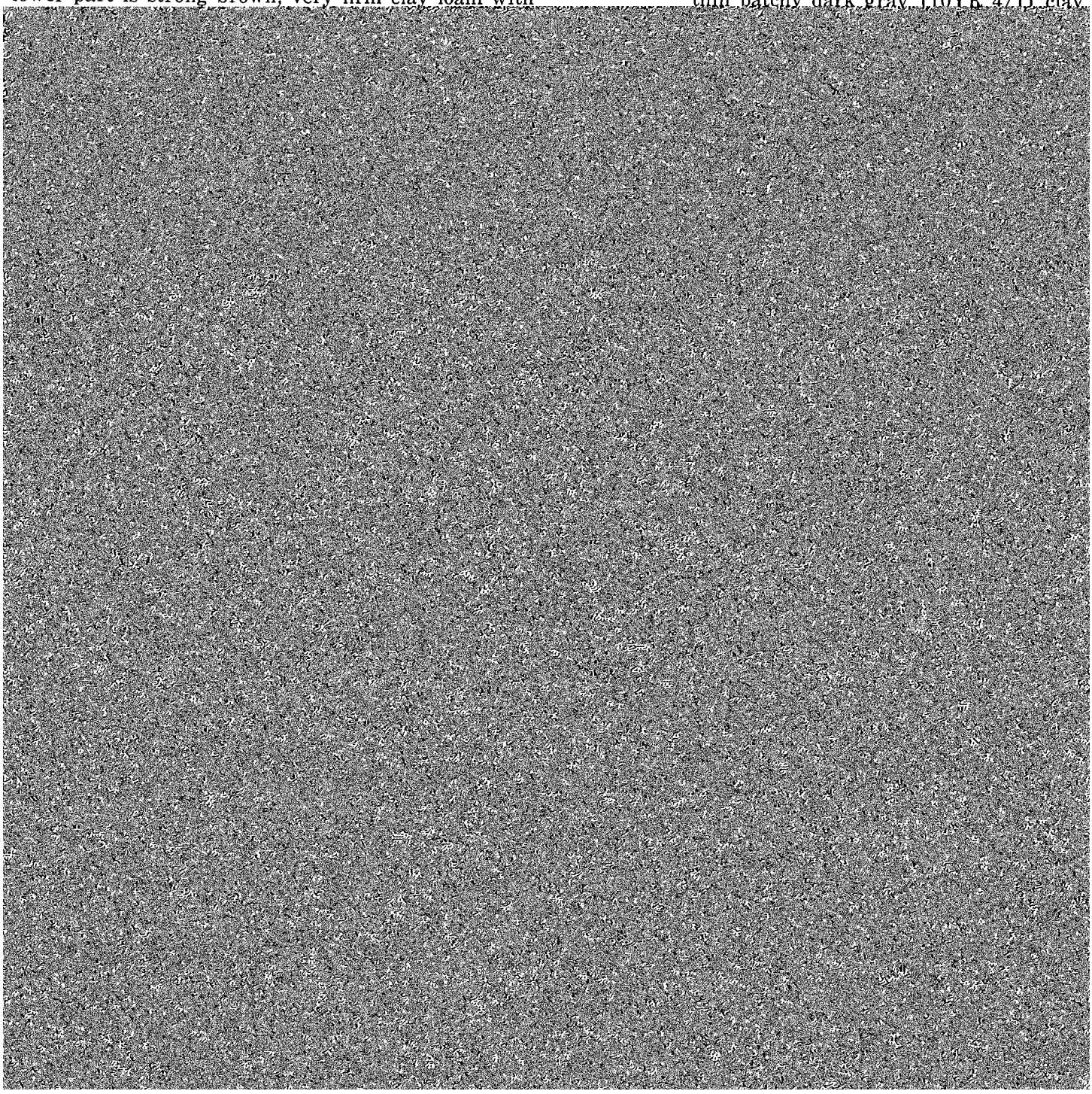
315—Loamy alluvial land. These areas consist of nearly level, recently deposited highly stratified sediment. The sediment has not been in place long enough for soil to develop. The areas are frequently flooded,

vegetation was deciduous trees and prairie grasses. In most places a layer of stones and pebbles is at the contact of the loamy material and the glacial till.

In a representative profile the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is brown loam about 3 inches thick. The subsoil extends to a depth of 44 inches. The upper part of the subsoil is dark yellowish brown, friable loam; the middle part is mottled strong brown, grayish brown, and olive gray, firm and very firm clay loam; and the lower part is strong brown, very firm clay loam with

structure parting to moderate fine subangular blocky; firm; strongly acid; clear smooth boundary.

IIB22t—22 to 32 inches; mottled strong brown (7.5YR 5/6) and olive gray (5Y 5/2) clay loam; discontinuous gray (5Y 5/1) and olive gray (5Y 5/2) coatings on prism faces; weak medium prismatic structure parting to moderate fine subangular and angular blocky; very firm; thin patchy dark gray (10YR 4/1) clay



in permeability in the loamy material and the underlying very firm glacial till at a depth of about 1½ feet, water accumulates at this contact and produces a temporary high water table, especially early in spring. A combination of terracing and tile drainage helps to provide adequate erosion control and drainage. Careful placement and spacing of tile are important because of the slowly permeable subsoil. The organic matter content is moderately low. Capability unit IIe–1.

781C—Lourdes loam, 5 to 9 percent slopes. This moderately sloping soil is on short, convex side slopes on uplands. Areas are about 5 to 10 acres in size and are elongated in shape.

This soil has a profile similar to the one described as representative of the series, but the surface layer is about 6 inches thick.

Included with this soil in mapping are a few moderately eroded areas of soils in which part of the subsurface layer has been incorporated into the plow layer. Also included are a few areas of soils that have a sandy surface layer and are more droughty than this Lourdes soil.

This soil is suited to corn and soybeans. It is subject to moderate or severe erosion if cultivated. It can have a seasonal perched water table because water accumulates at the contact between the loamy material and the underlying glacial till. Water tends to accumulate at a depth of 1 to 2 feet below the surface in soils upslope, and then moves downhill on these sloping soils. The water may surface part way down the slope as a seepy spot, or it may make a large part of the slope wet. A combination of terracing and tiling helps to provide adequate erosion control and drainage. The organic matter content is moderately low. Capability unit IIIe–1.

Marlean series

The Marlean series consists of dark colored, well drained to somewhat excessively drained soils. These gently sloping to strongly sloping soils are on ridges and side slopes on uplands. Slopes are 2 to 14 percent. These soils formed in 4 to 18 inches of loamy material

A11—0 to 5 inches; very dark brown (10YR 2/2) loam; black (10YR 2/1) coatings on peds; weak fine granular structure; friable; neutral; clear smooth boundary.

A12—5 to 9 inches; very dark brown (10YR 2/2) loam; weak fine subangular blocky structure parting to moderate fine granular; friable; slightly acid; clear smooth boundary.

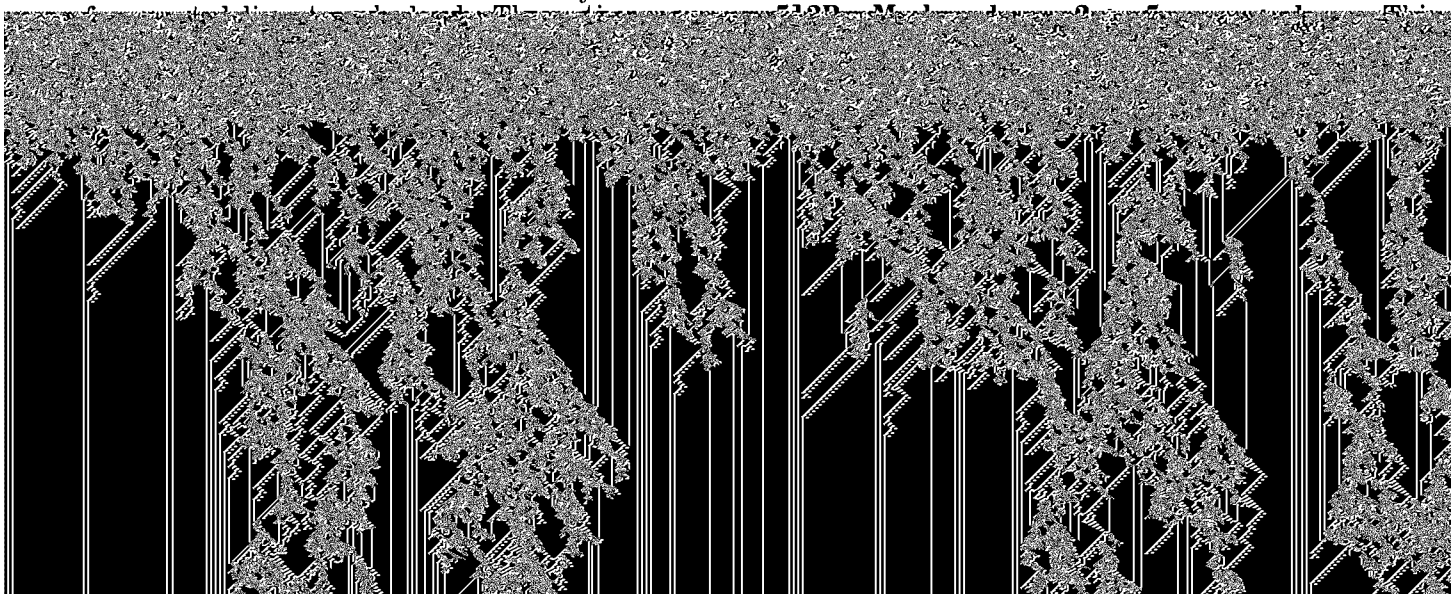
A3—9 to 15 inches; dark brown (10YR 3/3) loam; very dark grayish brown (10YR 3/2) coatings on peds; moderate medium subangular blocky structure; friable; slightly acid; abrupt wavy boundary.

IIC—15 to 52 inches; a bed of fragmented limestone with about 5 to 10 percent chert fragments; 60 to 80 percent is fragments of limestone ½ inch to 4 inches in diameter, with brown (10YR 4/3) and dark yellowish brown (10YR 4/4) loamy filling between fragments; fragments are moderately alkaline and strongly effervescent, and fillings are mildly alkaline.

IIR—52 inches; hard limestone bedrock.

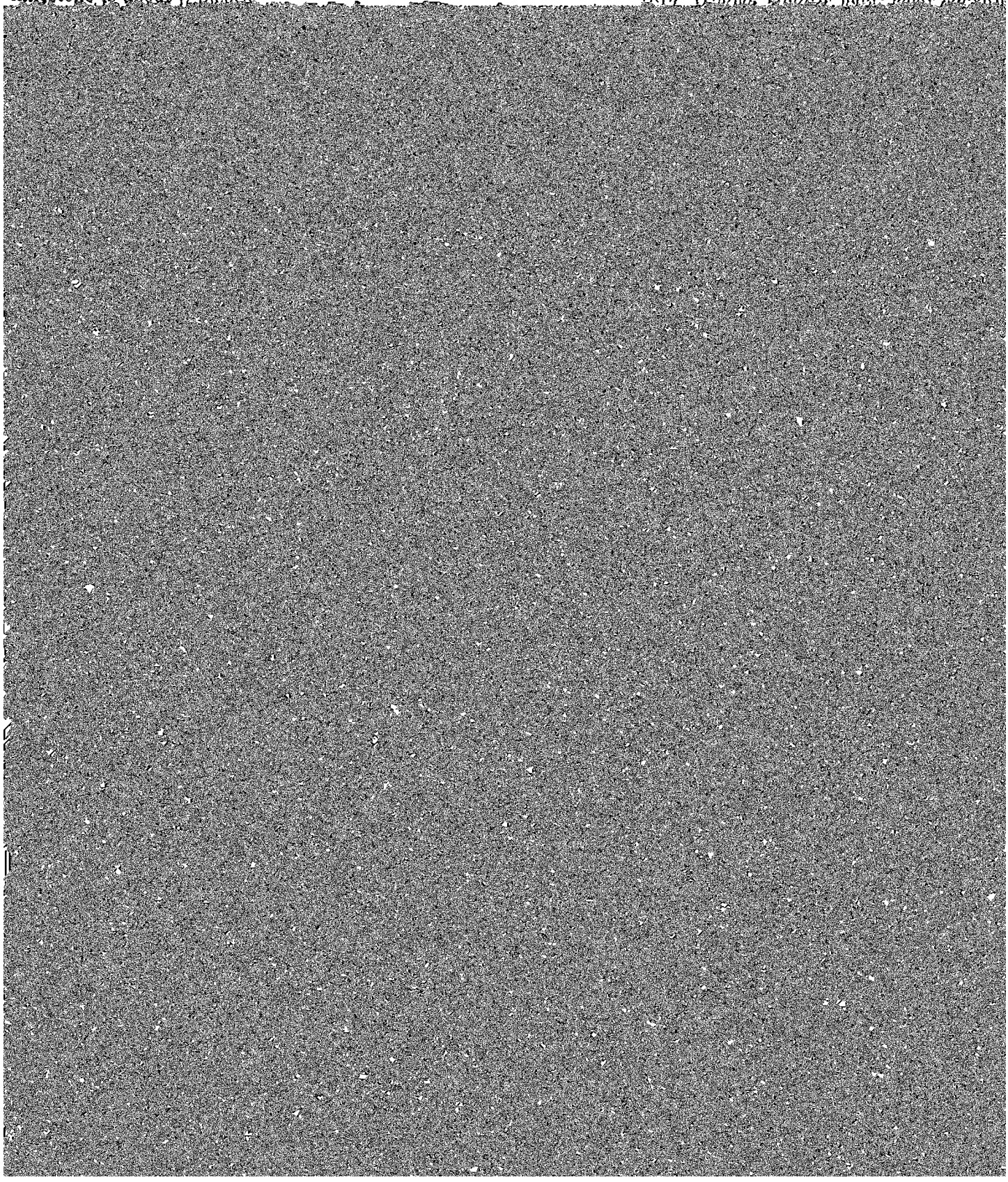
The solum is 4 to 8 inches thick. Fragmented limestone is below this depth. The A1 horizon is black (10YR 2/1) or very dark brown (10YR 2/2), but it is very dark grayish brown (10YR 3/2) where cultivated. The A horizon is loam or light clay loam to silt loam that is high in sand. It is 4 to 15 inches thick. The IIC horizon is typically soft, fragmented limestone with loamy fillings, but in some profiles it has as much as 80 percent hard fragments of limestone and chert. Generally no residuum is above the fragmented limestone.

Marlean soils are associated with Calamine, Jacwin, Rockton, and Winneshiek soils. They are underlain by limestone, whereas Calamine and Jacwin soils are underlain by shale. They are underlain by more fragmented limestone and are deeper to hard limestone than Rockton and Winneshiek soils.



representative of the series, but depth to fragmented limestone is about 8 inches.

loam; moderate medium granular structure; friable; slightly rigid; clear smooth



and gravel, 0 to 2 percent slopes. This nearly level soil is on stream benches and in outwash areas on uplands where there is erosional sediment from glacial till. Areas are about 10 acres in size and are irregular in shape.

This soil has a profile similar to the one described as representative of the series, but sand and gravel are at a depth of 32 to 40 inches.

Included with this soil in mapping are small areas of soils that have a sandy surface layer. These soils can be somewhat droughty.

This soil is suited to row crops if properly drained. It is subject to little surface runoff. The water table is high, especially in spring. Artificial drainage is needed for row crops. Tilth is generally good, but this soil puddles if worked when wet. The organic matter content is high. Capability unit IIw–1.

Nordness series

The Nordness series consists of light-colored, some

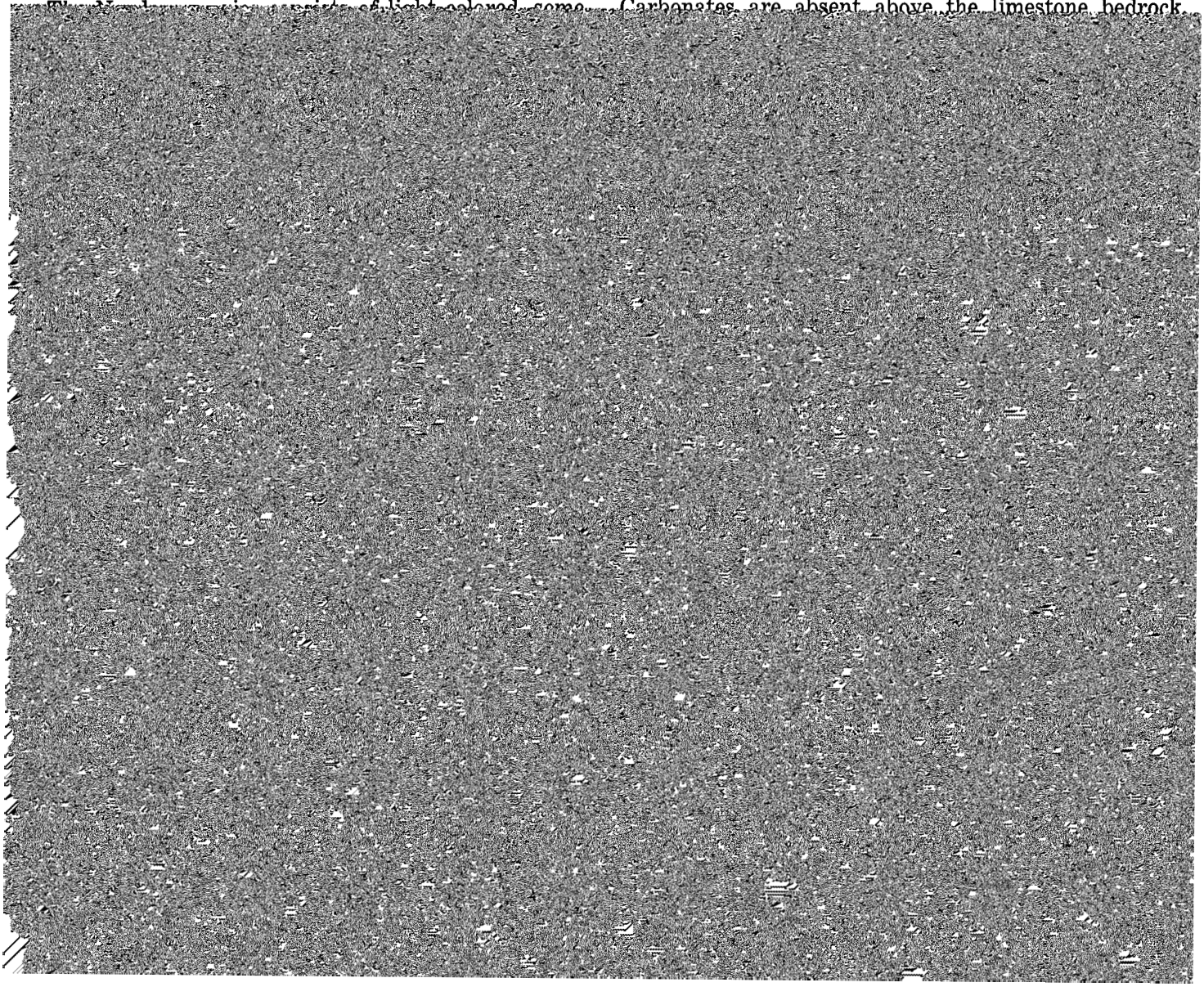
(10YR 3/2) clay films; slightly acid; clear smooth boundary.

IIB2t—11 to 16 inches; dark brown (7.5YR 4/4) clay; strong medium subangular blocky structure; very firm; thick continuous dark brown (7.5YR 3/2) clay films; neutral; abrupt wavy boundary.

IIR1—16 to 18 inches; level bedded limestone bedrock; flags of limestone with silty clay residuum interbedded; mildly alkaline; strong effervescence.

IIR2—18 inches; hard fractured limestone bedrock.

The solum is 5 to 18 inches thick. It is neutral to medium acid in the most acid part. The A1 horizon is very dark gray (10YR 3/1) or dark grayish brown (10YR 4/2) and is 1 to 4 inches thick. The A1 and A2 horizons typically are silt loam but range to loam that is high in silt. The IIB2t horizon is heavy silty clay loam to silty clay or clay and is 1 to 6 inches thick. Carbonates are absent above the limestone bedrock.



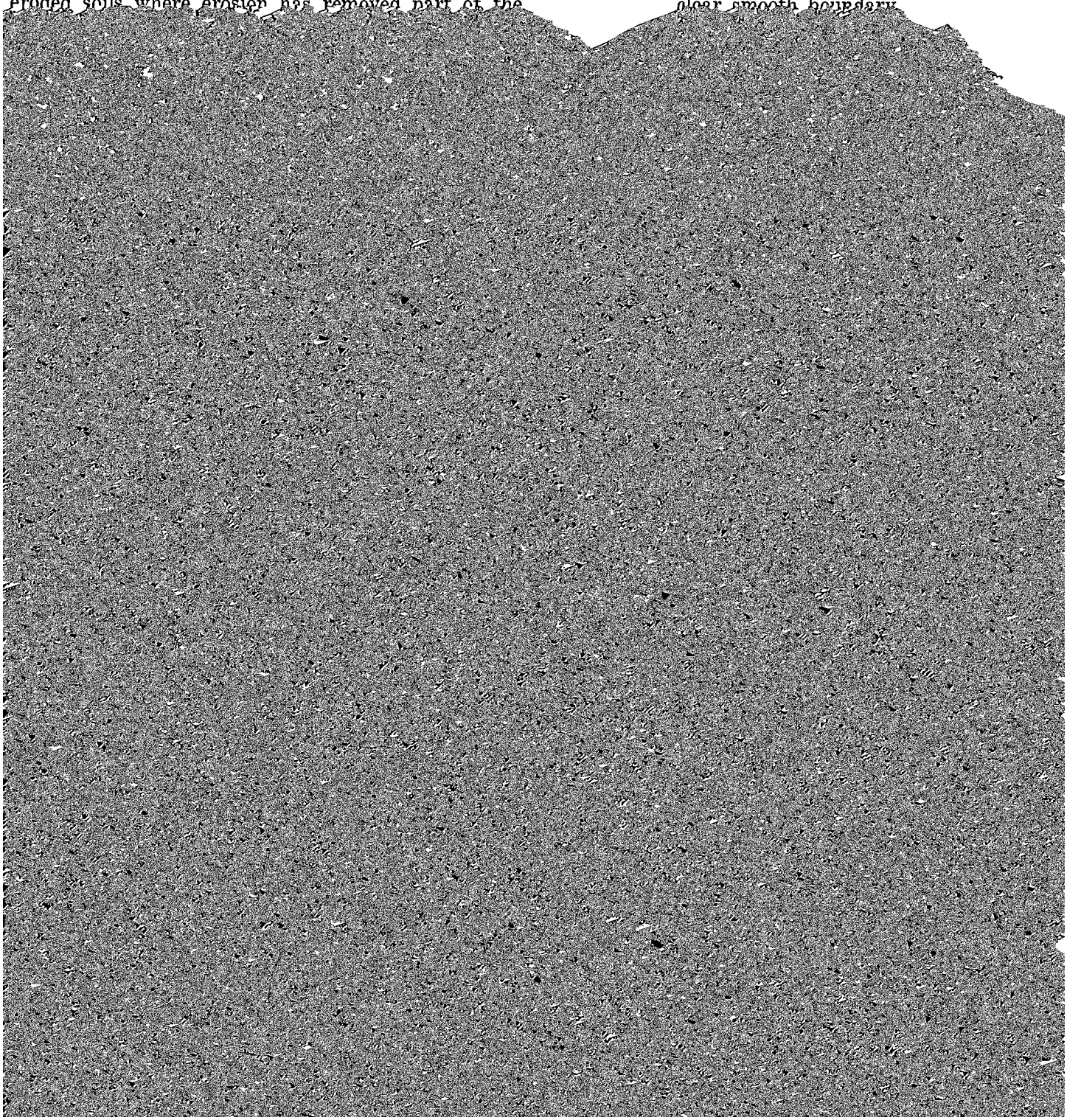
slopes on uplands. Areas are about 10 acres in size and are elongated in shape.

This soil has a profile similar to the one described as representative of the series, but depth to limestone bedrock is typically less.

Included with this soil in mapping are areas of soils where shattered slabs of limestone are near the surface or are exposed. Also included are areas of moderately eroded soils where erosion has removed part of the

B21—24 to 33 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; medium acid; clear smooth boundary.

IIB22—33 to 45 inches; yellowish brown (10YR 5/6) heavy loam; moderate medium subangular blocky structure; firm; pebble band at top of horizon; strongly acid; clear smooth boundary.



layer is thinner and depth to the loam glacial till is typically less.

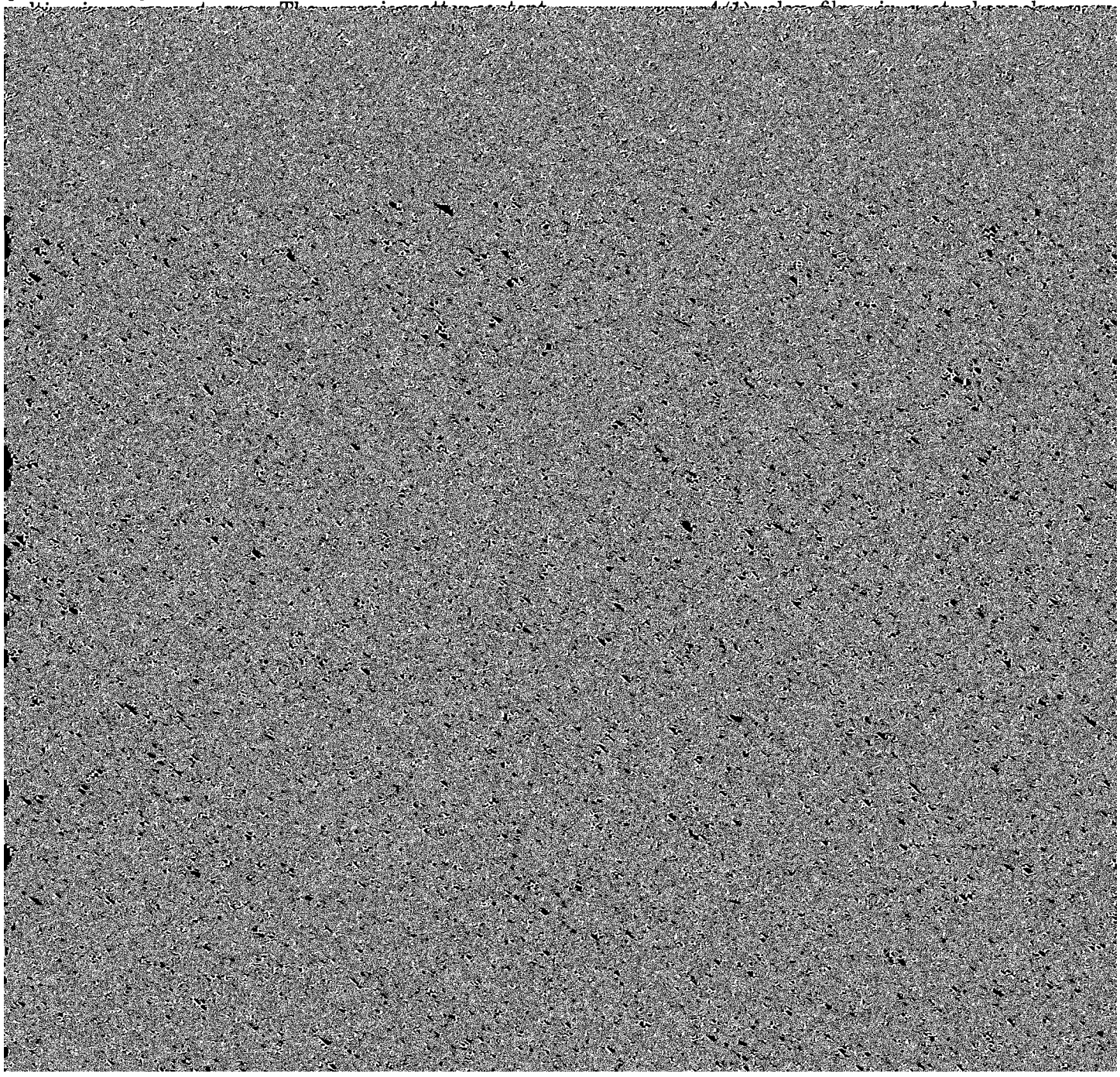
Included with this soil in mapping are areas of soils in which the dark surface layer is less than 10 inches thick. These soils are lower in organic matter content and fertility than this Olin soil.

This soil is suited to row crops if well managed. The surface layer is easy to work and dries out quickly. It is subject to soil blowing and water erosion. Because of the difference in permeability between the upper and lower parts of the subsoil, this soil can be droughty in some years. Water accumulates above the till in periods of high rainfall and then moves laterally, re-

dium platy structure; friable; very strongly acid; clear smooth boundary.

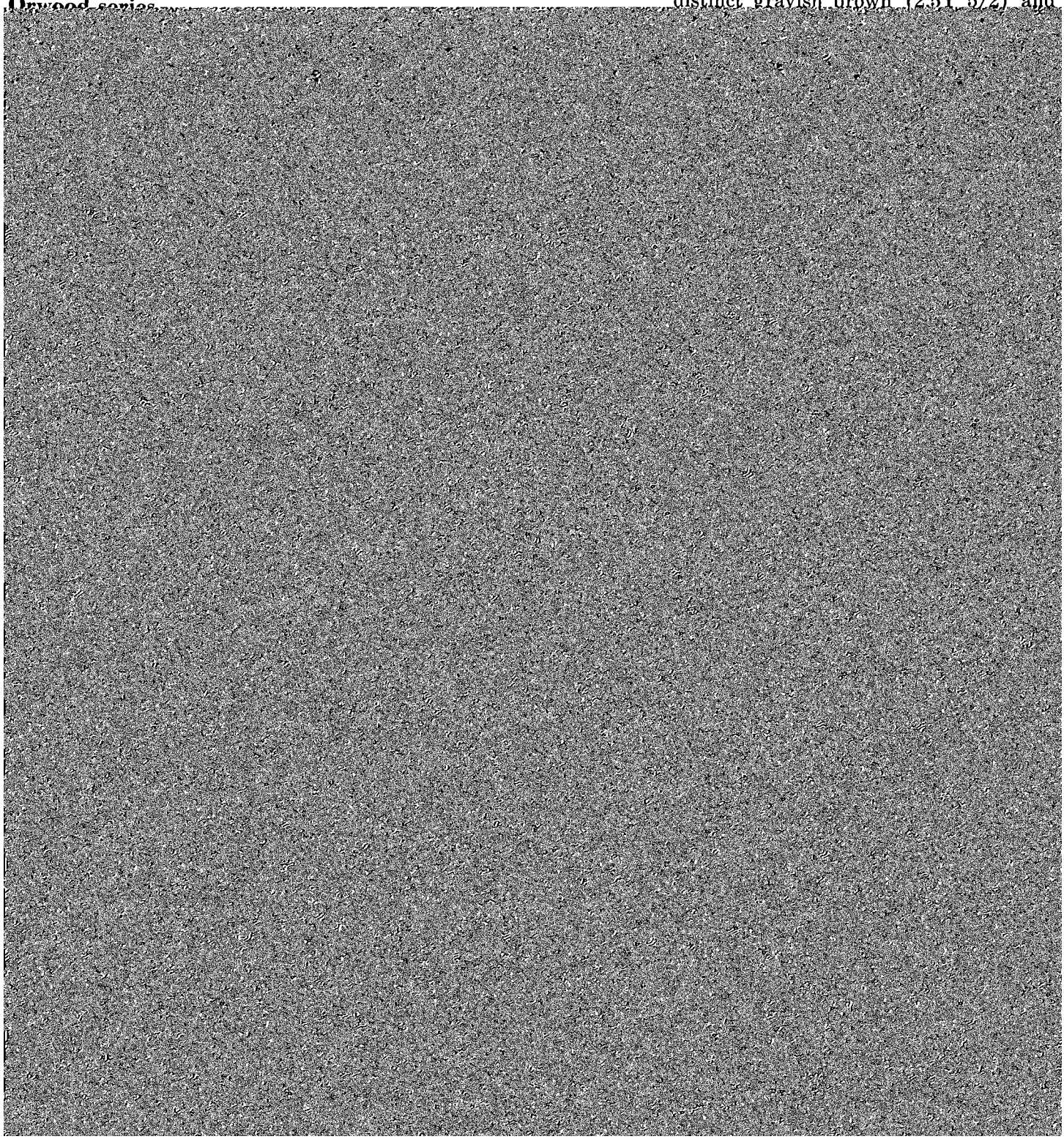
B1—12 to 18 inches; dark grayish brown (10YR 4/2) loam; few fine distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; very strongly acid; clear smooth boundary.

IIB21t—18 to 26 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) heavy loam; moderate medium subangular blocky structure; firm; few thin discontinuous dark gray (10YR



derlying glacial till, water accumulates at the contact of these materials producing a seasonal high water table. This soil will benefit from tile drainage in some years. The organic matter content is moderate. Capability unit I–2.

Orwood series



weak medium subangular blocky; friable; thin discontinuous dark yellowish brown (10YR 4/4) clay films; medium acid; gradual smooth boundary.

C—45 to 60 inches; yellowish brown (10YR 5/4 and 5/6) silt loam high in sand; few fine distinct grayish brown (2.5Y 5/2) and

as representative of the series, but the surface layer is thinner and lighter colored.

Included with this soil in mapping are a few areas of uneroded soils that are wooded or in pasture. These soils are high in fertility and organic matter content. Also included are a few small areas of severely eroded soils. These soils are lower in fertility and organic matter content and have poorer tilth than this Orwood soil.

This soil is suited to cultivated crops if they are occasionally rotated with hay crops. It is subject to severe erosion if cultivated. It generally has good tilth but puddles and becomes cloddy if worked when wet. The organic matter content is low. Capability unit IVe–1.

Ossian series

The Ossian series consists of dark colored, poorly drained soils. These nearly level soils are on first bottoms along streams. Slopes are 0 to 2 percent. They formed in medium textured, silty alluvium mainly from loess soils on the uplands. The native vegetation was mixed prairie grasses and water-tolerant plants.

In a representative profile the surface layer is black

iron segregations in root channels; neutral; clear smooth boundary.

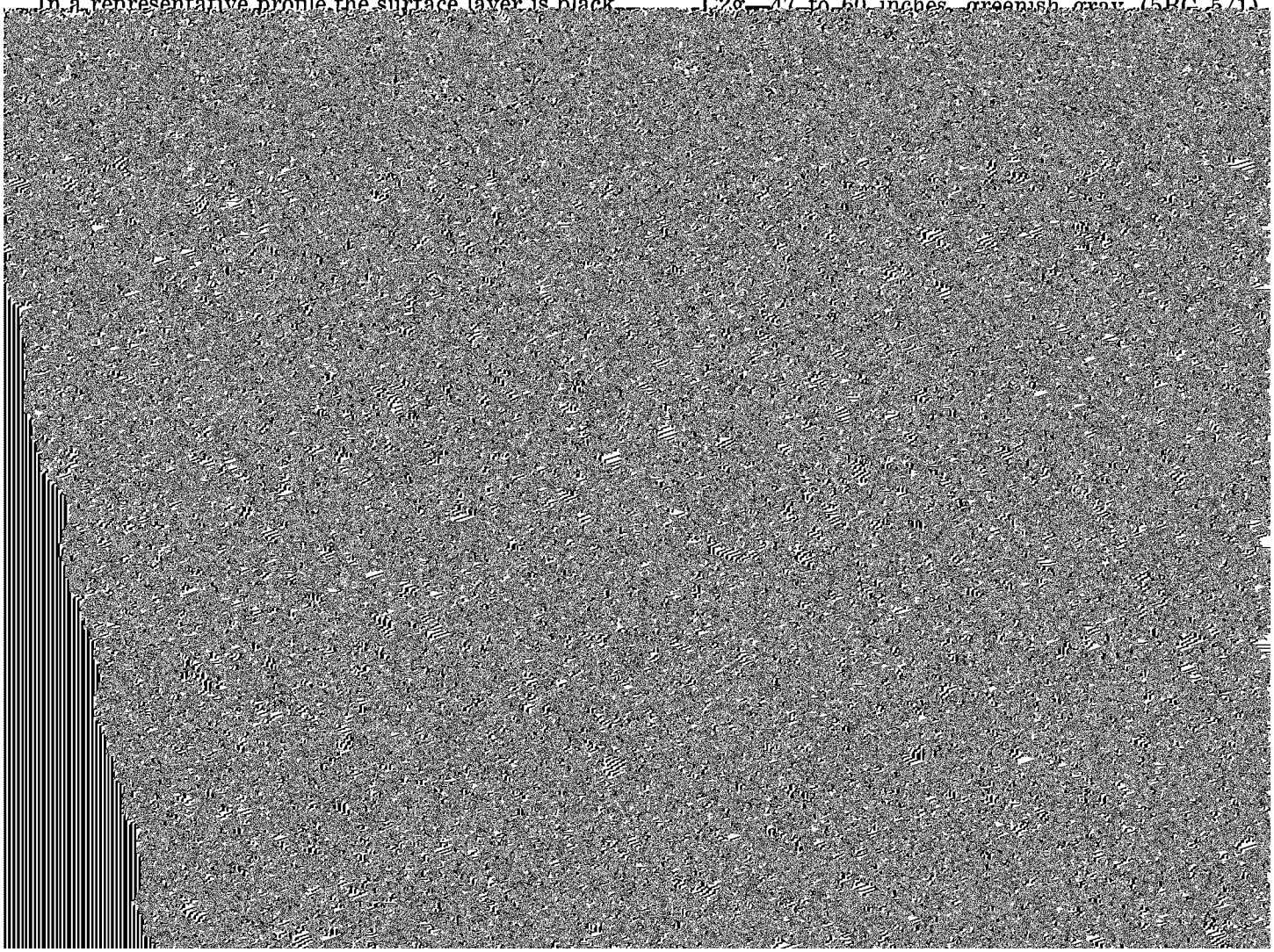
B2g—23 to 28 inches; mottled strong brown (7.5YR 5/8) and olive gray (5Y 5/2) silt loam; gray (5Y 5/1) coatings on peds; weak medium and coarse subangular blocky structure; friable; neutral; clear smooth boundary.

B31g—28 to 33 inches; olive gray (5Y 5/2) silt loam; few fine distinct yellowish brown (10YR 5/8) mottles; weak coarse prismatic structure; friable; neutral; clear smooth boundary.

B32g—33 to 41 inches; olive (5Y 5/3) light silt loam; very weak coarse prismatic structure parting to massive; friable; few fine distinct yellowish brown (10YR 5/8) iron segregations; neutral; clear smooth boundary.

C1g—41 to 47 inches; olive gray (5Y 5/2) light silt loam; massive; friable; few fine distinct yellowish brown (10YR 5/8) iron segregations; neutral; abrupt smooth boundary.

C2g—47 to 60 inches, greenish gray (5BG 5/1)

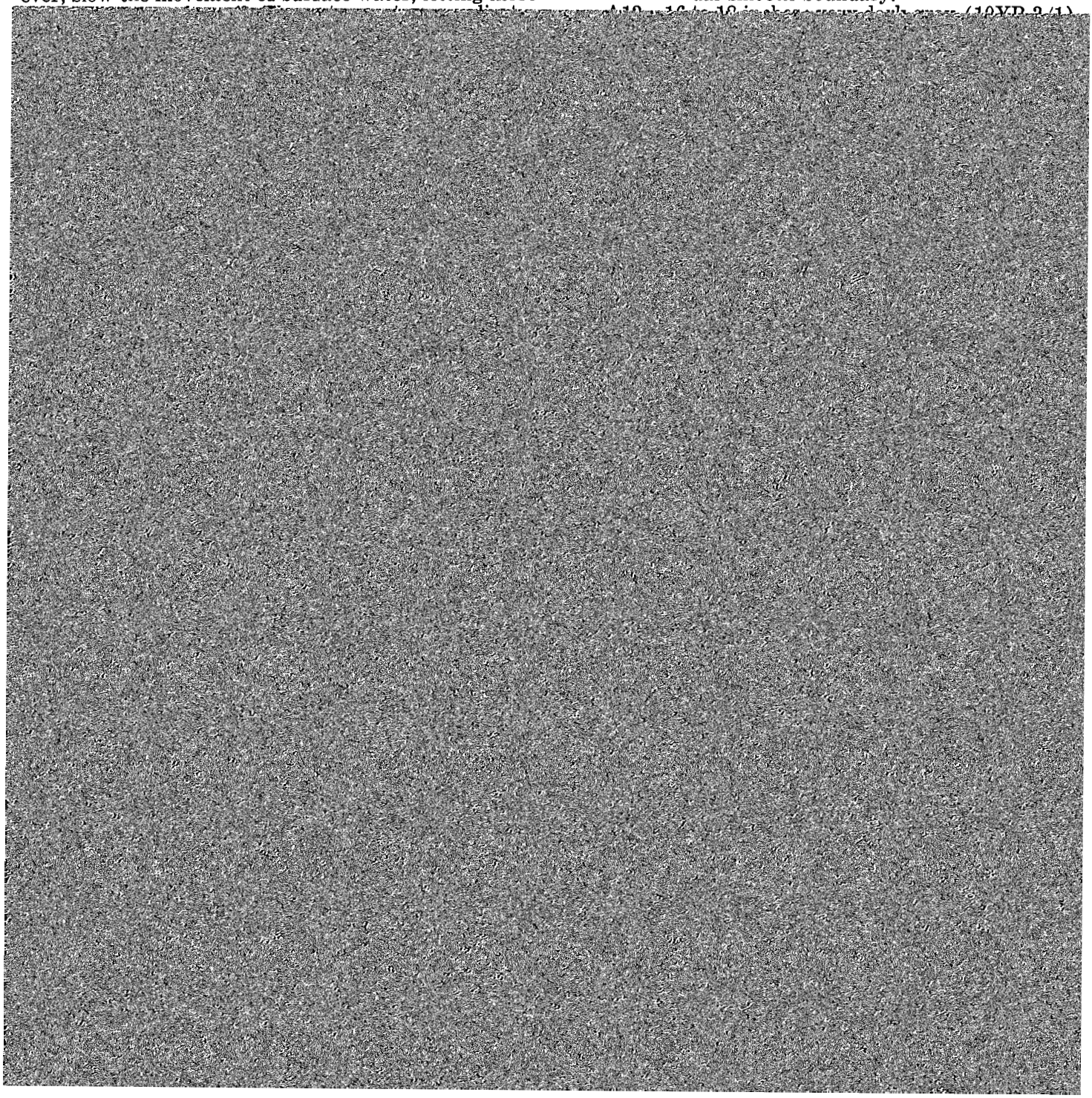


representative of the series, but the dark surface layer is not so thick.

Included with this soil in mapping are a few areas of sandy soils. These soils are droughty and less productive than this Ostrander soil.

This soil is suited to corn and soybeans if properly managed. It is subject to moderate or severe erosion if cultivated. Erosion control practices are needed when this soil is in row crops. Conservation practices, however, slow the movement of surface water, letting more

brown (10YR 5/2), very dark gray (10YR 3/1), dark grayish brown (10YR 4/2), and very dark grayish brown (10YR 3/2) silt loam, very dark grayish brown (10YR 3/2) kneaded; common, medium prominent red (2.5YR 4/6) and yellowish red (5YR 4/6) mottles associated with roots; moderate thin platy structure; friable; neutral; gradual smooth boundary.



and seepage from more sloping soils upslope. Drainageways that carry a high concentration of water need to be maintained in grass to help prevent gullying. Tile is needed on each side of some drainageways to remove the excess water.

Most of these soils are in permanent pasture or are cropped with the surrounding soils. Areas are generally too small and narrow and irregular in shape to be cropped separately. Capability unit IIw–1.

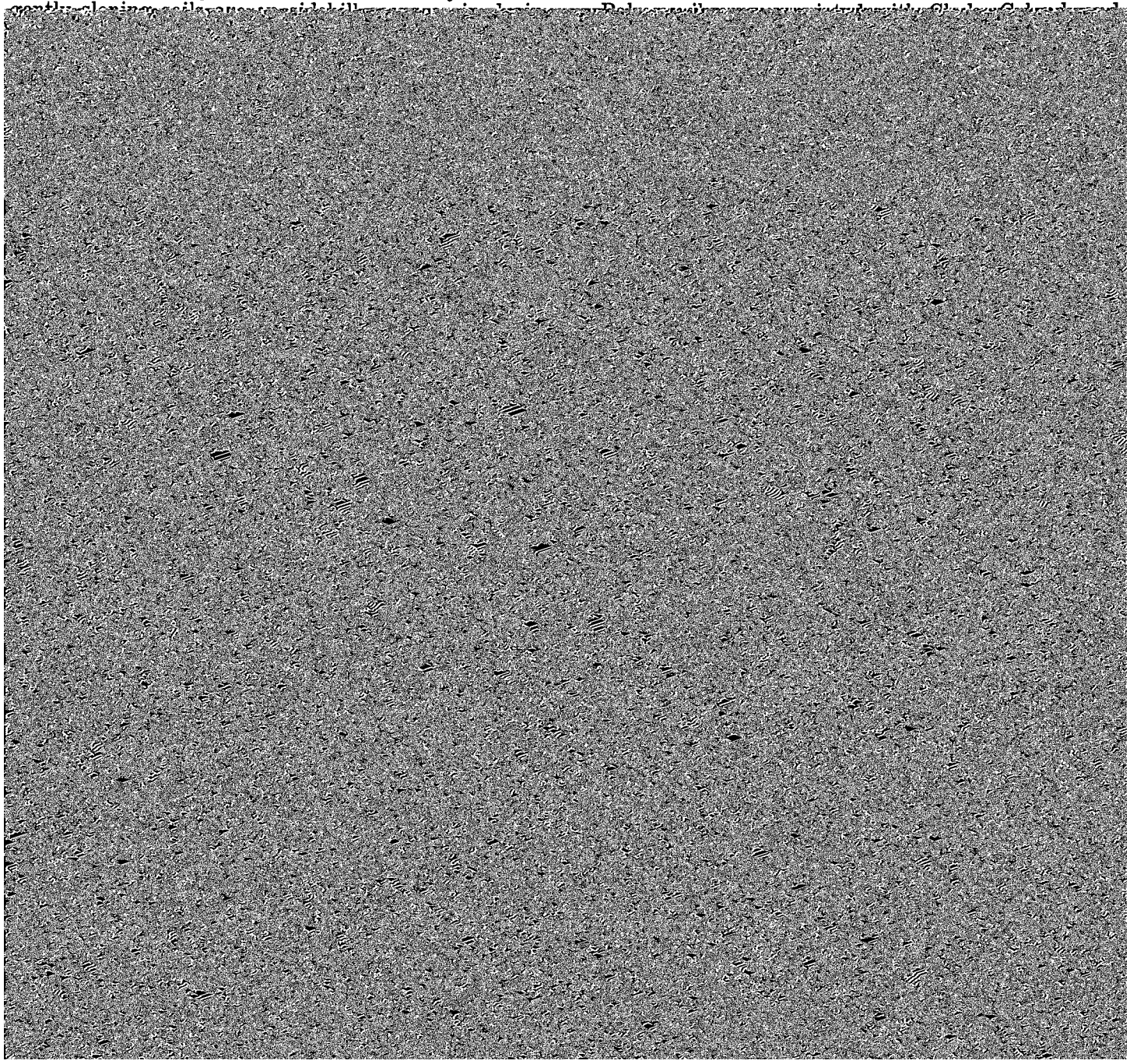
Palms series

The Palms series consists of dark colored, very poorly drained organic soils. These nearly level to

fine gravel; neutral; clear smooth boundary.

IIC3g—38 to 60 inches; dark greenish gray (5GY 4/1) loam; massive; friable; neutral.

The sapric material is generally 18 to 40 inches thick, but it is as much as 50 inches thick in places. It is black (N 2/0 or 10YR 2/1) or very dark brown (10YR 2/2). The fiber is mainly derived from herbaceous plants. The IIC horizon has hue of 10YR, to 5Y, chroma of 1 or 2, and value of 1 to 3. It is variable in texture, but it is typically silty clay loam, loam, or silt loam and has sandy strata in places. It is typically neutral but ranges from slightly acid to mildly alkaline.



and 108 feet west of the northeast corner of the western half of SW¼NW¼ sec. 6, T. 94 N., R. 8 W.:

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

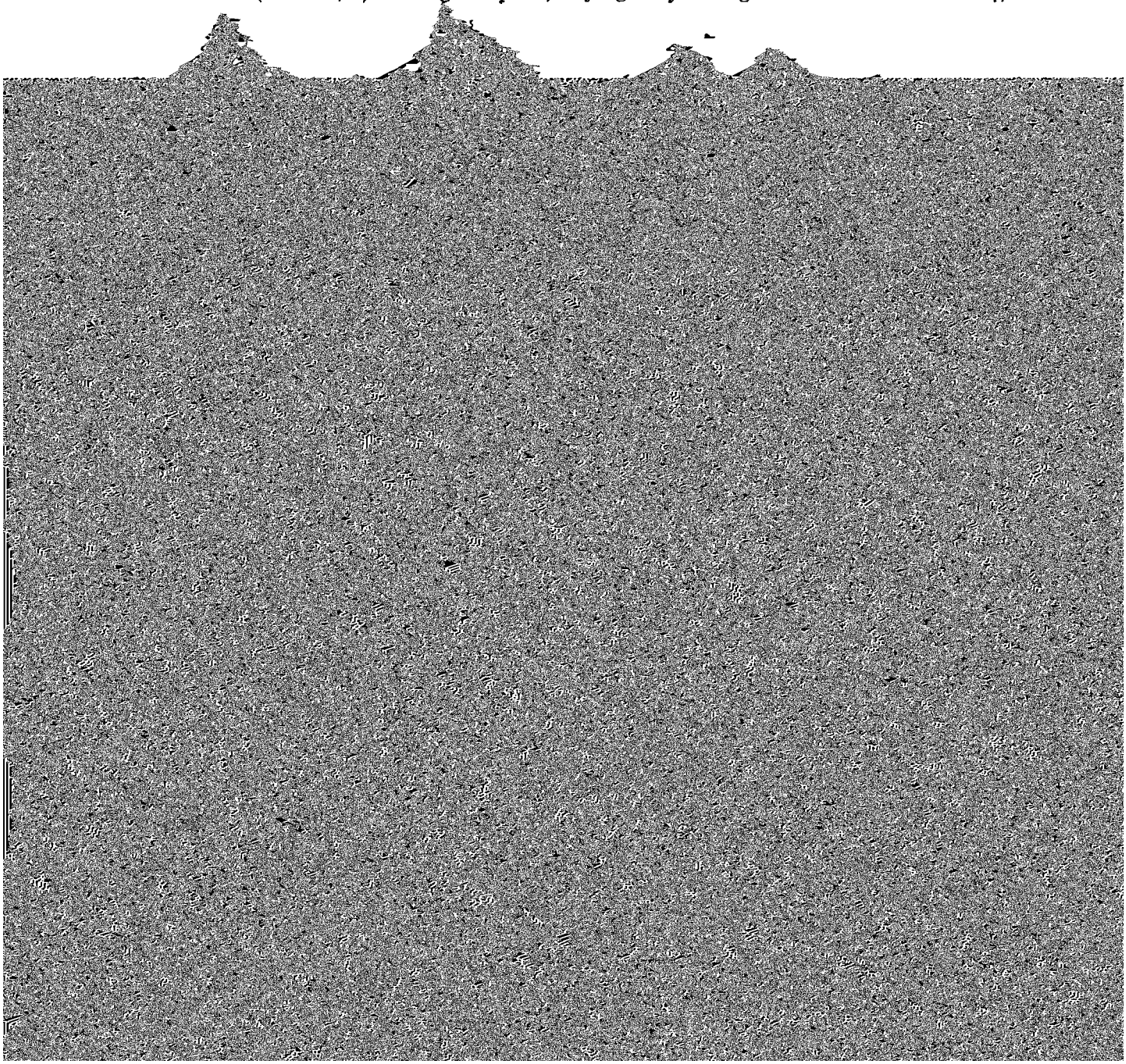
A12—8 to 15 inches; very dark grayish brown (10YR 3/2) silt loam; very dark brown (10YR 2/2) coatings on peds; moderate fine granular structure; friable; medium acid; clear smooth boundary.

B1t—15 to 22 inches; brown (10YR 4/3) silt loam; nearly continuous very dark grayish brown (10YR 3/2) coatings on peds;

This soil is well suited to cultivated crops. It is subject to erosion if cultivated. It is well suited to terracing because slopes are generally long and smooth. The organic matter content is moderate to high. Capability unit IIe–1.

Protivin series

The Protivin series consists of dark colored, somewhat poorly drained soils. These nearly level to gently sloping soils are on slightly concave side slopes on uplands. Slopes are 1 to 4 percent. These soils formed in 14 to 24 inches of loamy material and in the underlying very firm glacial till. The native vegetation was



and strong brown (7.5YR 5/6) medium clay loam; discontinuous gray (5Y 5/1) coatings on faces of prisms; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; pebble band at top of horizon; slightly acid; few thin discontinuous clay films on prisms; clear smooth boundary.

IIB3t—40 to 48 inches; mottled gray (5Y 5/1) and strong brown (7.5YR 5/6) medium clay loam; discontinuous gray (5Y 5/1) coatings on faces of prisms; weak medium prismatic structure parting to weak medium subangular blocky; very firm; neutral; clear smooth boundary.

IIC—48 to 64 inches; mottled light gray (5Y 6/1) and strong brown (7.5 5/6) light clay loam; massive; firm; neutral.

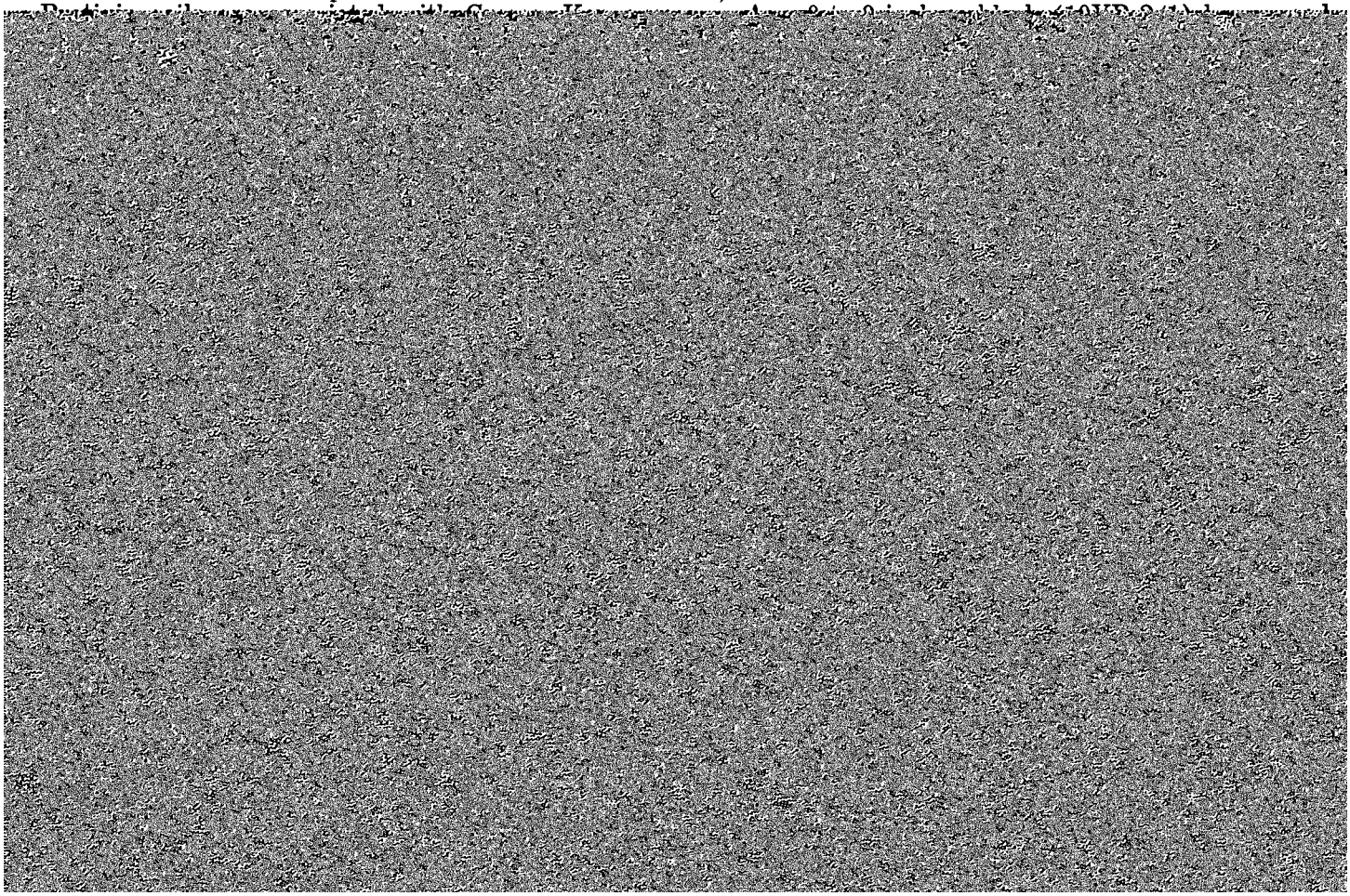
The solum is 40 to 60 inches thick. Carbonates are at a depth of 40 to 60 inches. The soils formed in 14 to 24 inches of loamy material and the underlying clay loam glacial till. The A horizon is typically heavy loam but ranges to light clay loam. It is 12 to 18 inches thick. The A3 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2 or 2.5Y 3/2). The IIB2 horizon is typically clay loam and is 30 to 35 percent clay, although in some pedons it is as much as 37 percent clay. Gray coatings on the faces of peds in this horizon decrease as depth increases.

about 18 inches thick. The subsoil extends to a depth of 43 inches. It is mottled dark grayish brown and olive brown, friable loam in the upper part; mottled dark grayish brown and strong brown, firm heavy loam in the middle part; and mottled yellowish brown and grayish brown, firm loam in the lower part. The underlying material is mottled yellowish brown and grayish brown firm loam that is mildly alkaline and strongly effervescent.

Available water capacity is high. Permeability is moderate in the upper part of the soil and moderately slow in the underlying glacial till. The rate at which water moves through the friable loam material differs considerably from the rate at which it moves through the underlying firm glacial till. Water moves more rapidly in the upper material and accumulates at the till contact, resulting in wet, seepy areas in some years. Available phosphorus and available potassium are very low. Unless they have been limed within the past 5 years, these soils are generally acid in the surface layer.

Readlyn soils are used mainly for cultivated crops. The major limitation for crops is a seasonal high water table. Readlyn soils benefit from tile drainage in some years.

Representative profile of Readlyn loam, 0 to 2 percent slopes, in a cultivated field, 875 feet south and 55 feet east of northwest corner of SW¼ sec. 7, T. 91 N., R. 10 W.:



dark gray (10YR 3/1) clay flows in root channels; neutral; abrupt wavy boundary.

Riceville series

The Riceville series consists of moderately dark colored somewhat poorly drained soils. These nearly level

tles; moderate very fine subangular blocky structure; friable; stone line at base of horizon; very strongly acid; clear smooth boundary.

IIB21—14 to 18 inches; mottled strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) light clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; very strongly acid; clear smooth boundary.

IIB22—18 to 21 inches; mottled strong brown (7.5YR 5/6) and gray (5Y 5/1) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; very strongly acid; clear smooth boundary.

IIB23t—21 to 36 inches; mottled yellowish red (5YR 5/6) and gray (5Y 5/1) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; thick nearly continuous dark gray (10YR 4/1) clay films on faces of prisms; thick very dark gray (10YR 3/1) clay flows in coarse root channels; strongly acid; clear smooth boundary.

IIB3t—36 to 46 inches; mottled gray (5YR 5/1) and strong brown (7.5YR 5/6) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; thick nearly continuous very dark gray (10YR 3/1) clay flows in thin root channels; medium acid; abrupt wavy boundary.

IIC—46 to 60 inches; mottled gray (5Y 5/1) and strong brown (7.5YR 5/6) light clay loam; nearly continuous light gray (5Y 6/1) coatings on faces of peds; massive; firm; mildly alkaline; strong effervescence.

The solum is typically about 45 inches thick but ranges from 40 to 60 inches in thickness. Carbonates are at a depth of 40 to 60 inches. These soils formed in 12 to 20 inches of loamy material and in the underlying very firm glacial till. The A1 or Ap horizon is very dark brown (10YR 2/2) or very dark gray (10YR 3/1) to very dark grayish brown (10YR 3/2) and is 6 to 9 inches thick. The A2 horizon is typically dark grayish brown (10YR 4/2) and ranges from very dark grayish brown (10YR 3/2) to grayish brown (10YR 5/2). It is 3 to 6 inches thick. In cultivated areas, the A2 horizon may be incorporated into the Ap horizon. The IIB2 horizon is typically light to medium clay loam and is 30 to 35 percent clay, although in some pedons this horizon is as much as 38 percent clay.

Riceville soils are associated with Bassett, Lourdes, Floyd, and Clyde soils. They formed in parent material similar to that of Lourdes, Cresco, and Protivin soils. They have grayer coatings on ped faces and more clay in the IIB horizon than Bassett, Floyd, and Clyde soils. They have grayer colors in the lower part of the A horizon and upper part of the B horizon than Lourdes and Cresco soils. They have a thinner and lighter colored A horizon than Protivin soils.

784B—Riceville loam, 1 to 4 percent slopes. This nearly level to gently sloping soil is on low, broad ridges and slightly concave side slopes on uplands. Areas are about 20 acres in size and are irregular in shape.

This soil is suited to corn and soybeans. It is subject to slight erosion on the more sloping areas if cultivated. Because of the difference in permeability between the loamy material and the underlying very firm glacial till at a depth of about 1½ feet, water accumulates at the contact of these materials and produces a temporary high water table, particularly early in spring. Because providing adequate erosion control and drainage is difficult on this soil, a combination of terracing and tile drainage is needed. Careful placement and spacing of tile is important because of the slowly permeable subsoil. The organic matter content is moderately low to low. Capability unit IIw–2.

Richwood series

The Richwood series consists of dark colored, well drained soils. These nearly level soils are on benches along streams. Slopes are 0 to 2 percent. These soils formed in silty alluvium. The native vegetation was mixed prairie grasses.

In a representative profile the surface layer is very dark brown and very dark grayish brown, friable silt loam about 18 inches thick. The subsoil extends to a depth of 49 inches. It is brown, friable silt loam in the upper part and yellowish brown, friable silt loam in the lower part. The substratum is yellowish brown and grayish brown, friable silt loam that has brown and strong brown mottles.

Available water capacity is high and permeability is moderate. Available phosphorus and available potassium are very low. Unless they have been limed within the past 5 years, these soils are generally acid in the surface layer.

Richwood soils are used mainly for cultivated crops. The major limitation for crops is occasional runoff and siltation from soils upslope.

Representative profile of Richwood silt loam, 0 to 2 percent slopes, in a cultivated field, 33 feet west and 262 feet north of road intersection on the southeast corner of SW¼NW¼ sec. 2, T. 95 N., R. 9 W.:

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam; cloddy parting to weak fine granular structure; friable; neutral; gradual smooth boundary.

A12—8 to 13 inches; very dark brown (10YR 2/2) silt loam; moderate fine subangular blocky structure parting to moderate fine granular; friable; neutral; clear smooth boundary.

A3—13 to 18 inches; very dark grayish brown (10YR 3/2) silt loam; very dark brown (10YR 2/2) coatings on peds; moderate medium and fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

B21—18 to 24 inches; brown (10YR 4/3) silt loam; very dark grayish brown (10YR 3/2) coatings on peds; moderate medium and fine subangular blocky structure; friable; thin discontinuous light

gray (10YR 7/1) silt coatings on peds; neutral; clear smooth boundary.

B22—24 to 30 inches; brown (10YR 4/3) silt loam; moderate medium subangular blocky structure; friable; thin discontinuous light gray (10YR 7/1) silt coatings on peds; slightly acid; clear smooth boundary.

B31t—30 to 41 inches; yellowish brown (10YR 5/4) silt loam; moderate coarse prismatic structure; friable; very dark grayish brown (10YR 3/2) clay films in root channels; slightly acid; clear smooth boundary.

B32t—41 to 49 inches; yellowish brown (10YR 5/4) silt loam; weak coarse prismatic structure; friable; very dark grayish brown (10YR 3/2) clay films in root channels; medium acid; clear smooth boundary.

surface layer is loam. Outcrops of limestone bedrock and fragments are at the surface in many areas.

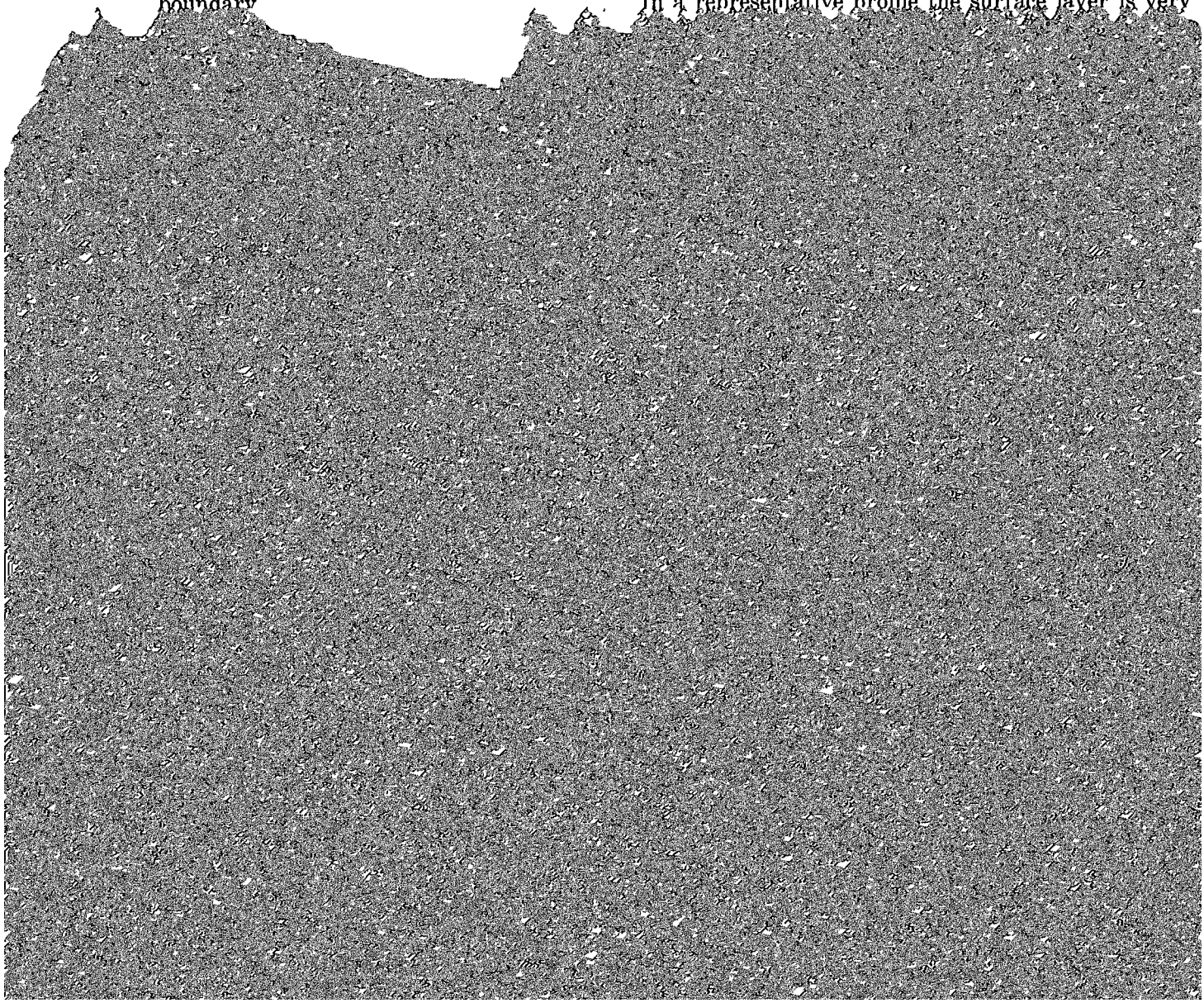
This complex is 50 percent Rock outcrop and 40 percent Nordness soils.

This complex is better suited to trees or wildlife habitat than to most other uses, but a few areas are in permanent pasture. The carrying capacity for pasture is very low. Because the slopes are steep, regular farm machinery cannot be used. Capability unit VIIs–1.

Rockton series

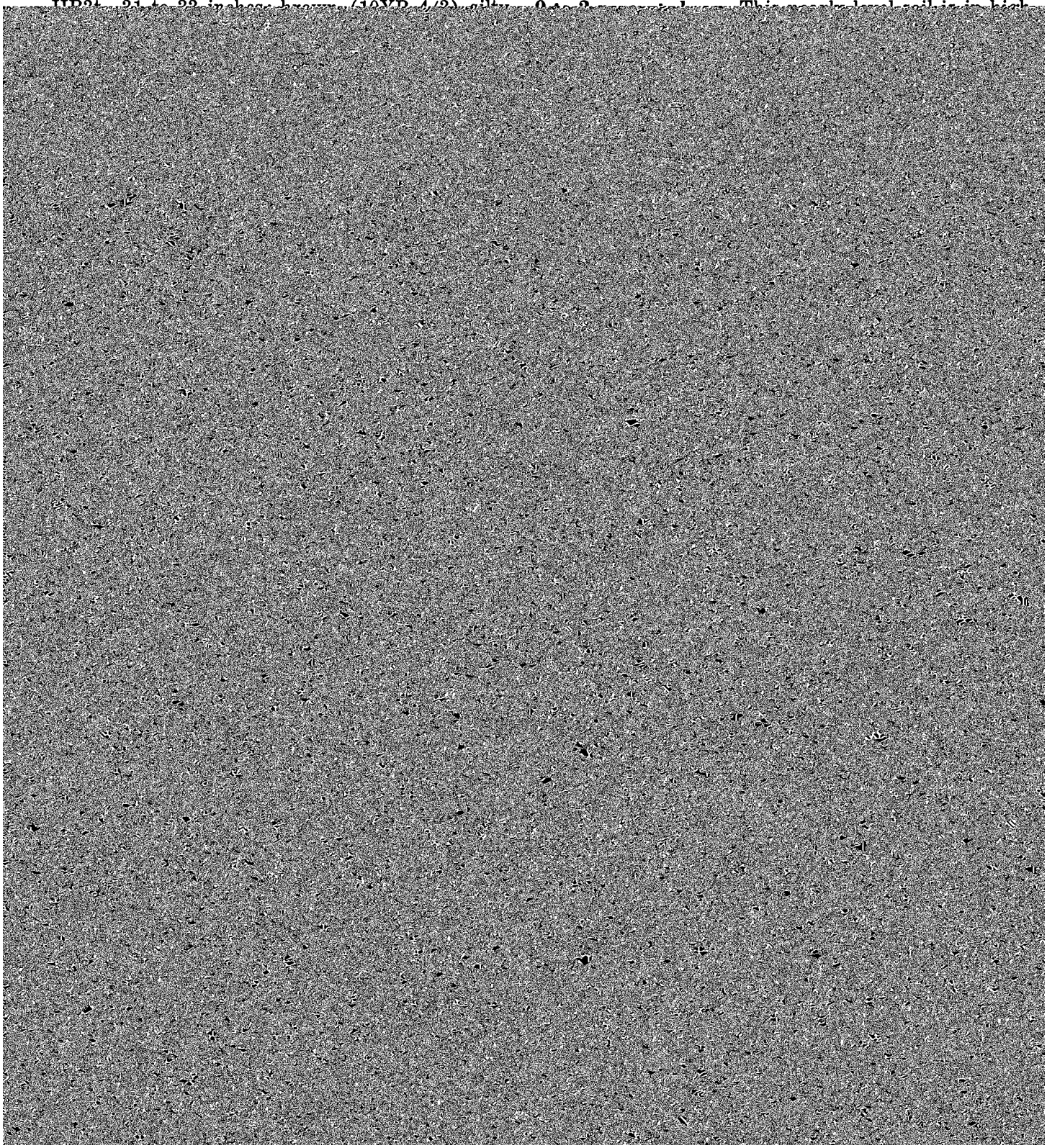
The Rockton series consists of dark colored, well drained soils. These nearly level to moderately sloping soils are on high benches and ridges and side slopes on uplands. Slopes are 0 to 9 percent. These soils formed in 20 to 40 inches of loamy material and a thin layer of residuum over limestone bedrock. The native vegetation was mixed prairie grasses.

In a representative profile the surface layer is very



B22t—27 to 31 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak coarse prismatic structure; thin discontinuous clay films on faces of peds; medium acid; clear wavy boundary.

IIB3t—31 to 33 inches; brown (10YR 4/3) silty [illegible]



erosion and is droughty if rainfall is not timely. The shallow depth to bedrock makes terrace construction difficult in some areas. The organic matter content is moderate. Capability unit IIe–2.

214—Rockton loam, 20 to 30 inches to limestone, [illegible] This [illegible] is high

life habitat than to most other uses, but there are some areas in permanent pasture. They are subject to severe gully erosion. Because they are underlain by sand or gravel, sandy escarpments are droughty. Fertility is variable but is generally very low. Capability unit VIIs–1.

Saude series

The Saude series consists of dark colored, well drained soils. These nearly level to moderately sloping soils are on stream terraces and in outwash areas on uplands. Slopes are 0 to 9 percent. These soils formed in 24 to 32 inches of loamy material and in the underlying sand and gravel. The native vegetation was mixed prairie grasses.

In a representative profile the surface layer is black and very dark brown, friable loam about 18 inches thick. The subsoil extends to a depth of 32 inches. It is brown, friable loam in the upper part and dark yellowish brown, friable sandy loam in the lower part. The substratum is yellowish brown, gravelly coarse sand.

Available water capacity is moderate. Permeability is moderate in the upper part of the soil and very rapid in the coarse textured substratum. Available phosphorus and available potassium are low. Unless they have been limed within the past 5 years, these soils are generally acid in the surface layer.

Saude soils are used mainly for cultivated crops. The major limitations for crops are droughtiness on the nearly level soils, and erosion and droughtiness on

grained; loose; strongly acid; gradual smooth boundary.

IIC2—50 to 60 inches; yellowish brown (10YR 5/6) gravelly coarse sand; single grained; loose; medium acid.

The solum is 24 to 40 inches thick. It is slightly acid to strongly acid in the most acid part. Carbonates are at a depth of more than 60 inches. Contrasting material is at a depth of 24 to 32 inches. The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The A horizon is 10 to 18 inches thick. The B3 horizon is typically sandy loam but ranges to loamy sand. The C horizon is 5 to 15 percent gravel.

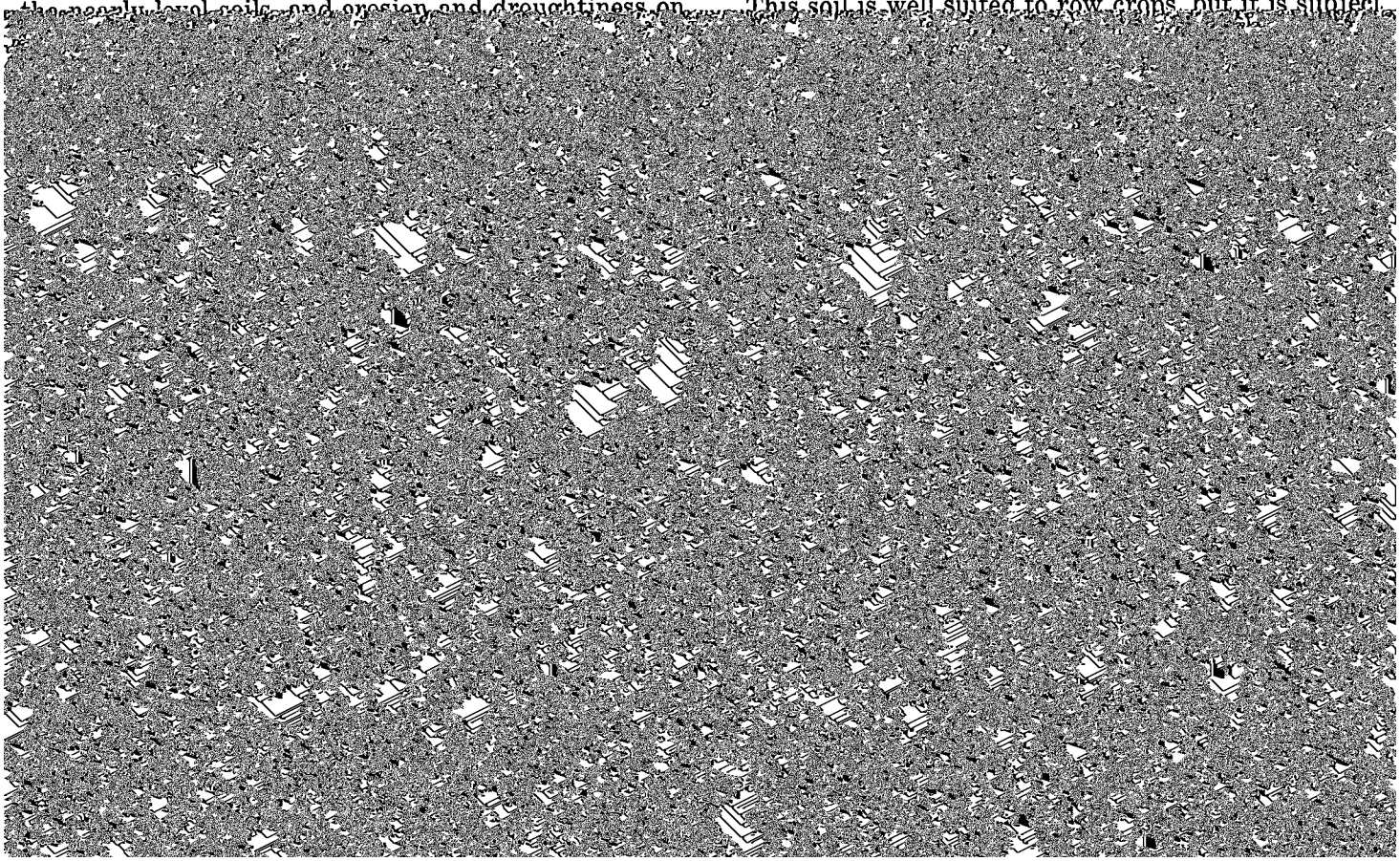
Saude soils are associated with Lawler, Marshan, Waukee, and Flagler soils. They formed in parent material similar to that of Waukee and Wapsie soils. Saude soils are browner in the upper part of the B horizon than Lawler and Marshan soils. They have more clay and less sand in the A horizon and the upper part of the B horizon than Flagler soils. Depth to coarse textured material is less in Saude soils than in Waukee soils. Saude soils have a thicker and darker A horizon than Wapsie soils.

177—Saude loam, 0 to 2 percent slopes. This nearly level soil is on stream benches and on uplands. Areas are 20 to 40 acres in size and are irregular in shape.

This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of sandy soils. These soils are more droughty than this Saude soil.

This soil is well suited to row crops, but it is subject



rainfall is normal or below normal. The organic matter content is moderate. Capability unit IIIe–3.

Schley series

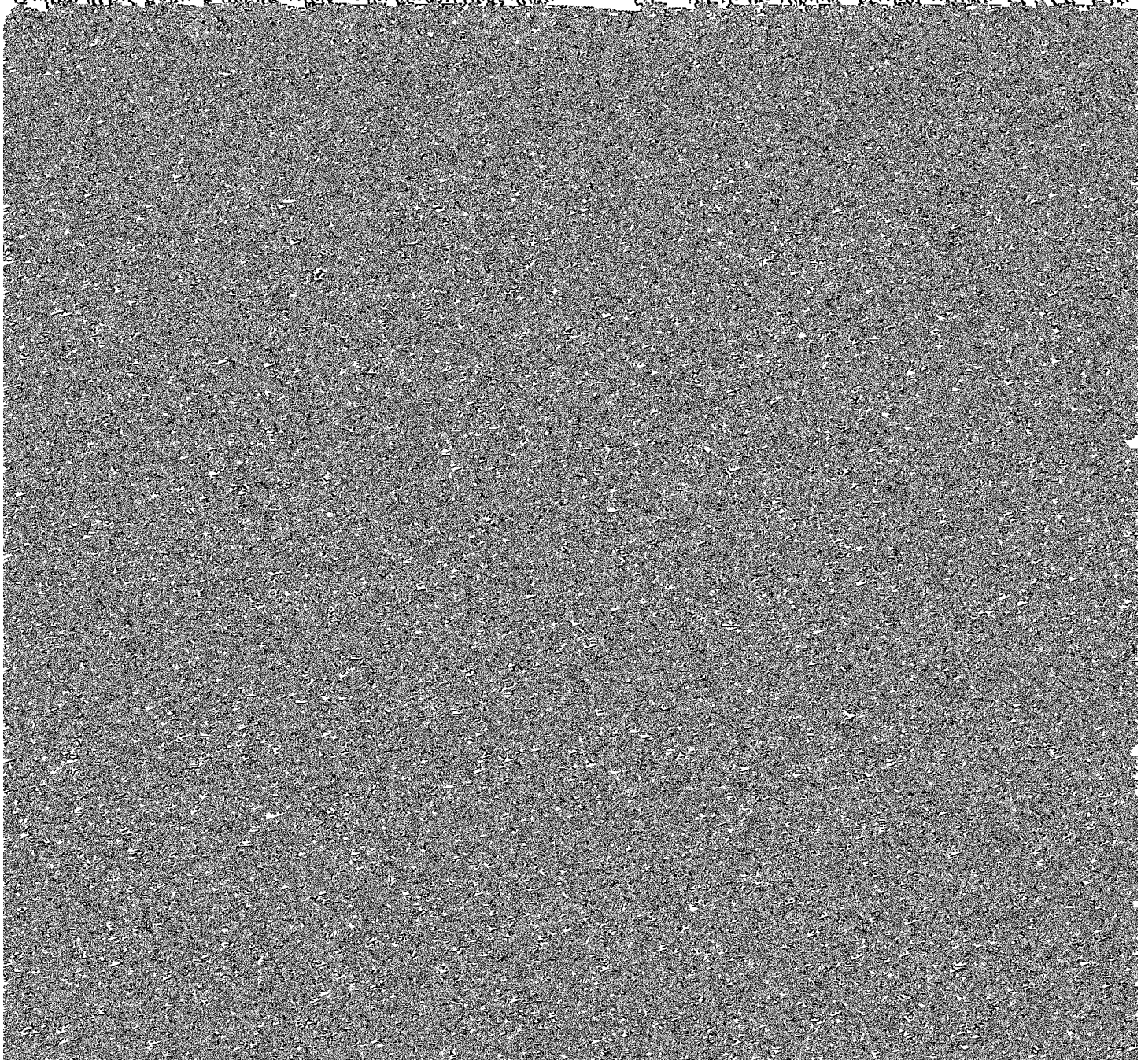
The Schley series consists of moderately dark colored, somewhat poorly drained soils. These nearly level to gently sloping soils are on concave side slopes along drainageways and at the upper ends of drainageways on uplands. Slopes are 1 to 4 percent. These soils formed in 30 to 50 inches of loamy, stratified material and in the underlying glacial till. The native vegetation was mixed prairie grasses and deciduous trees.

In a representative profile the surface layer is black, friable loam about 8 inches thick. The subsurface layer

B31t—30 to 45 inches; brown (10YR 5/3) loamy sand; few medium distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure; very friable; some clay bridging between sand grains; medium acid; abrupt smooth boundary.

IIB32t—45 to 55 inches; strong brown (7.5YR 5/6) heavy loam; common medium prominent light brownish gray (2.5Y 6/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; some clay bridging between sand grains; medium acid; gradual smooth boundary.

IIC—55 to 60 inches; strong brown (7.5YR 5/6)



sloping soils are on ridges and side slopes on uplands and on stream terraces. Slopes are 0 to 14 percent. These soils formed in coarse-textured eolian material and in sandy alluvium that has been reworked by wind. The native vegetation was mixed prairie grasses.

In a representative profile the surface layer is very dark brown and brown, very friable loamy fine sand about 16 inches thick. The subsoil extends to a depth of 32 inches. It is brown, loose fine sand. The substratum is yellowish brown, loose fine sand.

Available water capacity is very low. Permeability is very rapid. Available phosphorus and available potassium are very low. Unless they have been limited within the past 5 years, these soils are generally acid in the surface layer.

The less sloping Sparta soils are used mainly for cultivated crops, and the more sloping soils are used for pasture or woodland. The major limitations for crops are droughtiness and erosion. These soils are droughty even in years of average rainfall. Even with good management, yields of all crops are below average unless rainfall is above average and very timely.

Representative profile of Sparta loamy fine sand, 2

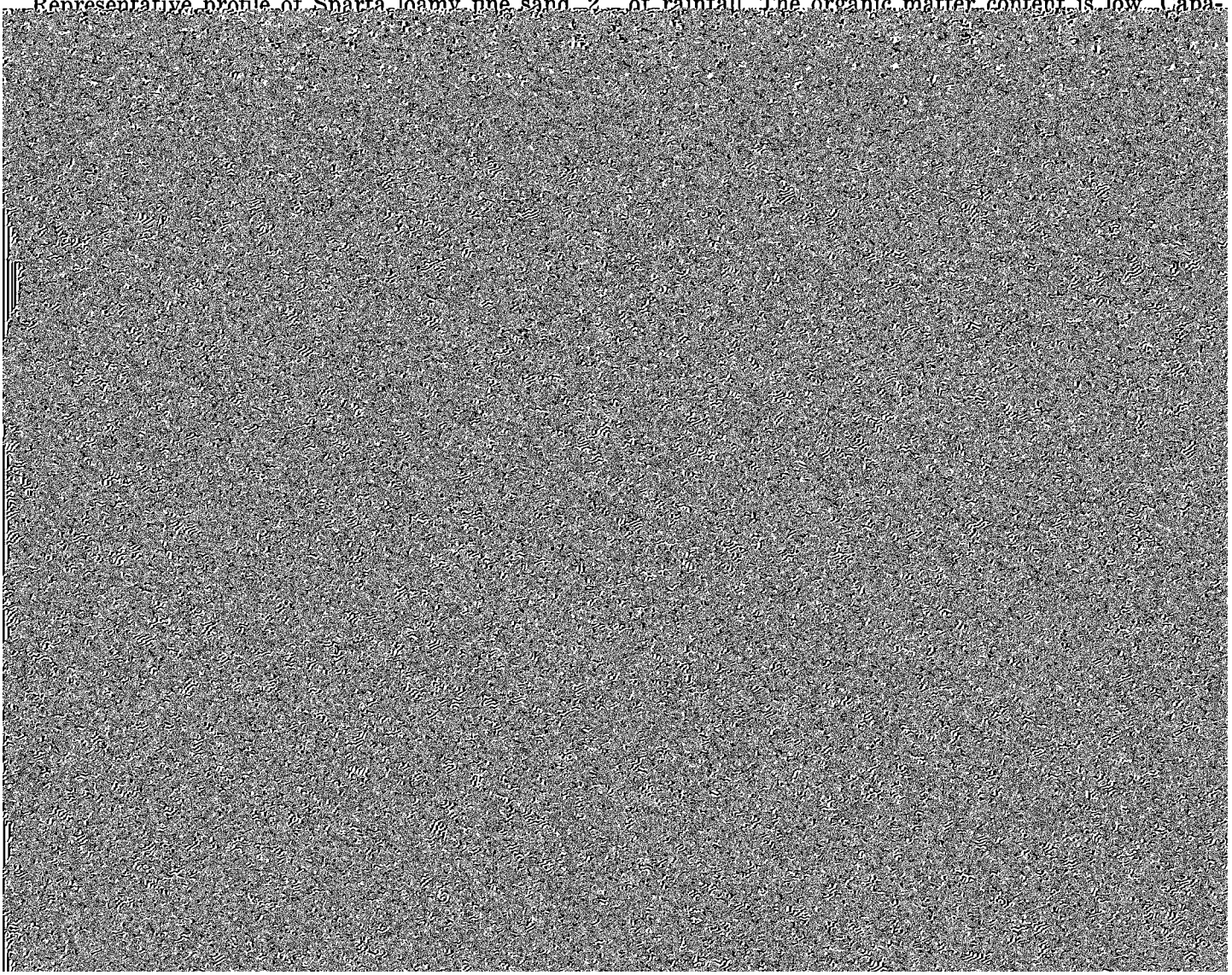
as Kenyon soils were. They have more sand and less clay in the A horizon and the upper part of the B horizon than Dickinson and Olin soils. They are not underlain with glacial till at a depth of less than 60 inches as are Olin soils. Sparta soils have a thicker, darker A horizon than Chelsea soils. They have more sand in the upper part of the solum and are deeper to gravel than Flagler and Burkhardt soils.

41—Sparta loamy fine sand, 0 to 2 percent slopes. This nearly level soil is on uplands and on stream benches. Areas are about 5 to 10 acres in size on the uplands and about 20 acres or more on the benches.

This soil has a profile similar to the one described as representative of the series, but the surface layer is generally thicker.

Included with this soil in mapping are a few areas of soils in which the dark surface layer is thicker than 24 inches. These soils are higher in organic matter content and fertility than this Sparta soil.

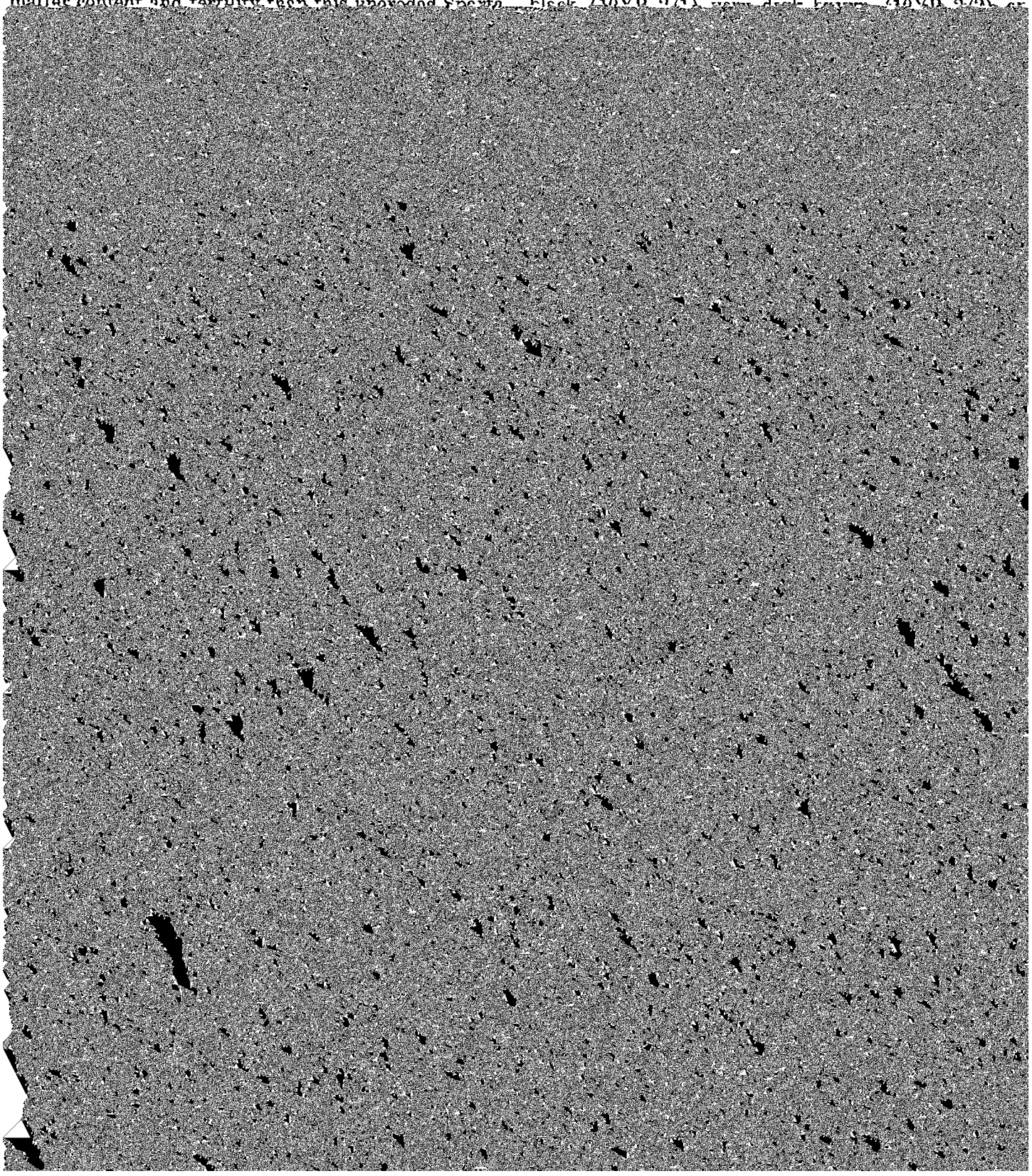
This soil is suited to cultivated crops. It is subject to droughtiness and soil blowing. Yields are generally low but vary, depending on the amount and timeliness of rainfall. The organic matter content is low. Capa-



Included with this soil in mapping are a few areas of soils that are eroded and have a thinner and lighter colored surface layer. These soils are lower in organic matter content and fertility than this uneroded Sparta

brown (7.5YR 5/6) mottles; massive; very friable; neutral.

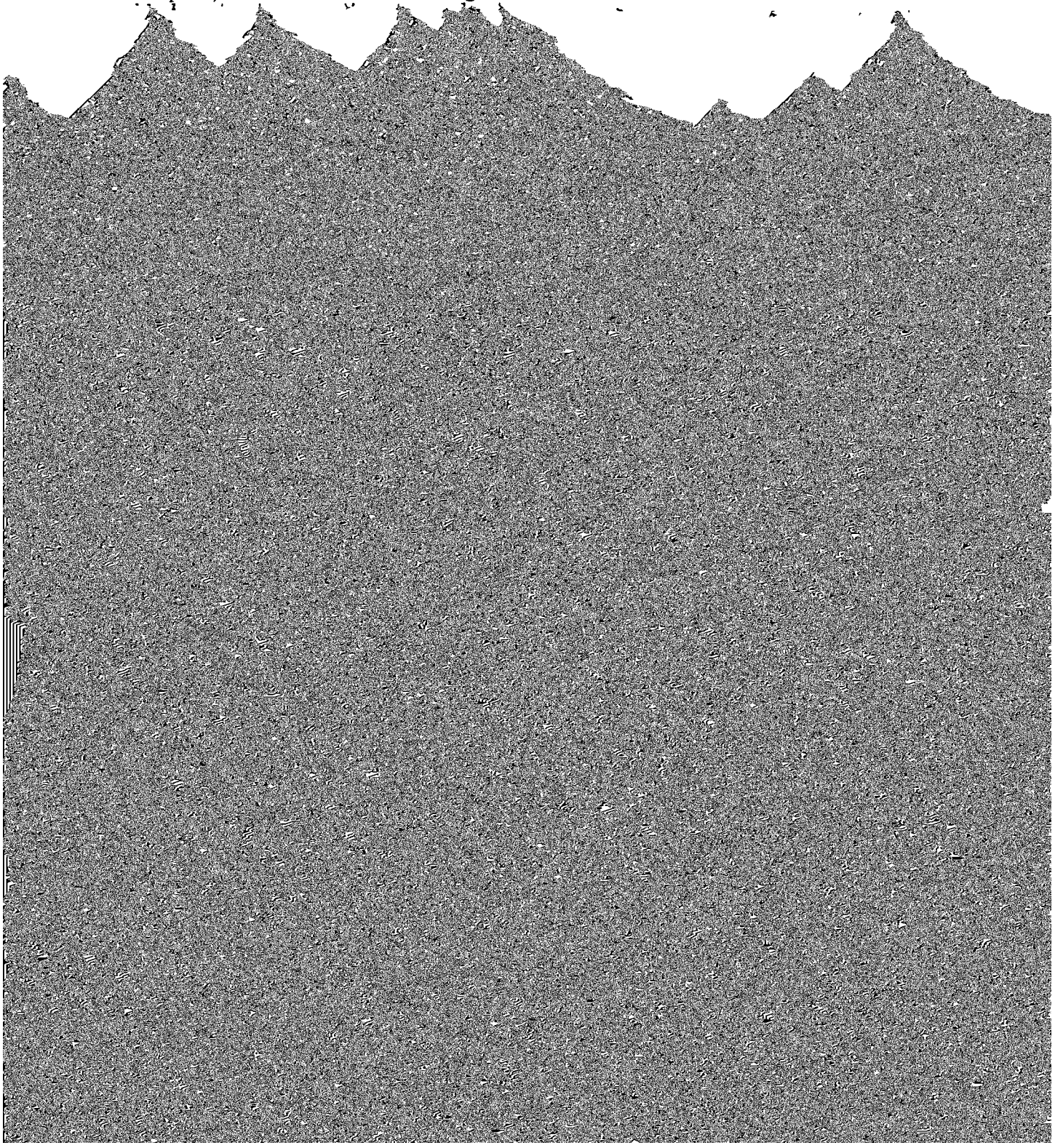
The solum is 36 to 55 inches thick. The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), or



structure parting to weak fine granular; friable; slightly acid; abrupt smooth boundary.

A12—7 to 18 inches; very dark brown (10YR 2/2) loam; black (10YR 2/1) coatings on peds; moderate medium subangular

erally farmed along with the adjacent soils. It is subject to slight erosion and to receiving runoff water and sediment from soils upslope. Diversion terraces help to control runoff from higher areas. The organic matter content is high. Capability unit IIe–4.



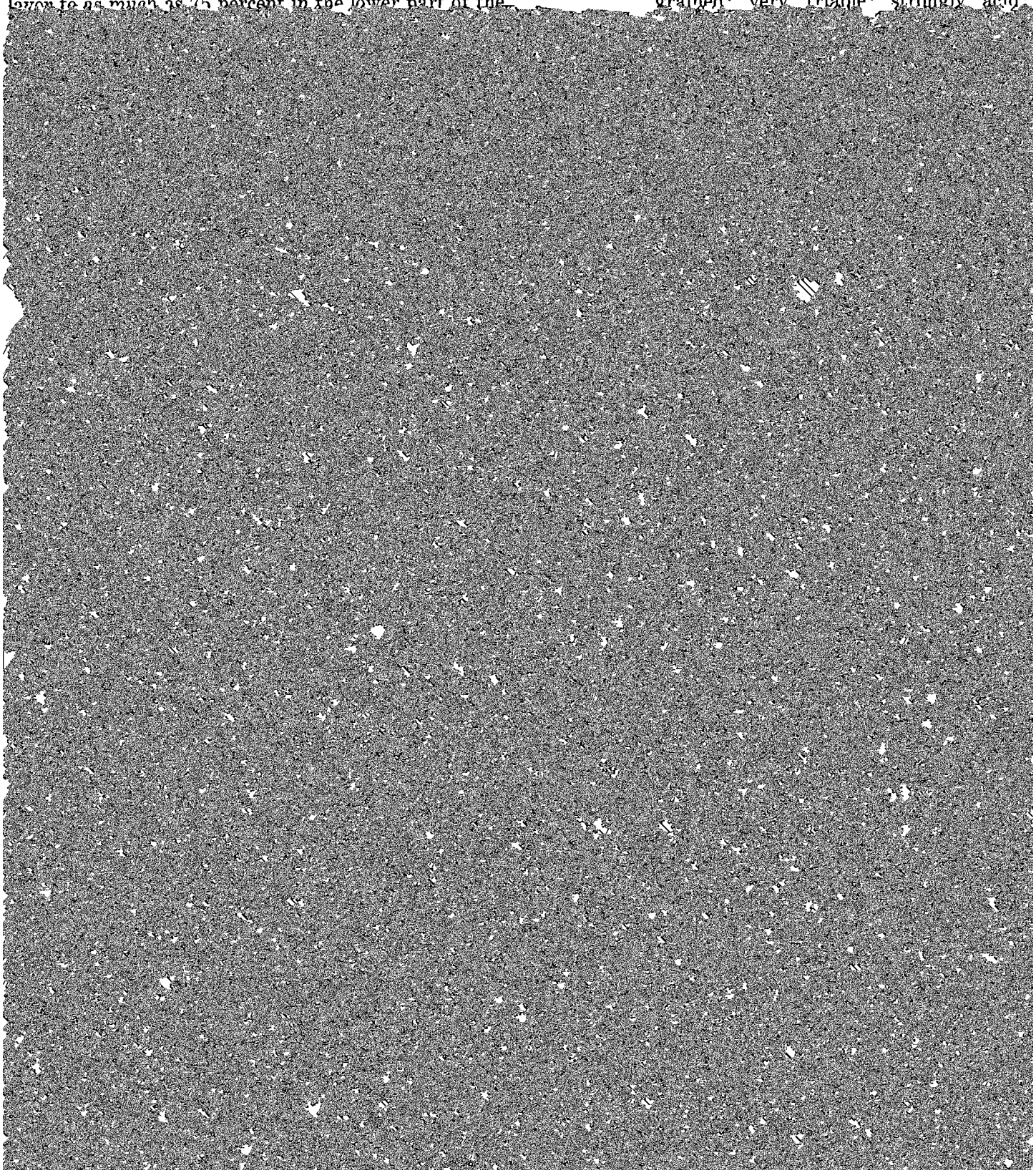
5/2) and yellowish brown (10YR 5/6) loam; weak medium prismatic structure; firm; mildly alkaline; abrupt wavy boundary.

IIC—36 to 60 inches; mottled yellowish brown (10YR 5/8) and olive gray (5Y 5/2) loam; massive; firm; few 1/8- to 1/4-inch accumulations of lime; mildly alkaline; strong effervescence.

The solum is 36 to 48 inches thick. Depth to car-

varies within short distances. Generally the percentage of limestone fragments increases as depth increases, ranging from 15 to 20 percent in the surface layer to as much as 75 percent in the lower part of the

IIB3—23 to 29 inches; brown (7.5YR 4/4) gravelly loamy sand; very weak fine subangular blocky structure parting to single grained; very friable; strongly acid;



Included with this soil in mapping are a few areas of soils that have coarse textured material at a depth of less than 20 inches. These soils are more droughty and less productive than this Wapsie soil.

This soil is suited to cultivated crops, but it is subject to droughtiness and moderate erosion. It is droughty in most seasons unless rainfall is above normal or very timely. The organic matter content is low. Capability unit IIIe–3.

Waukee series

The Waukee series consists of dark colored, well drained soils. These nearly level to gently sloping soils are on stream terraces and in outwash areas on uplands. Slopes are 0 to 5 percent. These soils formed in 32 to 40 inches of loamy alluvial deposits and in the underlying coarse textured sediment. The native vegetation was mixed prairie grasses.

In a representative profile the surface layer is very dark brown and very dark grayish brown, friable loam about 21 inches thick. The subsoil extends to a depth of 47 inches. It is brown, friable loam in the upper part; dark yellowish brown, friable loam and sandy clay loam in the middle part; and dark yellowish brown, and strong brown sandy loam and gravelly loamy sand in the lower part. The substratum is yellowish brown medium and coarse sand.

Available water capacity is moderate. Permeability is moderate in the upper part of the soil and rapid in the coarse textured substratum. Available phosphorus is low, and available potassium is very low. Unless they have been limed within the past 5 years, these soils are generally acid in the surface layer.

Waukee soils are used mainly for cultivated crops. The major limitation for crops is erosion on the more sloping areas. These soils are somewhat droughty when rainfall is below normal and in extended dry periods.

Representative profile of Waukee loam, 0 to 2 percent slopes, in a cultivated field, 150 feet west and 380 feet south of northwest corner of NE¼NE¼ sec. 27, T. 93 N., R. 7 W.:

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam high in silt; cloddy parting to moderate fine granular structure; friable; neutral; abrupt smooth boundary.

A12—7 to 15 inches; very dark brown (10YR 2/2) loam high in silt; moderate medium subangular blocky structure parting to moderate fine granular; friable; neutral; clear smooth boundary.

A3—15 to 21 inches; very dark grayish brown (10YR 3/2) loam; very dark brown (10YR 2/2) coatings on peds; moderate subangular blocky structure; friable; strongly acid; clear smooth boundary.

B22—33 to 37 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak medium subangular blocky structure; friable; strongly acid; abrupt wavy boundary.

IIB31t—37 to 39 inches; dark yellowish brown (10YR 4/4) sandy loam; very weak fine subangular blocky structure; very friable; few thin brown (7.5YR 4/4) clay bridgings between sand grains; medium acid; clear smooth boundary.

IIB32t—39 to 47 inches; strong brown (7.5YR 5/6) gravelly loamy sand; very weak coarse subangular blocky structure; very friable; few thin brown (7.5YR 4/4) clay bridgings between sand grains; medium acid; clear smooth boundary.

IIC—47 to 60 inches; yellowish brown (10YR 5/6) medium and coarse sand; single grained; loose; 5 to 10 percent gravel; medium acid.

The solum is 35 to 48 inches thick. It is medium acid or strongly acid in the most acid part. Carbonates are absent above a depth of 60 inches. Contrasting material is at a depth of 32 to 40 inches. The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It is typically loam but ranges to silt loam that is high in sand. It is 10 to 21 inches thick. The B2 horizon is typically medium loam but ranges to heavy loam or sandy clay loam. The C horizon is coarse loamy sand, gravelly sand, or medium sand. It commonly is 10 to 20 percent gravel, but is as much as 50 percent in some places.

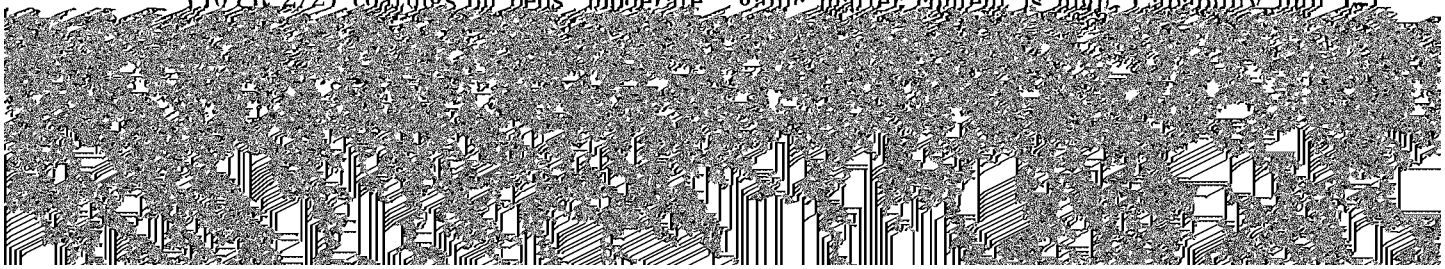
Waukee soils are associated with Saude, Lawler, and Marshan soils and formed in parent material similar to that of those soils. They are browner in the upper part of the B horizon than Lawler and Marshan soils and are deeper to coarse textured material than Saude soils.

178—Waukee loam, 0 to 2 percent slopes. This nearly level soil is on stream benches and in a few outwash areas on uplands. Areas are about 10 acres in size and are irregular in shape.

This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that have a sandy textured surface layer. These soils are droughty and less productive than this Waukee soil.

This soil is well suited to intensive row crops. It is subject to droughtiness when rainfall is below normal. It is easily tilled and has little or no runoff. The organic matter content is high. Capability unit I-1



These soils are more droughty and less productive than this Waukee soil.

This soil is well suited to row crops if properly managed. It is subject to slight erosion if cultivated and can be somewhat droughty when rainfall is below normal. The organic matter content is high. Capability unit IIe–1.

Winneshiek series

The Winneshiek series consists of moderately dark colored, well drained soils. These nearly level to strongly sloping soils are on ridges and side slopes on uplands. Slopes are 0 to 14 percent. These soils formed in 20 to 30 inches of loamy glacial material and in the underlying thin layer of residuum weathered from limestone bedrock. The native vegetation was mixed prairie grasses and deciduous trees.

In a representative profile the surface layer is very dark brown, friable loam about 7 inches thick. The

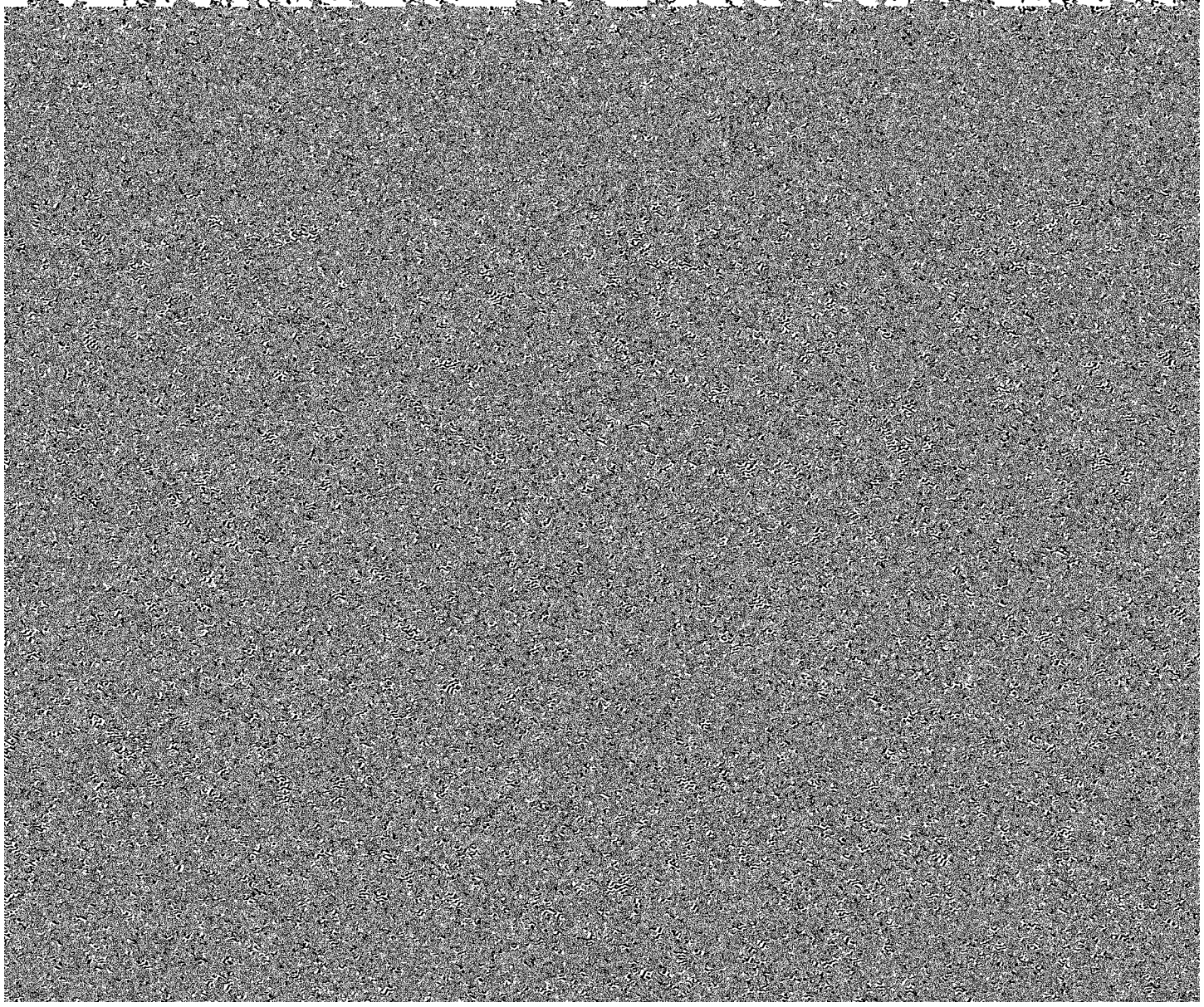
films; slightly acid; clear wavy boundary.

IIB22t—18 to 24 inches; yellowish brown (10YR 5/6) light clay; strong coarse prismatic structure parting to strong medium subangular blocky; very firm; thick continuous very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) clay films; neutral; abrupt wavy boundary.

IIR1—24 to 31 inches; limestone, soft, weathered along joints and partially fractured; flags of limestone with brown (7.5YR 4/2) clay residuum interbedded; mildly alkaline; strong effervescence.

IIR2—31 inches; hard limestone bedrock.

The solum is 20 to 30 inches thick. It is typically slightly acid or medium acid in the most acid part. Carbonates are absent above the limestone bedrock.



shallow depth to limestone bedrock. The organic matter content is moderately low. Capability unit IIe–2.

714C—Winneshiek loam, 20 to 30 inches to limestone, 5 to 9 percent slopes. This moderately sloping soil is on convex side slopes on uplands. Areas are about 5 to 10 acres in size and are irregular in shape.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and depth to limestone is about 20 to 24 inches.

Included with this soil in mapping are small areas of soils where the limestone is near the surface or is exposed. These soils are more droughty and the limestone hinders farming operations.

This soil is suited to cultivated crops, but the root zone is limited because of the shallow depth to bedrock. It is subject to erosion if cultivated, and it is droughty when rainfall is average or below average. This soil is not well suited to terraces because of the shallow depth to limestone bedrock. The organic matter content is moderately low. Capability unit IIIe–4.

714D—Winneshiek loam, 20 to 30 inches to limestone, 9 to 14 percent slopes. This strongly sloping soil is on convex side slopes on uplands. Areas are about 5 to 10 acres in size and are irregular in shape.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and depth to limestone is generally about 20 to 24 inches.

Included with this soil in mapping are small areas of soils where the limestone bedrock is exposed. These areas are more droughty than this Winneshiek soil, and the limestone hinders farming.

This soil is poorly suited to cultivated crops. It is subject to erosion if cultivated. Because of the shallow depth to limestone bedrock, it is droughty when the rainfall is average or below average. The organic matter content is low. Capability unit IVe–2.

sites, highways and other transportation systems, sanitary facilities, parks and other recreational developments, and wildlife habitat. From the data presented, the potential of each soil for specified land uses may be determined, soil limitations to these land uses may be identified, and costly failures in homes and other structures, because of unfavorable soil properties, may be avoided. A site can be selected where the soil properties are favorable, or practices can be planned that will overcome the soil limitations.

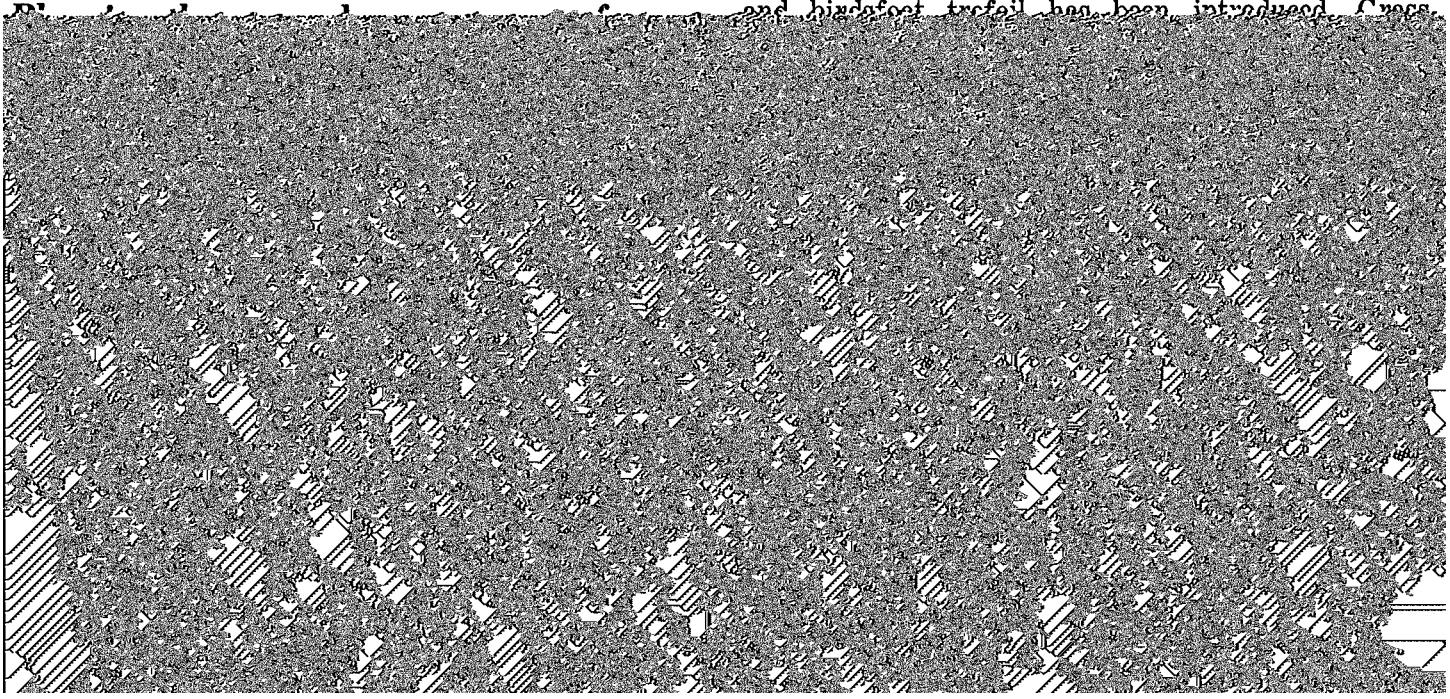
Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area, and on the environment. Both of these factors are closely related to the nature of the soil. Plans can be made to maintain or create a land use pattern in harmony with the natural soil.

Contractors can find information useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, trees and shrubs, and most other uses of land are influenced by the nature of the soil.

Crops

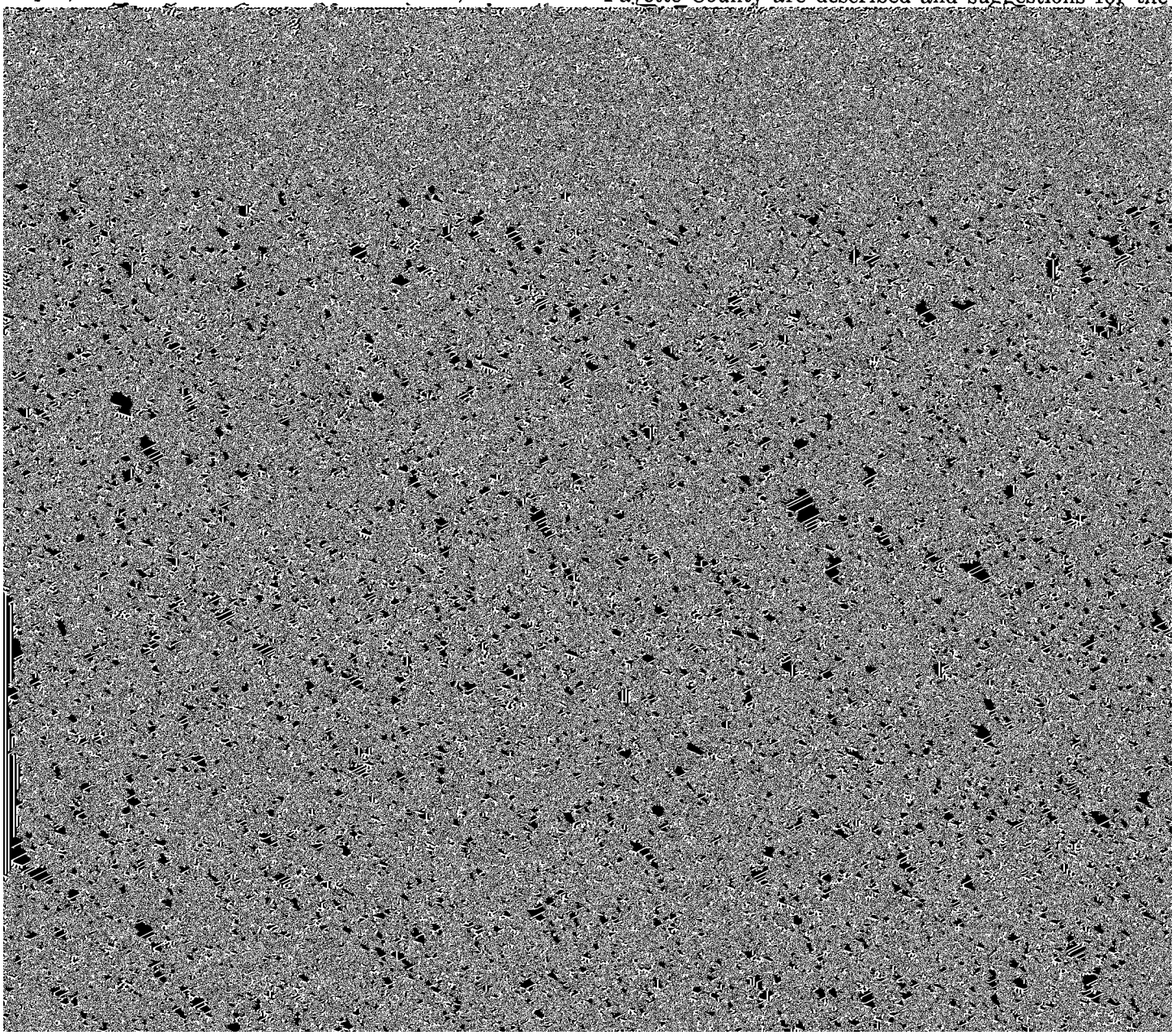
Of the total 465,920 acres in Fayette County, 250,000 acres was in crops during 1971, 105,000 acres was in pasture, and 75,000 acres was other land in farms, according to the 1971 State of Iowa Annual Farm Census. Corn, soybeans, oats, and legume-grass are the principal crops. Most areas of permanent pasture are in bluegrass. Some areas have been renovated, and birdsfoot trefoil has been introduced. Crops



generally have long, uniform slopes and are well suited to erosion control practices.

Capability grouping

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on the limitations of the soils, the risk of damage when they are used for ordinary field crops or sown pastures, and the way they respond to treatment. The classification does not apply to horticultural crops, or to rice and other crops that have their own special requirements for economical production. The soils are classified according to degree and kind of permanent limitations, but without consideration of major and generally expensive land-forming that would change the slope, depth, or other characteristics of the soils, and with-



that is too cold or too dry. Subclass *c* is not in Fayette County.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–1 or IIIs–1.

A complete explanation of the capability classification is in Agriculture Handbook No. 210, Land Capability Classification (*14*).

Management by capability units

In the following pages, the capability units of Fayette County are described and suggestions for the

These soils are well suited to cultivated crops. Corn, soybeans, oats, and hay are grown on these soils. Most areas are used for cultivated crops; corn is the major crop. Soybeans are often grown instead of corn in a rotation. These soils are also suited to pasture and woodland and to other less intensive uses.

Water sometimes collects on the surface for short periods. Field operations can be more timely if these soils are tiled. Erosion is not a hazard.

Capability unit I–3

This unit consists of nearly level soils of the Dorchester, Huntsville, and Spillville series. These soils are mainly dark colored, but Dorchester soils are moderately dark to light colored. They are well drained to somewhat poorly drained. These soils are on flood plains and in narrow upland valleys.

The surface layer and subsoil are friable and medium textured. Available water capacity is high, and permeability is moderate. These soils are subject to short-duration, high-velocity flooding during spring runoff and after heavy rains. They have a moderately high but variable water table.

These soils are well suited to row crops. Because these soils are subject to occasional overflow, however, about half of the acreage is in permanent pasture. These soils are also suited to woodland and wildlife habitat and to other less intensive uses. Cropping patterns and yields vary from year to year because of the flooding hazard.

Erosion and droughtiness are not hazards on these soils. The Dorchester and Spillville soils need some artificial drainage in places when rainfall is above normal.

Capability unit IIe–1

This unit consists of gently sloping soils on the Bassett, Coggon, Cresco, Downs, Fayette, Kenyon, Lourdes, Ostrander, Port Byron, Readlyn, and Waukee series. These soils are dark to light colored. They are mainly moderately well drained to well drained; Readlyn soils are somewhat poorly drained. These soils are on uplands, and Waukee soils are also on stream benches.

The surface layer is friable and medium textured. The subsoil is mainly friable to firm and medium textured. Cresco and Lourdes soils have a very firm, moderately fine textured subsoil. Available water capacity is mainly high, but in Waukee soils it is moderate. Permeability ranges mainly from moderate to slow, but Waukee soils are rapidly permeable in the substratum. The surface layer of Fayette, Downs, and Port Byron soils tends to seal during rains, and a crust is likely to form as the surface layer dries. Unless limed within the past 5 years, these soils are acid. Most of these soils are not droughty. Waukee soils are somewhat droughty when rainfall is below normal.

These soils are suited to corn and soybeans. Most areas are used for corn, soybeans, small grain, and alfalfa. Bassett, Coggon, Downs, Fayette, Kenyon, Ostrander, Lourdes, Ostrander, and Readlyn soils because erosion control and drainage conflict to some extent. Conservation practices tend to slow the movement of surface water and allow more water to soak into the soil. This increases the need for artificial drainage. A combination of practices, such as the use of terraces and tile drainage, can be the most successful management. Terrace cuts should be minimal to avoid exposing the less productive glacial till subsoil in Bassett, Coggon, Cresco, Kenyon, Lourdes, Ostrander, and Readlyn soils or the sandy substratum in Waukee soils.

Capability unit IIe–2

This unit consists of gently sloping soils of the Bixby, Olin, Rockton, Saude, Wapsie, and Winneshiek series. These soils are dark to light colored and are well drained. They are on the uplands or stream benches and are moderately deep to deep over bedrock, coarse textured material, or glacial till.

The surface layer and the subsoil are friable and moderately coarse textured or medium textured. Available water capacity is low to moderate. Permeability is mainly moderate to very rapid, but Olin soils are moderately slowly permeable in the glacial till subsoil. Unless limed within the past 2 to 5 years, these soils are acid.

These soils are used mainly for corn, small grain, and alfalfa and they are suited to these crops. These soils are also suited to pasture and woodland and to other less intensive uses.

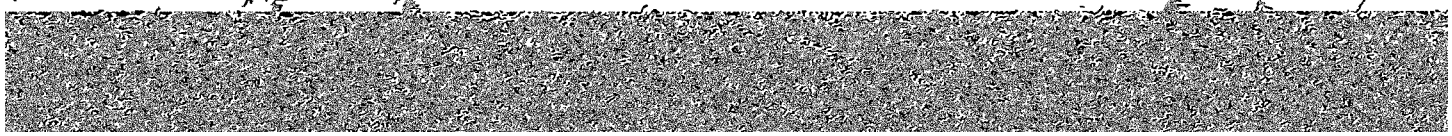
Erosion is a hazard on these soils. They are somewhat droughty in most years. Unless rainfall is timely, yields are often reduced because of the lack of moisture. The soils are not well suited to terraces because of the shallowness to limestone or to sand and gravel. Olin soils have sandy texture to a depth of about 2 feet, thus making it difficult to maintain a terrace ridge. Terraces should be shallow to avoid exposing bedrock or coarse textured material in the terrace channels. The underlying limestone or sand and gravel may limit the rooting of some crops.

Capability unit IIe–3

Donnan loam, 2 to 5 percent slopes, is the only soil in this unit. This soil is moderately dark colored and moderately well drained to somewhat poorly drained. It is on uplands.

The surface layer is friable and medium textured. The subsoil is firm to very firm and moderately fine textured to fine textured. Available water capacity is high. Because of the high clay content, however, not all the moisture reaches the plants. This soil is sometimes wet because of the moderately high but variable water table. Farming is sometimes delayed by excess moisture. This soil is subject to erosion. Included in this unit are some areas of soils that have a sandy loam surface layer and a higher infiltration rate than this Donnan soil. These soils are very seepy in wet seasons; at other times, they can be droughty.

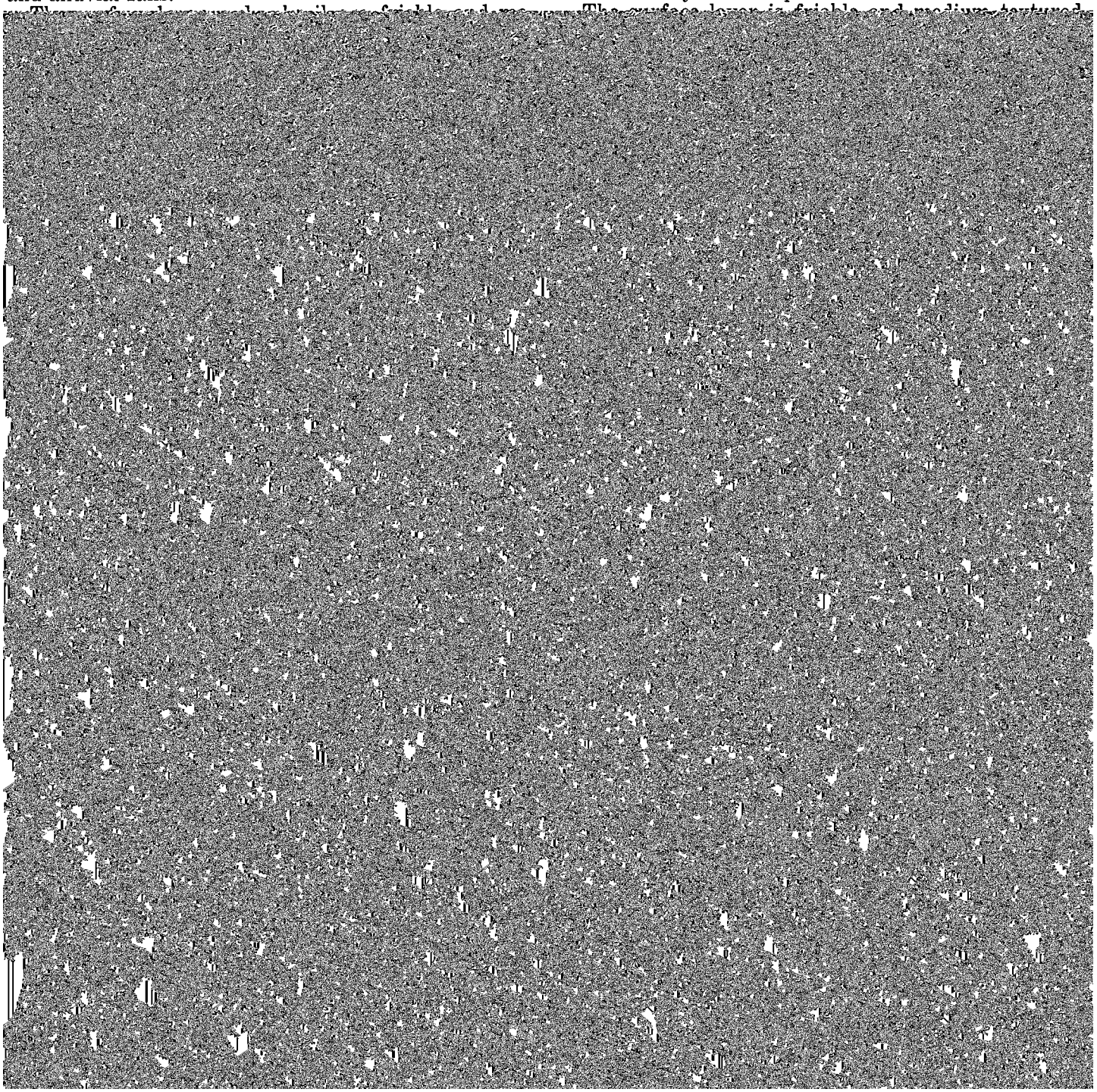
This soil is suited to corn, soybeans, small grain,



well suited to this soil. Terrace construction may expose the less productive, very slowly permeable, clayey subsoil, and extra water entering the soil will increase wetness.

Capability unit IIe–4

This unit consists of gently sloping soils of the Huntsville, Chaseburg, and Terril series. These moderately well drained to well drained soils are dark to moderately dark. They are along upland drainageways and alluvial fans.



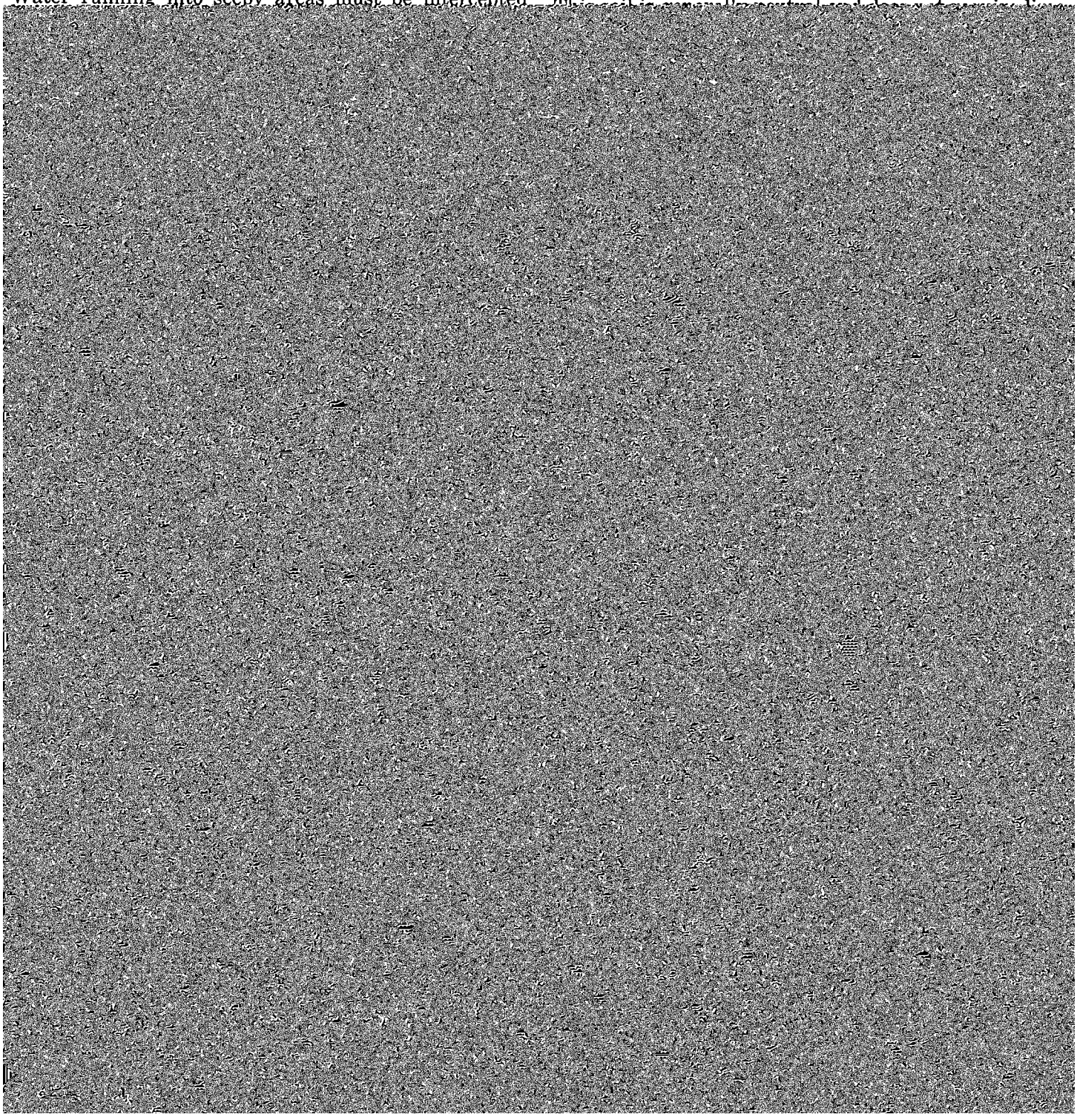
They dry somewhat slowly in spring and cannot be worked soon after rains. The complexes of Clyde and Floyd soils have some stones and boulders on the surface.

Capability unit IIw–2

This unit consists of nearly level soils of the Donnan series, and the nearly level to gently sloping soils of the Protivin and Riceville series. These soils are dark and moderately dark and are somewhat poorly drained. They are on uplands.

fine textured shale. Available water capacity is moderate, and permeability is very slow. This soil is generally neutral in the surface layer.

This soil is suited to cultivated crops if properly drained. Because permeability is very slow in the clayey shale, tile drainage is not fully effective. Drain tile must not be placed too deeply in the shale. Because it receives water from soils upslope, this soil is seepy. Water running into seepy areas must be intercepted



Capability unit IIs–3

Hanlon fine sandy loam, 0 to 2 percent slopes, is the only soil in this unit. This soil is dark and moderately well drained. It is on natural levees along streams.

The surface layer and the subsoil are friable to very friable and moderately coarse textured. The substratum is coarse textured. Available water capacity is moderate, and permeability is moderately rapid.

Capability unit IIIe–2

This unit consists of strongly sloping soils of the Bassett, Downs, Exette, Fayette, and Orwood series. These soils are moderately dark colored to light colored and are moderately well drained to well drained. They are on uplands.

The surface layer is friable and medium textured. The subsoil is friable to firm and medium textured. Available water capacity is high. Permeability is mostly moderate, but in Bassett soils it is moderately slow. Unless limed within the past 5 years, these soils are acid.

These soils are suited to cultivated crops if erosion is controlled. They are used for corn, soybeans, small grain, and alfalfa. These soils are also suited to pas-

Capability unit IIIe–3

This unit consists of gently sloping to moderately sloping soils of the Dickinson, Flagler, Lamont, Saude, and Wapsie series. These soils are light colored to dark colored and are well drained to somewhat excessively drained. They are on uplands and on stream benches.

The surface layer and subsoil are friable to very friable and medium textured or moderately coarse textured. The substratum is mainly coarse textured, except for Dickinson till substratum soils. Available water capacity is low to moderate. Permeability is mainly moderate to very rapid. Dickinson till substratum soils are moderately slowly permeable in the till. The organic matter content is moderate to very low. Unless limed in the last 2 to 4 years, these soils

gently sloping to moderately sloping sandy soils. Terraces are difficult to construct and maintain in the sandy areas.

Capability unit IIIe–4

This unit consists of moderately sloping soils of the Dubuque, Rockton, and Winneshiek series that are

capacity is very high. Permeability is moderately rapid in the organic layer and moderate in the underlying mineral material.

This soil is suited to row crops if it is well managed and artificially drained. It is suited to oats, but oats are subject to lodging. The use of early-maturing varieties of crops helps to alleviate the hazard of frost,

Capability unit IVe–1

This unit consists of moderately steep, moderately eroded soils of the Bassett, Downs, Exette, and Orwood series; moderately steep, slightly eroded and moderately eroded soils of the Fayette series; and strongly sloping, severely eroded soils of the Fayette series. These soils are moderately dark to light colored and moderately well drained to well drained. They are on uplands.

The surface layer is friable and medium textured. The subsoil is friable to firm and medium textured or moderately fine textured. Available water capacity is high. Permeability is mainly moderate, but Bassett soils are moderately to moderately slowly permeable. Unless limed within the past 5 years, these soils are acid.

These soils are better suited to hay and pasture than to cultivated crops. Corn is generally grown only in rotation to reestablish the grass and legumes to hay and pasture. Soybeans are generally not substituted for corn in the rotation because they are more susceptible to erosion than corn. Cultivated areas should be tilled on the contour to prevent excess soil loss. The hazard of erosion is serious because runoff is rapid and the soils are highly erodible. The surface layer tends to seal during rains, and a crust forms when the soil dries, particularly on Fayette and Exette soils. Crop residue should be left on the surface. Gullies and drainageways need to be shaped and reseeded in places. Areas that are difficult to farm provide good habitat for wildlife or are suitable for growing trees.

Capability unit IVe–2

This unit consists of strongly sloping soils of the Backbone and Dickinson series and strongly sloping, moderately deep soils of the Dubuque and Winneshiek series. These soils are light colored to dark colored and well drained to somewhat excessively drained. These soils are mainly on uplands, and Dickinson soils are also on stream benches.

The surface layer is very friable to friable and moderately coarse textured or medium textured. The subsoil is very friable to friable and coarse textured to moderately fine textured. Dickinson soils have a coarse textured substratum. Backbone, Dubuque, and Winneshiek soils have limestone bedrock at a depth of about 2 to 3 feet. Available water capacity is low. Permeability is moderate to very rapid. Unless limed in the last 2 to 5 years, these soils are acid.

The soils of this unit are better suited to hay or pasture than to cultivated crops because these soils are subject to erosion and are droughty. These soils are used mainly for hay and pasture. Corn and oats are generally grown only in rotation to reestablish pasture. Yields vary, depending on the amount and timeliness of rainfall. Establishing new seeding can be difficult on the sandy soils. Crop residue left on the surface will help to prevent soil blowing and water erosion and help to conserve moisture. Terraces are not well suited to the sandy soils because they are difficult to construct and maintain. Terraces are generally not

to farm provide good habitat for wildlife or are suitable for trees.

Capability unit IVe–3

Jacwin loam, 9 to 14 percent slopes, is the only soil in this unit. This soil is dark and somewhat poorly drained. It is on high, upland structural benches.

The surface layer is friable and medium textured. The subsoil is friable to very firm and moderately fine textured or fine textured. The substratum is clayey shale. Available water capacity is moderate. Permeability is moderate in the loamy material and very slow in the clayey substratum. This soil is wet because of the moderately high but variable water table. Farm operations are delayed to some extent by the excess moisture. Because of the high clay content, not all the moisture is available to plants. This soil is generally neutral or slightly acid and seldom requires lime.

This soil is better suited to hay or pasture than to cultivated crops because it is subject to erosion and is seasonally wet. Terraces are not well suited because their construction can expose the less productive, very slowly permeable, clayey shale and they allow extra water to enter the soil, increasing wetness.

This soil is used mainly for hay and pasture. Corn and oats are generally grown only in rotation to reestablish pasture. Areas that are difficult to farm provide good habitat for wildlife or are suitable for trees.

Capability unit IVs–1

This unit consists of nearly level to moderately sloping soils of the Burkhardt and Sparta series, gently sloping to strongly sloping soils of the Marlean series, gently sloping to moderately sloping soils of the Chelsea series, and gently sloping soils of the Nordness series. These soils are dark to light colored and are somewhat excessively drained and excessively drained. These soils are mainly on uplands, and Burkhardt, Sparta, and Chelsea soils are also on stream benches.

The surface layer and subsoil are friable to very friable and coarse textured to medium textured. These soils have a coarse textured substratum, but Nordness and Marlean soils have limestone at a depth of less than 15 inches. Available water capacity is very low to low. Permeability is very rapid in Burkhardt, Chelsea, and Sparta soils and is moderate to rapid in Nordness and Marlean soils. Unless limed in the last 2 to 3 years, these soils are mainly acid; however, Nordness and Marlean soils generally do not require lime.

These soils are used for corn, oats, soybeans, hay, pasture, and woodland. They are better suited to permanent pasture, hay, woodland, or wildlife habitat than to most other uses. Droughtiness is the principal limitation on these soils, but erosion is also a hazard. Yields depend on the timeliness of rainfall during the growing season. Blowing sand may damage new seedlings on these soils and on adjacent soils.

These soils warm up quickly in spring and can be worked very soon after rains. They absorb moisture

face help to control soil blowing and to conserve moisture.

Capability unit Vw–1

This unit consists of nearly level, channeled Coland and Dorchester soils and Loamy alluvial land. These soils are well drained to very poorly drained. They are on nearly level bottom lands and are commonly cut up by stream channels and oxbows.

The surface layer is dark to light colored and is coarse textured to moderately fine textured. Available water capacity and permeability are variable. Reaction is slightly acid to mildly alkaline.

These soils are frequently flooded. Flooding is the main hazard. Water is ponded in many places during part of the year, and the water table is high. Without major reclamation, the soils in this unit are better suited to pasture, woodland, or wildlife habitat than to most other uses. If cultivated crops are grown, land leveling, flood control, and surface drainage are needed in many places. Most of these soils are in permanent pasture or woodland, but a few areas are cultivated with areas of adjacent soils. If protected from flooding, these soils are suited to row crops; if not protected, they are poorly suited to cultivated crops.

Capability unit VIe–1

This unit consists of moderately steep, slightly eroded and moderately eroded soils of the Dubuque

The surface layer is friable or very friable and coarse textured to medium textured. The subsoil is mainly very friable and coarse textured but Dorchester soils have a friable and medium textured subsoil. Limestone is at a depth of less than 15 inches in Nordness soils, and limestone outcrops are in many places. Sparta soils are sandy, and Volney soils have limestone fragments throughout the profile. Goss soils are dominantly chert fragments at a depth of less than 15 inches. Available water capacity is mainly low to very low; it is high in Dorchester soils. Permeability is moderate to rapid in Nordness, Goss, Dorchester, and Volney soils and very rapid in Sparta soils. Unless limed within the last 2 or 3 years, Dorchester and Volney soils are moderately alkaline, Nordness and Goss soils are generally neutral, and Sparta soils are acid.

Because they are droughty and susceptible to erosion, these soils are poorly suited to cultivated crops. Dorchester and Volney soils are subject to runoff from adjoining steep uplands. These soils absorb moisture readily but lose much of it through deep percolation. They are better suited to pasture, woodland, or wildlife habitat. Small areas that are left idle provide good wildlife habitat. Trees that are suited to these soils grow reasonably well in places. Areas should be protected from grazing. Establishing new seedings for pasture may be difficult on Sparta soils because of the sandy surface layer. Leaving crop residue on the sur-

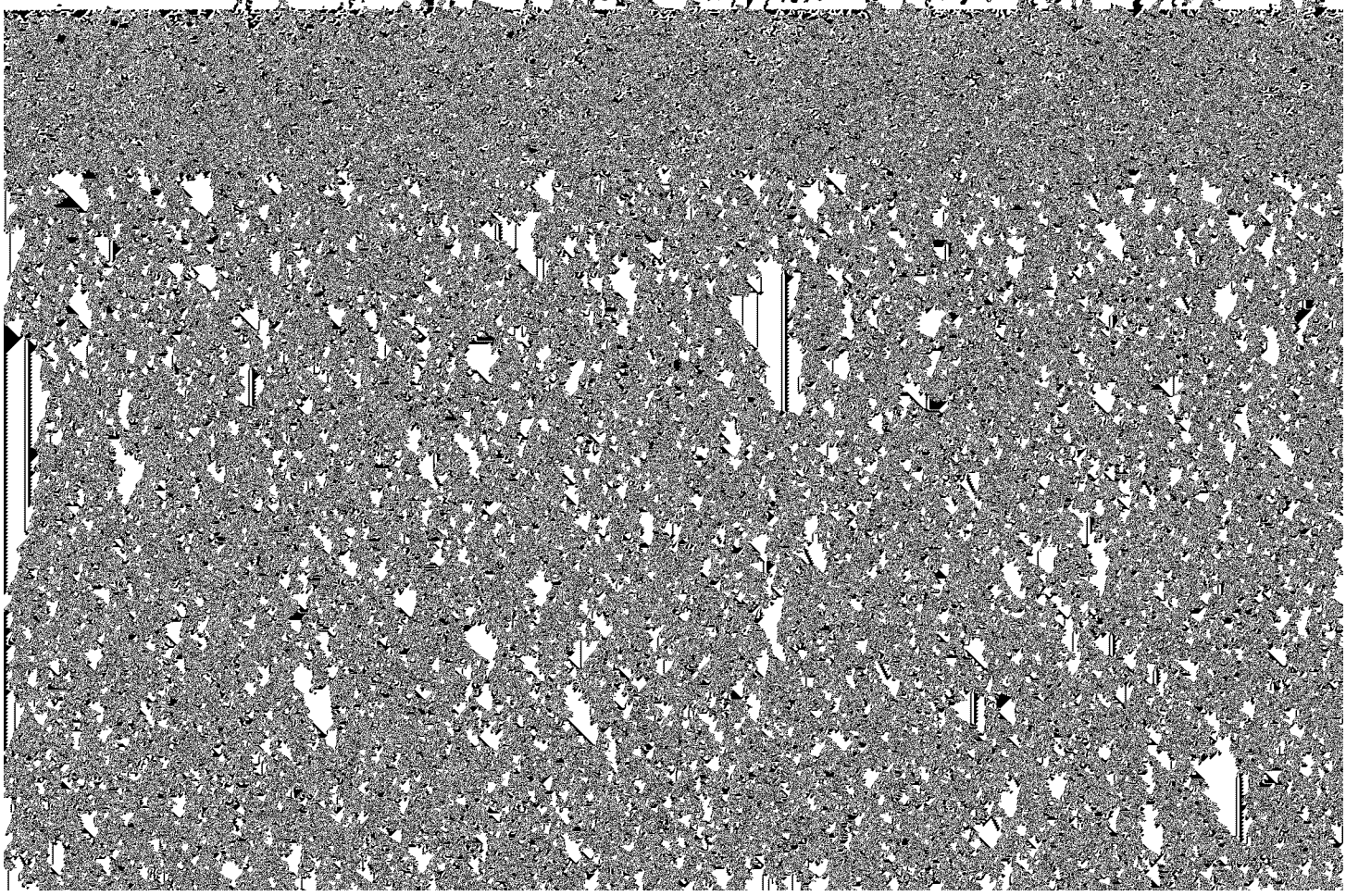


Figure 14.—Typical area of Rock outcrop-Nordness complex.

are not suited to most farming uses. They are suited to wildlife habitat and recreational areas. Waterfowl, muskrats, and upland game animals find food and nesting places in Marsh areas and around its edges. These areas can be improved as habitat by providing controls to maintain a more constant water level.

Capability unit VIIs–1

This unit consists of moderately steep to steep soils of the Chelsea and Nordness series. Sandy escarpments and the Rock outcrop-Nordness complex are also included. These soils are light colored and somewhat excessively drained to excessively drained.

Chelsea soils have a very friable, coarse textured surface layer and subsoil. Nordness soils have a thin, medium textured surface layer and are underlain by limestone bedrock at a depth of less than 18 inches. Sandy escarpments vary from medium textured to coarse textured. Rock outcrop-Nordness complex has a small amount of medium textured soil material in the surface layer. The soil material is between the fragments of limestone and in the fractures in the limestone. Available water capacity is very low (fig. 14).

be higher or lower than those indicated in table 2 because of seasonal variations in rainfall and other climatic factors. Absence of a yield estimate indicates that the crop is not suited to or not commonly grown on the soil or that irrigation of a given crop is not commonly practiced on the soil.

The predicted yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The latest soil and crop management practices used by many farmers in the county are assumed in predicting the yields. Hay and pasture yields are predicted for varieties of grasses and legumes suited to the soil. A few farmers may be using more advanced practices and obtaining higher average yields than those shown in table 2.

The management needed to achieve the indicated yields of the various crops depends upon the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-

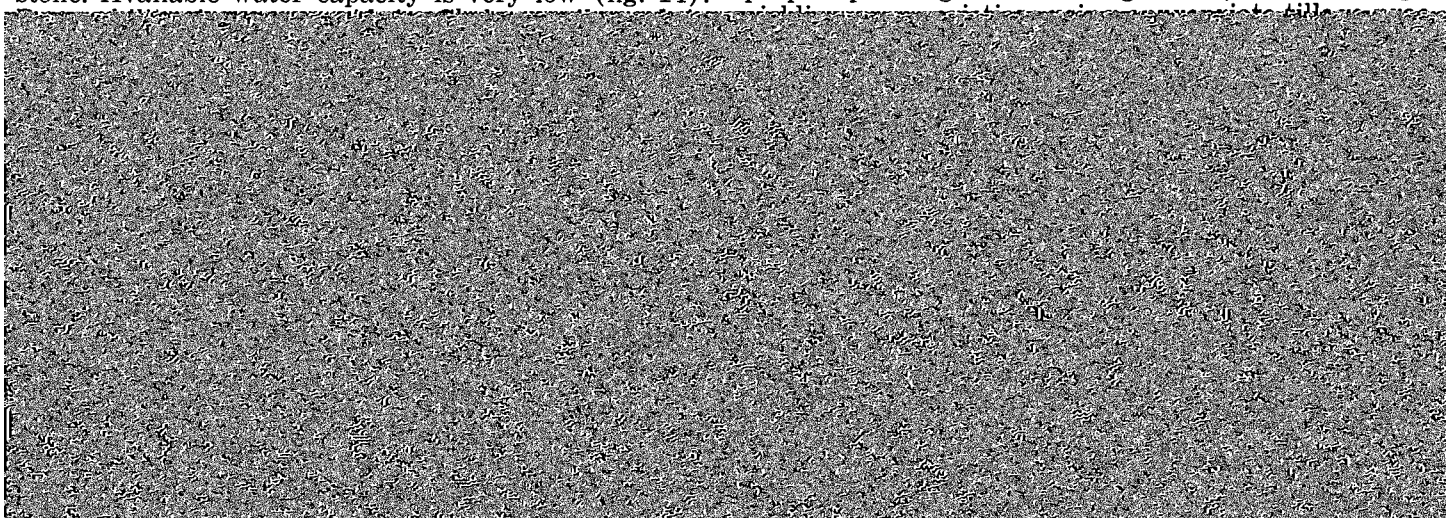


TABLE 2.—*Yields per acre of crops and pasture*

[All yields were estimated for a high level of management in 1975. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Map symbol and soil name	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass
	Bu	*Bu*	*Bu*	*Ton*	*AUM* [1]	*AUM* [1]
27B:						
Terril	118	45	94	5.0	8.3	4.2
41, 41B:						
Sparta	63	24	47	2.5	4.3	2.0
41C:						
Sparta	61	23	45	2.5	4.3	2.0
41D:						
Sparta	56	21	42	2.3	3.8	1.8

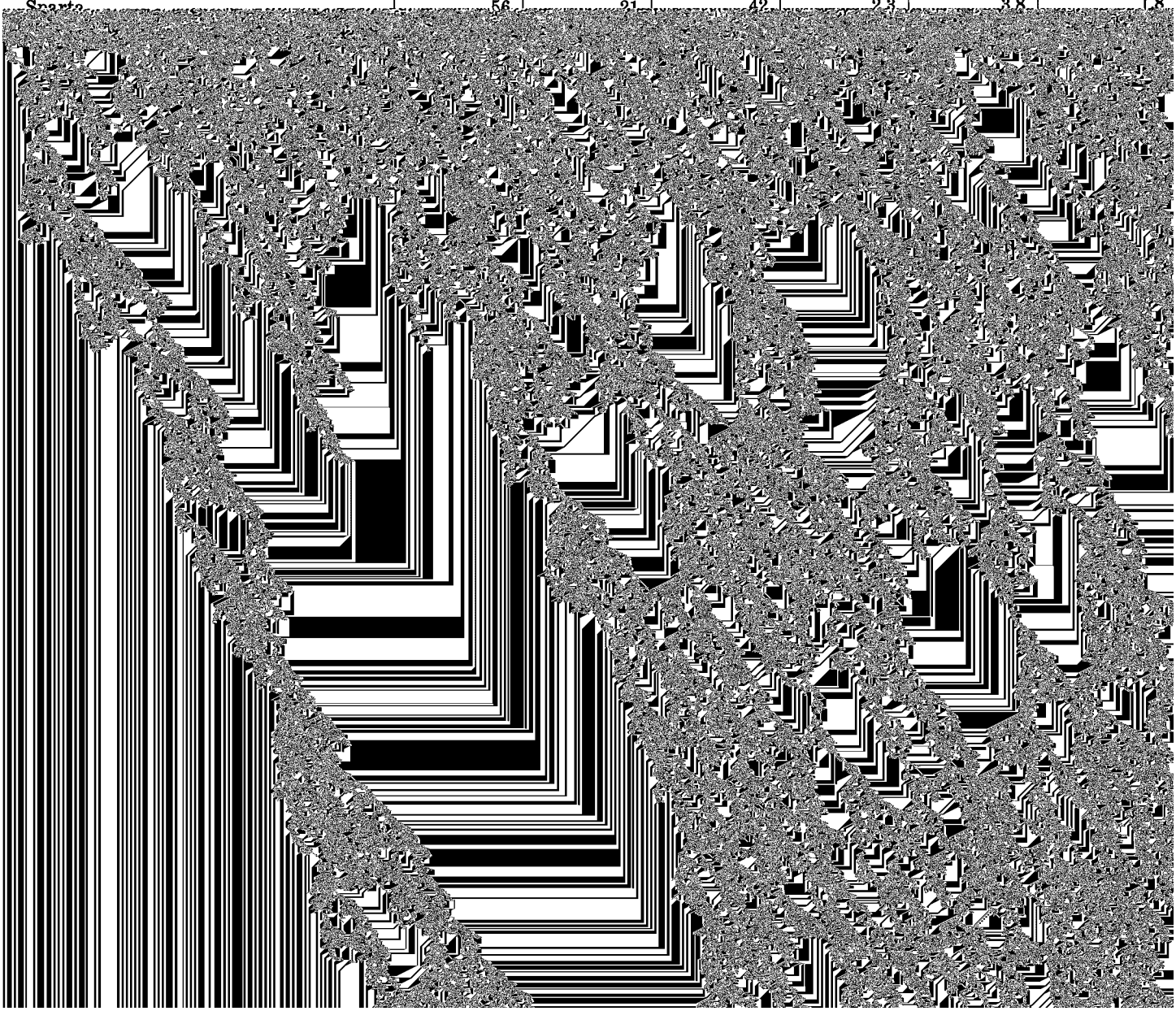


TABLE 2.—*Yields per acre of crops and pasture*—Continued

Map symbol and soil name	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass
	Bu	*Bu*	*Bu*	*Ton*	*AUM* [1]	*AUM* [1]
158:						
Dorchester	104	40	83	4.4	7.3	4.0
C158:						
Dorchester						3.0
162B:						
Downs	119	45	95	5.0	8.3	4.1
162C:						
Downs	114	43	91	4.8	8.1	4.0
162C2:						
Downs	111	42	89	4.7	7.8	3.8
162D:						
Downs	105	40	84	4.4	7.3	3.8
162D2:						
Downs	102	39	82	4.3	7.1	3.6
162E2:						
Downs	87	33	69	3.7	6.1	3.5
163B:						
Fayette	113	43	90	4.7	7.8	4.0

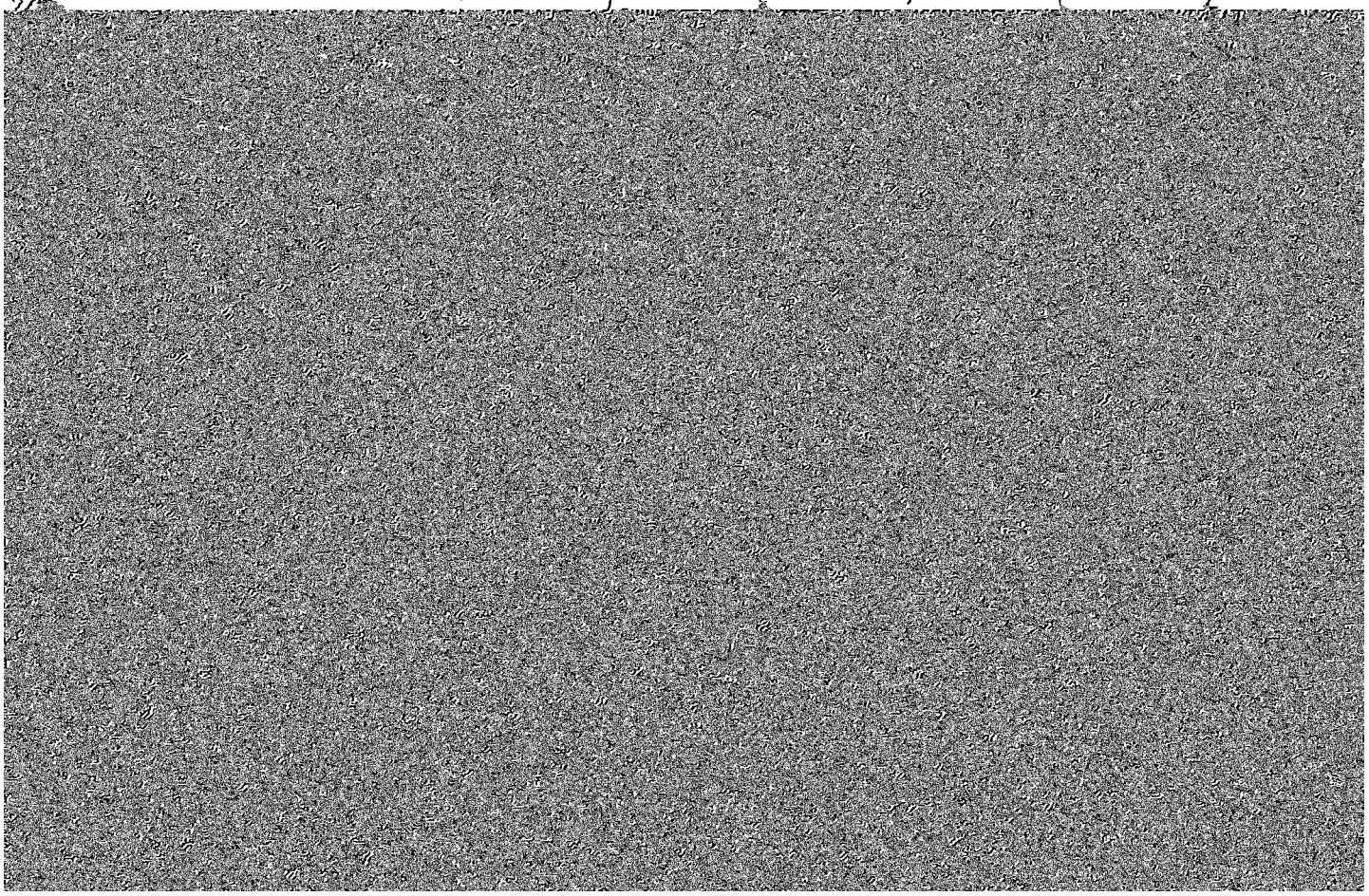


TABLE 2.—*Yields per acre of crops and pasture*—Continued

Map symbol and soil name	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass

TABLE 2.—*Yields per acre of crops and pasture*—Continued

Map symbol and soil name	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass
	Bu	*Bu*	*Bu*	*Ton*	*AUM* [1]	*AUM* [1]
225: Lawler	85	32	68	3.6	6.0	3.7
226: Lawler	100	38	80	4.2	7.0	4.0
265: Bixby	70	26	65	3.5	4.0	3.0
265B: Bixby	65	24	60	3.0	4.0	3.0
284: Flagler	63	24	47	2.6	3.8	2.3
284B: Flagler	61	23	46	2.5	3.6	2.1
284C:	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 2.—*Yields per acre of crops and pasture*—Continued

Map symbol and soil name	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass
	Bu	*Bu*	*Bu*	*Ton*	*AUM* [1]	*AUM* [1]
408C: Olin	92	35	70	3.9	6.5	3.2
409B: Dickinson	86	33	69	3.6	6.0	3.1
409C: Dickinson	81	31	65	3.4	5.6	3.0
444B: Jacwin	85	32	68	3.4	5.6	3.0
444C: Jacwin	70	30	56	2.8	4.6	2.6
444D: Jacwin	50	20	40	2.0	3.3	2.3
471: Oran	107	40	85	4.5	7.5	3.8
478G: Rock outcrop-Nordness						
480C: Orwood	100	38	80	4.2	7.0	3.7
480D2: Orwood	86	33	69	3.6	6.0	3.4
480E2: Orwood	70	27	57	2.9	4.8	3.2
485: Spillville	122	46	98	5.1	8.5	4.3
487B: Otter-Huntsville	102	39	76	4.0	6.6	3.8
489: Ossian	110	42	88	4.6	7.6	4.1
490: Caneek	96	38	80	4.0	6.6	3.8
496B: Dorchester-Volney				3.0	5.0	2.8
497F: Fayette-Dubuque-Jacwin					3.2	1.8
497G: Fayette-Dubuque-Jacwin						
499B: Nordness	36	14	29	1.5	2.5	1.5
499D: Nordness			20	1.2	2.0	1.0
499F: Nordness				0.5	0.8	0.7
512B: Marlean	46	17	37	2.0	3.3	1.8
512D: Marlean			32	1.5	2.6	1.5
536: Hanlon	90	34	72	3.0	5.0	3.3

TABLE 2.—*Yields per acre of crops and pasture*—Continued

Map symbol and soil name	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass
	Bu	*Bu*	*Bu*	*Ton*	*AUM* [1]	*AUM* [1]
551:						
Calamine	75	29	60	3.0	5.0	3.0
620B:						
Port Byron	122	46	95	5.0	8.3	4.1
714:						
Winneshiek	72	27	58	3.0	5.0	2.6
714B:						
Winneshiek	70	27	56	2.9	4.8	2.6
714C:						
Winneshiek	65	25	52	2.7	4.5	2.5
714D:						
Winneshiek	56	21	45	2.3	3.8	2.0
725:						
Hayfield	79	30	63	3.0	5.0	3.0
763D2:						
Exette	92	35	73	3.9	6.6	3.6
763E2:						

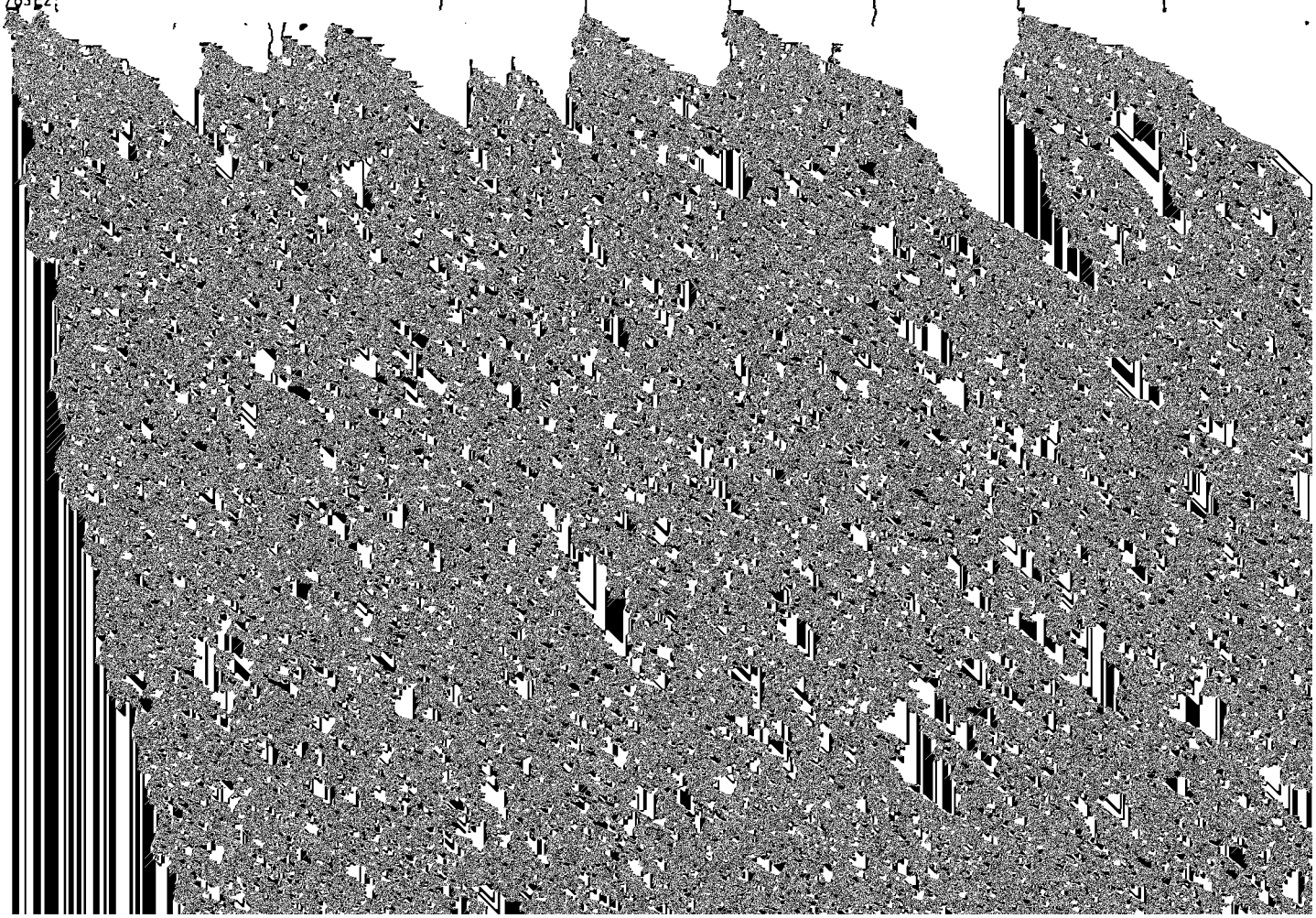
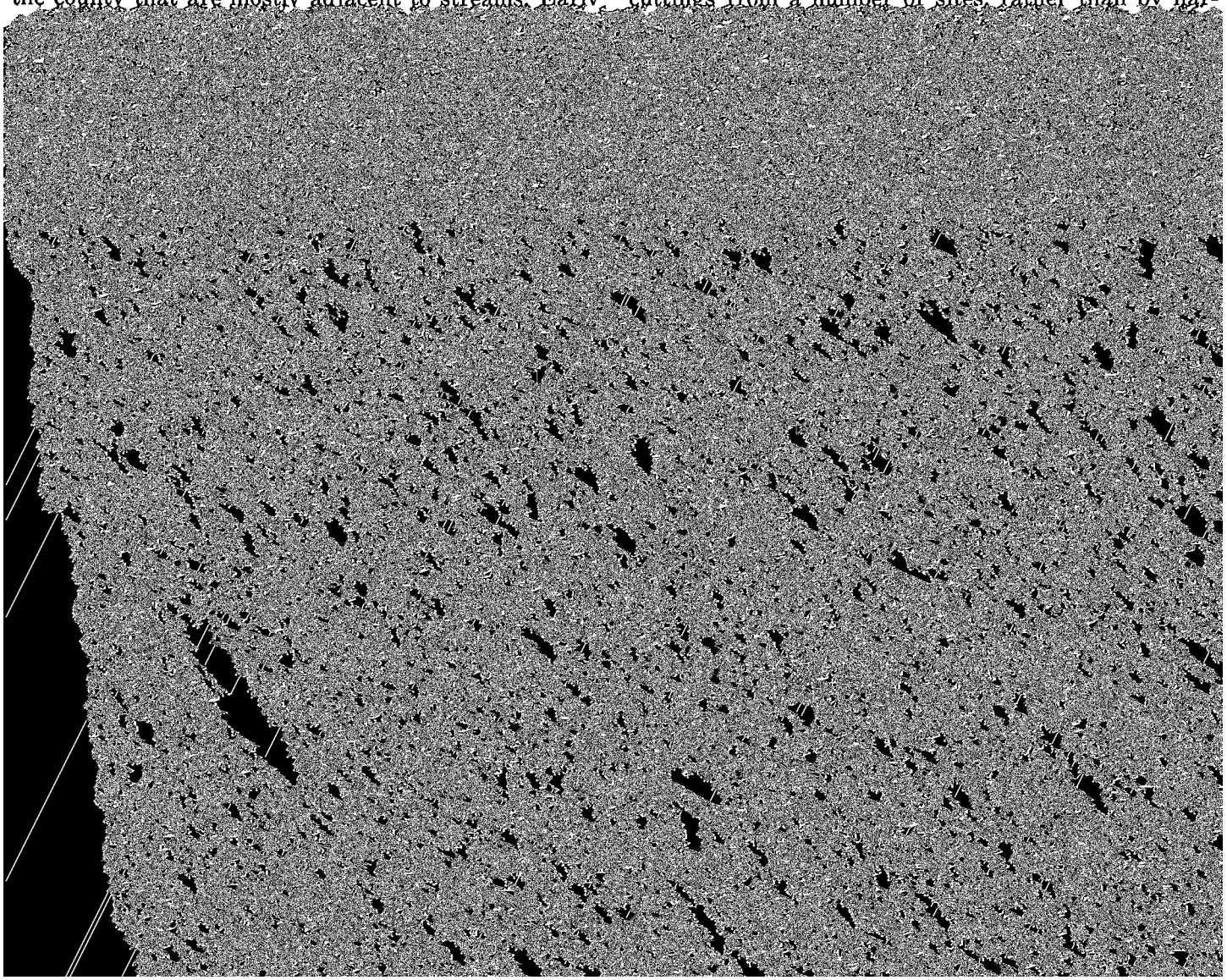


TABLE 2.—*Yields per acre of crops and pasture*—Continued

Map symbol and soil name	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass
	Bu	*Bu*	*Bu*	*Ton*	*AUM* [1]	*AUM* [1]
926: Canoe	120	46	96	5.0	8.3	4.2
977: Richwood	122	46	98	5.1	8.4	4.2
978: Festina	116	44	93	4.9	8.1	4.0

[1] Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days.

ern part of Fayette County. They also covered parts of the county that are mostly adjacent to streams. Early logs for the sawmills are usually obtained from selected cuttings from a number of sites, rather than by har-



Erosion. Eroded soils are generally not suitable for hardwoods, though pines may be planted on those sites. Natural reseeding of trees is greatly reduced by erosion. Examples of soils which have been eroded are some Bassett, Downs, Dubuque, and Fayette soils.

Soil reaction and soil fertility. Reaction and fertility have some influence on the adaptation and growth of different species of trees. For example, walnut and locust trees grow best on neutral or slightly calcareous soils. Pine trees need a slightly acid soil. Most species of pine, especially the native species, are poorly suited to soils that are high in lime. On the other hand, hardwoods commonly grow well on those soils. Eastern redcedar is also tolerant of lime. Dorchester soils contain excess lime in the upper 2 to 3 feet. Most of the other bottom land soils in Fayette County are neutral. Hardwoods should not be planted

seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree that the soil affects expected mortality of planted tree seedlings when plant competition is not a limiting factor. The ratings are for seedlings from good planting stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality of the planted seedlings is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of plant competition indicate the degree to which undesirable plants are expected to invade or grow if openings are made in the tree canopy. The invading plants compete with native plants or planted seedlings by impeding or preventing their growth. A rating of *slight* indicates little or no competition from

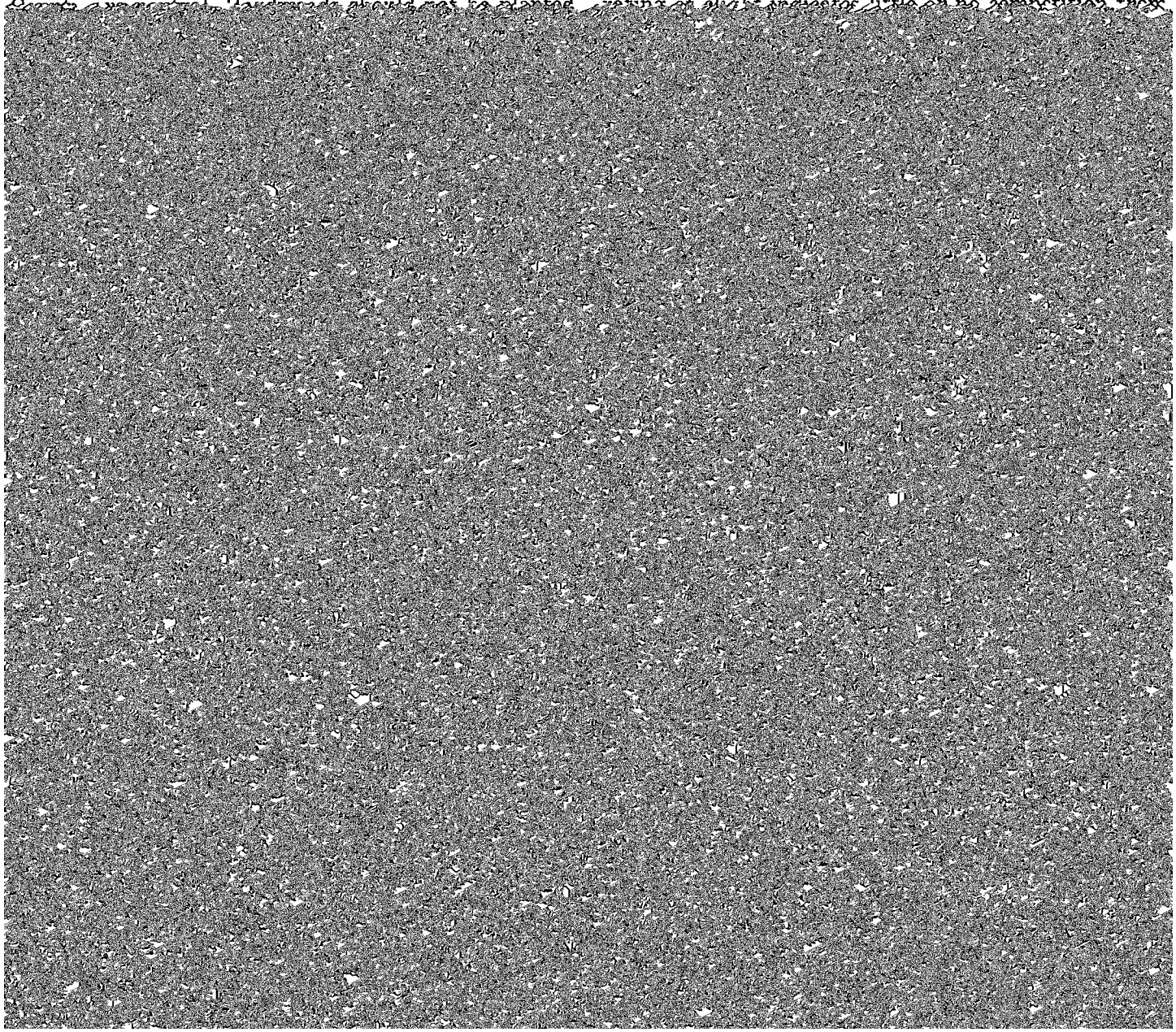


TABLE 3.—*Woodland management and productivity*

[Only the soils suitable for production of commercial trees are listed in this table. Absence of an entry in a column means the information was not available]

Map symbol and soil name	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Important trees	Site index	
63C: Chelsea	3s	Slight	Slight	Moderate	Slight	White oak	55	Eastern white pine, Scotch pine, European larch, eastern redcedar, red pine, jack pine.
63E: Chelsea	3s	Moderate	Moderate	Moderate	Slight	White oak	55	Eastern white pine, Scotch pine, European larch, eastern redcedar, red pine, jack pine.

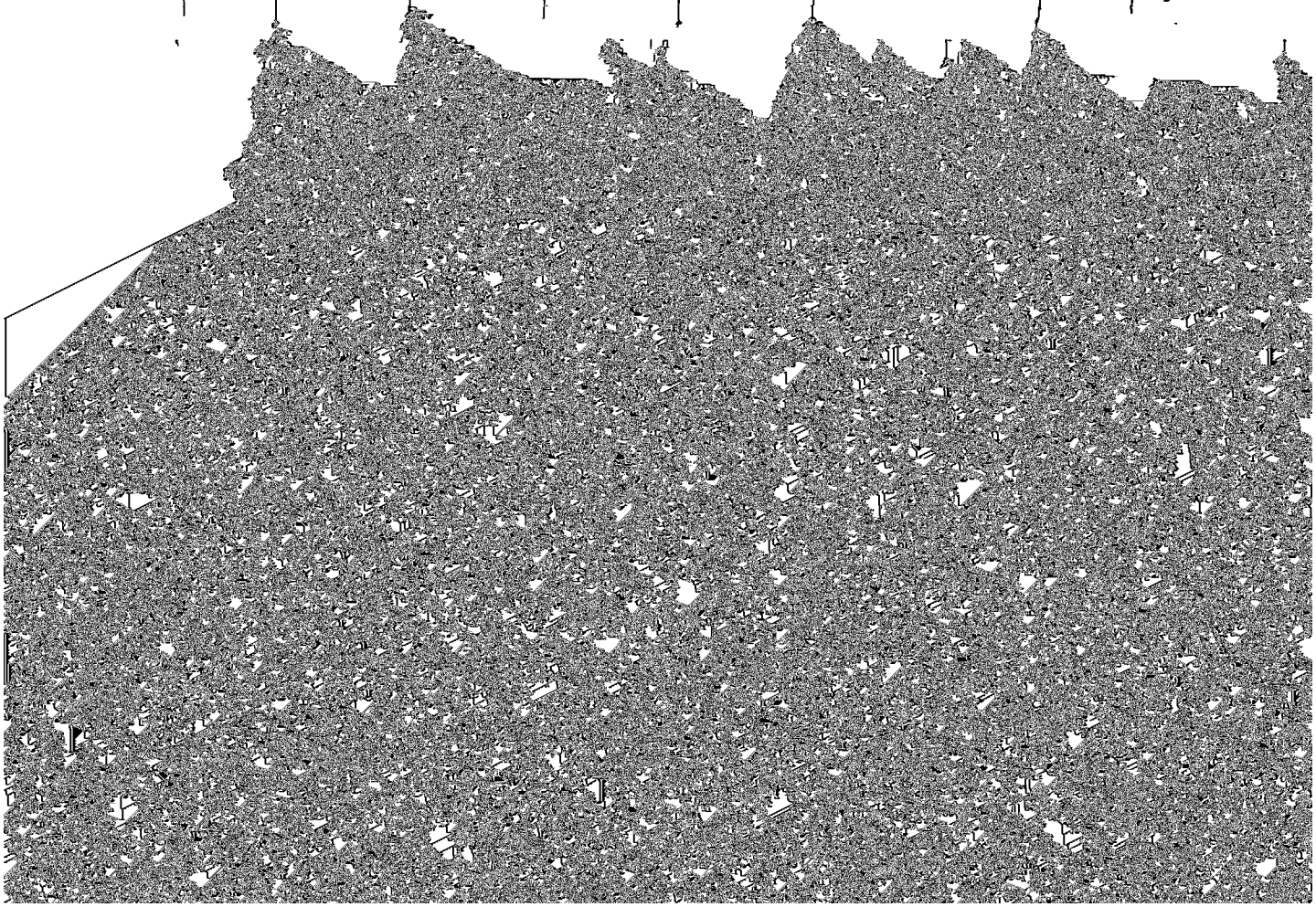


TABLE 3.—*Woodland management and productivity*—Continued

Map symbol and soil name	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Important trees	Site index	
162E2: Downs	2r	Moderate	Moderate	Slight	Moderate	White oak Northern red oak	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
163B, 163C, 163C2, 163D, 163D2, 163D3: Fayette	2o	Slight	Slight	Slight	Moderate	White oak Northern red oak	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
163E, 163E2, 163E3, 163F, 163F2, 163F3: Fayette	2r	Moderate	Moderate	Slight	Moderate	White oak	65	Eastern white pine, red pine,

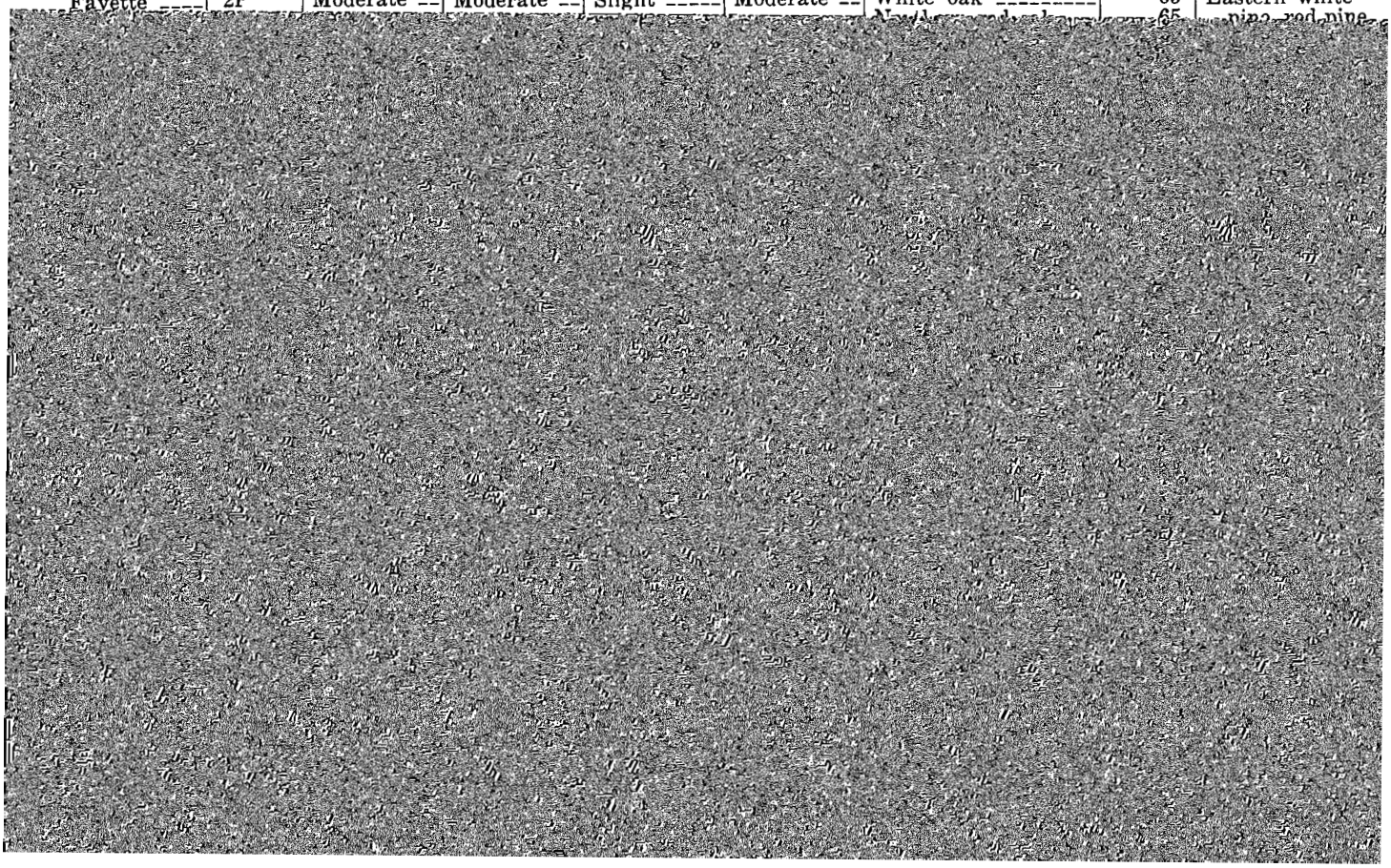


TABLE 3.—*Woodland management and productivity*—Continued

Map symbol and soil name	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Important trees	Site index	
183C, 183D2: Dubuque	2o	Slight	Slight	Slight	Moderate	Northern red oak	65	Eastern white pine, red pine,

TABLE 3.—*Woodland management and productivity*—Continued

Map symbol and soil name	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Important trees	Site index	
471: Oran	3o	Slight	Slight	Slight	Moderate	White oak Northern red oak	55 55	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
478G: Rock outcrop part								
Nordness part	4d	Moderate	Moderate	Severe	Moderate	Northern red oak White oak	45 45	Eastern white pine, red pine, Norway spruce, Scotch pine.
480C, 480D2: Orwood	2o	Slight	Slight	Slight	Moderate	White oak Northern red oak	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
480E2: Orwood	2r	Moderate	Moderate	Slight	Moderate	White oak Northern red oak	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple

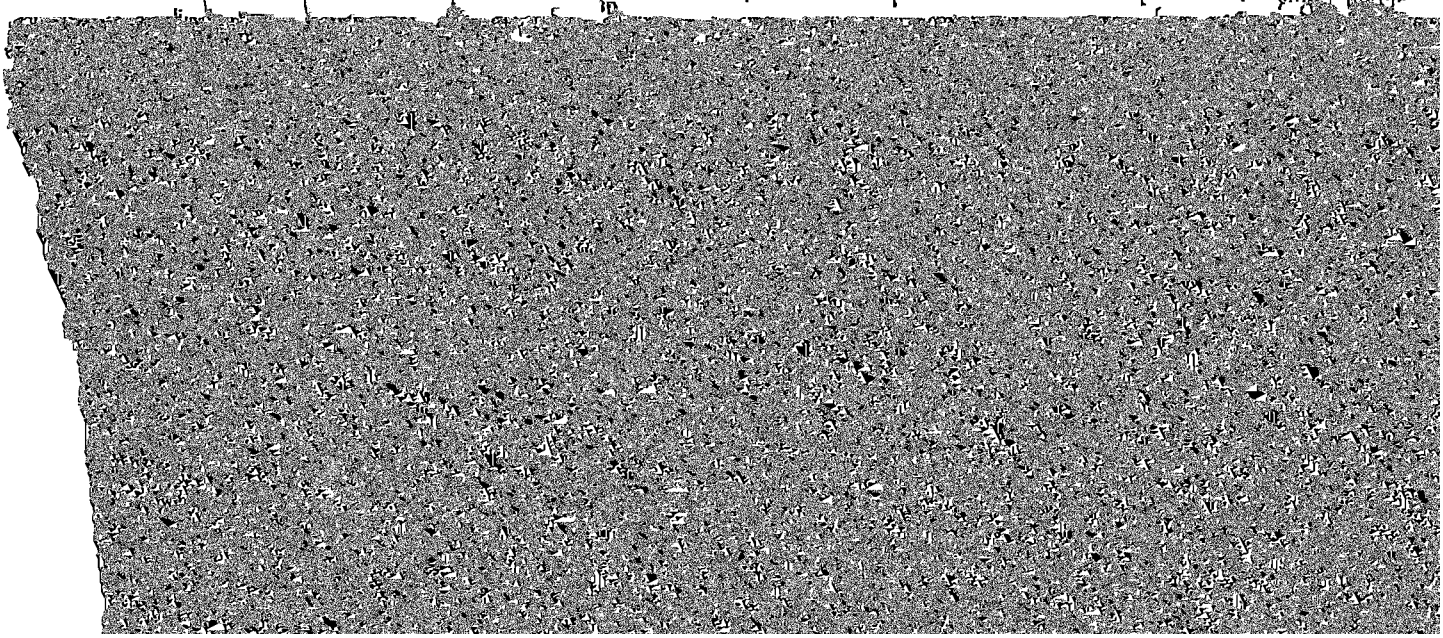


TABLE 3.—*Woodland management and productivity*—Continued

Map symbol and soil name	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Important trees	Site index	
497F con. Dubuque part	2r	Moderate	Moderate	Slight	Moderate	Northern red oak White oak	65 65	Eastern white pine, red pine, Scotch pine, eastern redcedar, Norway spruce, European larch, Douglas-fir, black walnut.
Jacwin part								
497G: Fayette part	2r	Severe	Severe	Slight	Moderate	White oak Northern red oak	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
Dubuque part	2r	Moderate	Moderate	Slight	Moderate	Northern red oak White oak	65 65	Eastern white pine, red pine, Scotch pine, eastern redcedar, Norway spruce, European larch, Douglas-fir, black walnut.
Jacwin part								
499B, 499D, 499F: Nordness	4d	Moderate	Moderate	Severe	Moderate	Northern red oak White oak	45 45	
714, 714B, 714C, 714D: Winneshiek	2o	Slight	Slight	Slight	Moderate	Northern red oak White oak	65 65	Eastern white pine, red pine, Scotch pine, eastern redcedar, Norway spruce, European larch, Douglas-fir, black walnut.
725: Hayfield	3o	Slight	Slight	Slight	Moderate	Northern red oak White oak	55 55	Eastern white pine, red pine, Norway spruce, Scotch pine, black walnut, sugar maple.

TABLE 3.—*Woodland management and productivity*—Continued

Map symbol and soil name	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Important trees	Site index	
763D2: Exette	2o	Slight	Slight	Slight	Moderate	White oak Northern red oak	65 65	Eastern white pine, red pine,

TABLE 3.—*Woodland management and productivity*—Continued

Map symbol and soil name	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Important trees	Site index	
784B: Riceville	3o	Slight	Slight	Slight	Moderate	White oak Northern red oak	55 55	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
926: Canoe	2o	Slight	Slight	Slight	Moderate	White oak Northern red oak	65 65	Eastern white pine, red pine, sugar maple, Norway spruce, Scotch pine, white spruce, European larch, poplars.
978: Festina	2o	Slight	Slight	Slight	Moderate	White oak Northern red oak	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.

4. Determining areas that are suitable for acquisition to manage for wildlife.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderate intensity of management and fairly frequent attention are required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and requires intensive effort. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. Examples are corn, oats, barley, soybeans, and rye. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Examples are fescue, bluegrass, lovegrass, switchgrass, bromegrass, timothy, orchardgrass, clover, alfalfa, trefoil, and crownvetch. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations.

Wild herbaceous plants are native or naturally established herbaceous grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestem, indiangrass, goldenrod, ragweed, sunflower, pigweed, and dock. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or

TABLE 4.—*Wildlife*

[See text for definitions of "good," "fair," "poor," and "very

Map symbol and soil name	Potential for habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees
27B: Terril	Good	Good	Good	Good
41, 41B, 41C, 41D: Sparta	Poor	Fair	Fair	Fair
63C, 63E: Chelsea	Poor	Fair	Fair	Poor
83B: Kenyon	Good	Good	Good	Good
83C, 83C2: Kenyon	Fair	Good	Good	Good
84: Clyde	Good	Good	Good	Fair
98, 98B: Huntsville	Good	Good	Good	Good
109B: Backbone	Fair	Fair	Good	Fair
109C, 109D: Backbone	Poor	Fair	Fair	Fair
110B: Lamont	Good	Good	Good	Good
110C: Lamont	Fair	Good	Good	Good
115F: Sandy escarpments	Very poor	Fair	Fair	Fair
135, C135: Coland	Good	Good	Good	Fair
142B: Chaseburg	Good	Good	Good	Good
151, 152: Marshan	Good	Good	Good	Fair
158, C158: Dorchester	Fair	Fair	Fair	Fair
162B: Downs	Good	Good	Good	Good
162C, 162C2, 162D, 162D2: Downs	Fair	Good	Good	Good
162E2: Downs	Poor	Fair	Good	Good
163B: Fayette	Good	Good	Good	Good
163C, 163C2, 163D, 163D2, 163D3: Fayette	Fair	Good	Good	Good
163E, 163E2, 163E3, 163F, 163F2, 163F3, 163G: Fayette	Poor	Fair	Good	Good
171B: Bassett	Good	Good	Good	Good

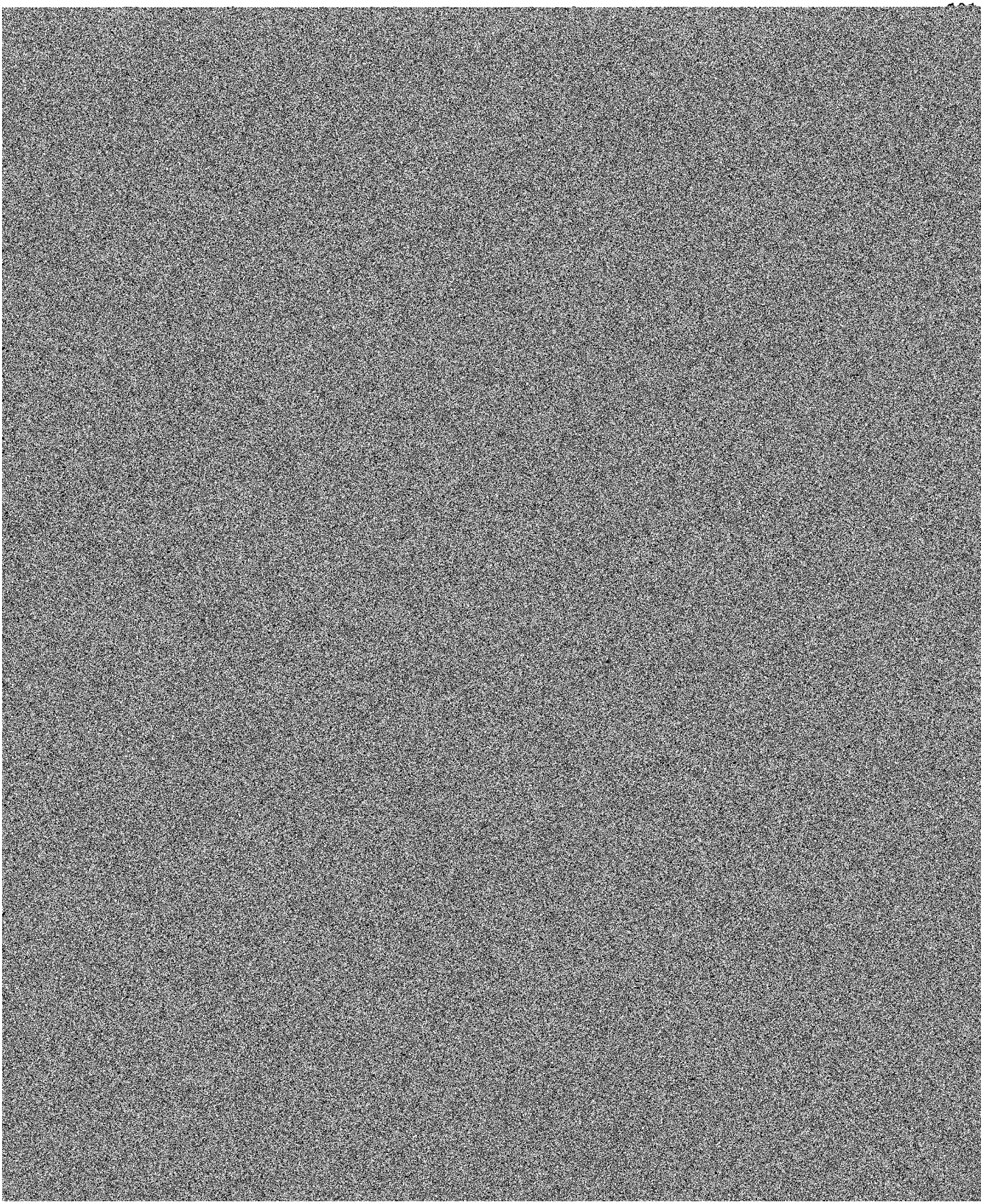


TABLE 4.—*Wildlife habitat*

Map symbol and soil name	Potential for habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees
171C, 171C2, 171D2: Bassett	Fair	Good	Good	Good
171E2: Bassett	Poor	Fair	Good	Good
175B: Dickinson	Fair	Fair	Fair	Fair
175C, 175D: Dickinson	Fair	Fair	Fair	Fair
177, 177B: Saude	Good	Good	Good	Good
177C: Saude	Fair	Good	Good	Good
178, 178B: Waukee	Good	Good	Good	Good
183C, 183D2: Dubuque	Fair	Fair	Good	Good
183E, 183E2, 183F: Dubuque	Poor	Fair	Fair	Fair
193: Camden	Good	Good	Good	Good
198B: Floyd	Good	Good	Good	Fair
213, 213B, 214, 214B, 214C: Rockton	Good	Good	Good	Good
215E: Goss	Very poor	Poor	Fair	Fair
221: Palms	Good	Poor	Poor	Poor
225, 226: Lawler	Good	Good	Good	Good
265, 265B: Bixby	Good	Good	Good	Good
284, 284B: Flagler	Fair	Fair	Fair	Fair
284C: Flagler	Poor	Fair	Fair	Fair
285, 285B, 285C2: Burkhardt	Poor	Fair	Fair	Fair
285E2: Burkhardt	Very poor	Fair	Fair	Fair
302B: Coggon	Good	Good	Good	Good
302C: Coggon	Fair	Good	Good	Good
315: [illegible]	Poor	Fair	Fair	Fair

potentials—Continued

Potential for habitat elements—Continued			Potential as habitat for—		
Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Good	Poor	Fair	Good	Good	Fair.
Good	Poor	Poor	Fair	Good	Poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Fair	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Poor	Good	Good	Poor.
Fair	Good	Good	Good	Fair	Good.
Good	Very poor	Very poor	Good	Good	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Poor	Good	Good	Fair	Poor	Good.
Good	Fair	Fair	Good	Good	Fair.
Good	Poor	Very poor	Good	Good	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor
Fair	Very poor	Very poor	Poor	Fair	Very poor.
Good	Fair	Fair	Good	Good	Fair.
Good	Poor	Fair	Good	Good	Fair.
Poor	Good	Fair	Fair	Fair	Fair.

TABLE 4.—*Wildlife habitat*

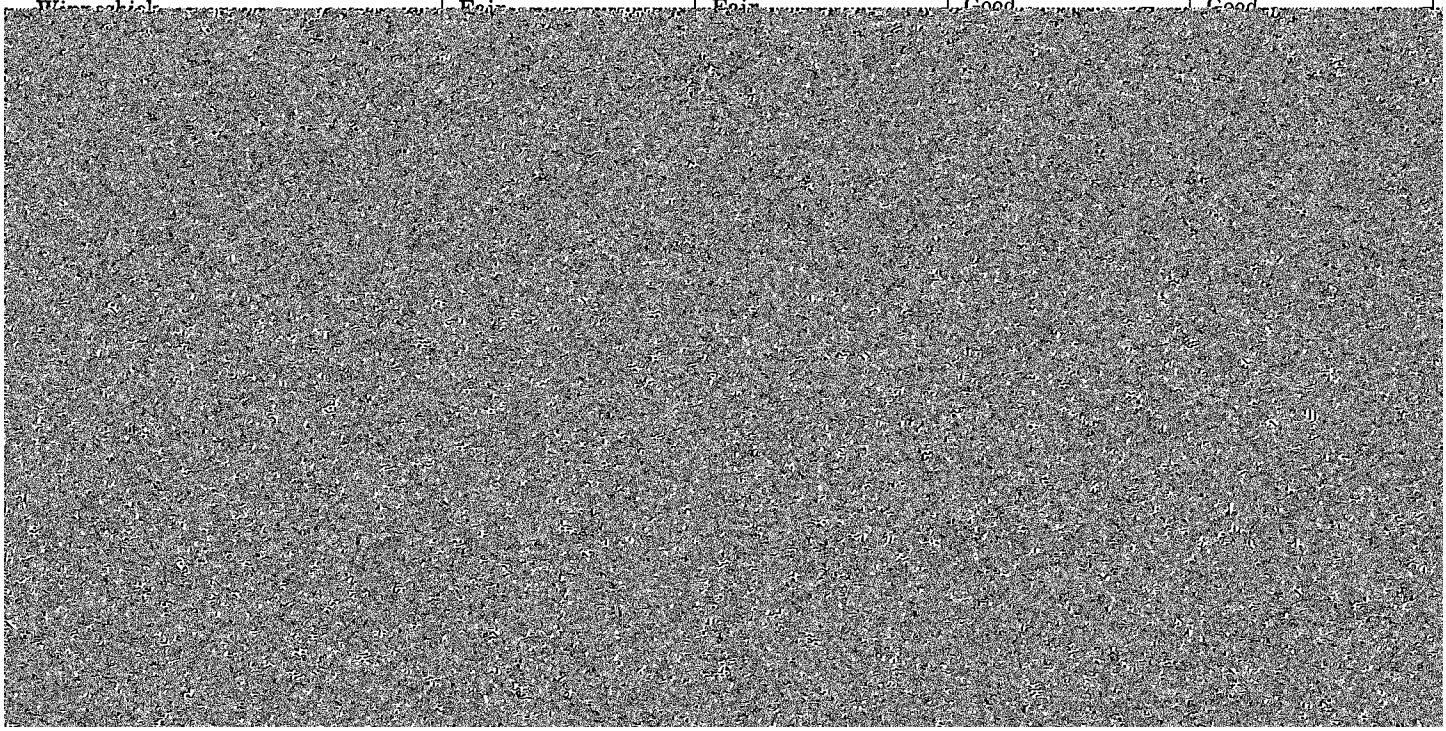
Map symbol and soil name	Potential for habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees
354: Marsh	Very poor	Very poor	Very poor	Very poor
391B: Clyde part	Good	Good	Good	Fair
Floyd part	Good	Good	Good	Fair
394B: Ostrander	Good	Good	Good	Good
394C, 394C2: Ostrander	Fair	Good	Good	Good
398: Tripoli	Good	Good	Good	Fair
399, 399B: Readlyn	Good	Good	Good	Fair
407B: Schley	Good	Good	Good	Fair
408B: Olin	Good	Good	Good	Good
408C: Olin	Fair	Good	Good	Good
409B: Dickinson	Fair	Fair	Fair	Fair
409C: Dickinson	Fair	Fair	Fair	Fair
444B: Jacwin	Fair	Fair	Fair	Poor
444C, 444D: Jacwin	Poor	Poor	Fair	Poor
471: Oran	Good	Good	Good	Fair
478G: Rock outcrop part				
Nordness part	Very poor	Poor	Poor	Poor
480C, 480D2: Orwood	Fair	Good	Good	Good
480E2: Orwood	Poor	Fair	Good	Good
485: Spillville	Good	Good	Good	Good
487B: Otter part	Good	Good	Good	Fair
Huntsville part	Good	Good	Good	Good
489: Ossian	Good	Good	Good	Fair
490: Caneek	Fair	Fair	Fair	Fair
496B: Dorchester part	Fair	Fair	Fair	Fair
Volney part	Poor	Fair	Fair	Fair

potentials—Continued

Potential for habitat elements—Continued			Potential as habitat for—		
Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Very poor	Good	Good	Fair	Very poor	Good.
Poor	Good	Good	Good	Fair	Good.
Fair	Good	Good	Good	Fair	Good.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Poor	Good	Good	Good	Fair	Good.
Fair	Fair	Fair	Good	Fair	Fair.
Fair	Good	Good	Good	Fair	Good.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Poor	Good	Good	Poor.
Fair	Poor	Poor	Fair	Fair	Very poor.
Fair	Very poor	Poor	Fair	Fair	Very poor.
Poor	Good	Good	Fair	Poor	Good.
Poor	Fair	Fair	Poor	Poor	Fair.
Fair	Fair	Fair	Good	Good	Fair.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Fair	Fair	Good	Good	Fair.
Poor	Good	Good	Good	Fair	Good.
Good	Poor	Poor	Good	Good	Poor.
Poor	Good	Good	Good	Fair	Good.
Poor	Good	Good	Fair	Fair	Good.
Poor	Fair	Poor	Fair	Poor	Poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.

TABLE 4.—*Wildlife habitat*

Map symbol and soil name	Potential for habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees
497F:				
Fayette part	Poor	Fair	Good	Good
Dubuque part	Poor	Fair	Fair	Fair
Jacwin part	Very poor	Very poor	Fair	Poor
497G:				
Fayette part	Very poor	Fair	Good	Good
Dubuque part	Very poor	Fair	Fair	Fair
Jacwin part	Very poor	Very poor	Fair	Fair
499B:				
Nordness	Poor	Poor	Poor	Poor
499D:				
Nordness	Poor	Poor	Poor	Poor
499F:				
Nordness	Very poor	Poor	Poor	Poor
512B, 512D:				
Marlean	Poor	Poor	Fair	Fair
536:				
Hanlon	Good	Good	Good	Good
551:				
Calamine	Poor	Poor	Fair	Poor
620B:				
Port Byron	Good	Good	Good	Good
714, 714B:				
Winneshiek	Fair	Good	Good	Good
714C, 714D:				
Winneshiek	Fair	Fair	Good	Good



potentials—Continued

Potential for habitat elements—Continued			Potential as habitat for—		
Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Good	Very poor	Very poor	Fair	Good	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Poor	Fair	Poor	Poor	Poor	Fair.
Good	Very poor	Very poor	Fair	Good	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Poor	Poor	Poor	Poor	Fair	Poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Fair	Very poor	Very poor	Poor	Poor	Very poor.
Good	Poor	Fair	Good	Good	Poor.
Poor	Good	Good	Fair	Poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.

TABLE 4.—*Wildlife habitat*

Map symbol and soil name	Potential for habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees
784B: Riceville	Fair	Fair	Good	Fair
798B: Protivin	Fair	Fair	Good	Fair
926: Canoe	Good	Good	Good	Good
977: Richwood	Good	Good	Good	Good
978: Festina	Good	Good	Good	Good

other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Examples of native plants are oak, poplar, cherry, apple, hawthorn, hickory, black walnut, blackberry, grape, and briers. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated good are Russian-olive, autumn-olive, and crabapple. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness.

Coniferous plants are cone-bearing trees, shrubs, or ground cover that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Examples are pine, spruce, hemlock, fir, yew, cedar, and juniper. Major soil properties that affect the growth of coniferous plants are depth of the root zone, available water capacity, and wetness.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Examples of wetland plants are smartweed, rushes, sedges, reeds, arrowhead, and cattail. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness.

Shallow water areas are bodies of surface water that have an average depth of less than 5 feet and are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control devices in marshes or streams. Examples are muskrat marshes, waterfowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds. Major soil properties affecting shallow water areas are depth to bedrock, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, killdeer, cottontail rabbit, red fox, and woodchuck.

Woodland habitat consists of hardwoods or conifers or a mixture of both, with associated grasses, legumes, and wild herbaceous plants. Examples of wildlife attracted to this habitat are woodpeckers, fox squirrels, fox, raccoon, and white-tailed deer.

Wetland habitat consists of water-tolerant plants in open, marshy, or swampy shallow water areas. Examples of wildlife attracted to this habitat are ducks, geese, herons, shore birds, kingfishers, muskrat, mink, and beaver.

Recreation

The soils of the survey area are rated in table 5 according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreational use by the duration of flooding and the season when it occurs. Onsite assessment of height, duration, and frequency of flooding is essential in planning recreational facilities.

In table 5 the limitations of soils are rated as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation,

potentials—Continued

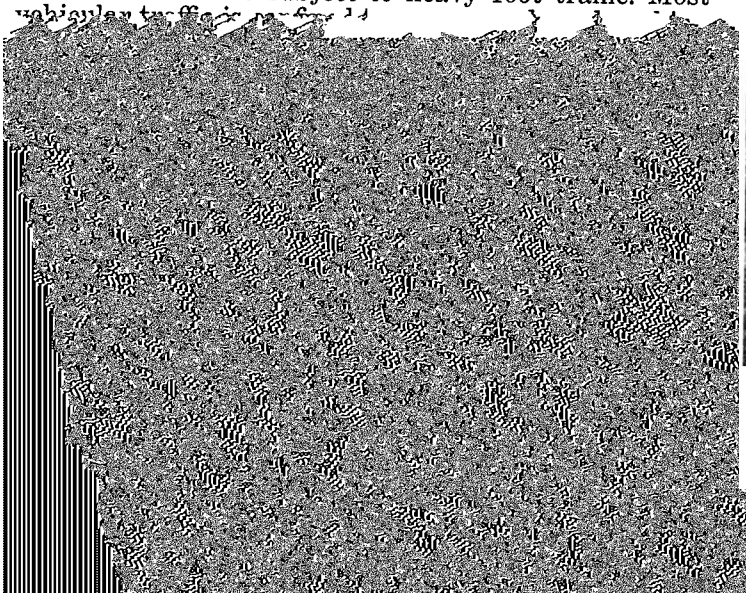
Potential for habitat elements—Continued			Potential as habitat for—		
Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Fair	Fair	Fair	Fair	Fair	Fair.
Fair	Fair	Fair	Fair	Fair	Fair.
Good	Fair	Fair	Good	Good	Fair.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Poor	Good	Good	Poor.

special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 5 can be supplemented by additional information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 9, and interpretations for dwellings without basements and for local roads and streets, given in table 10.

Camp areas require such site preparation as shaping and leveling tent and parking areas, stablizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet nor subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is [illegible]



should have moderate slopes and have few or no stones or boulders on the surface (fig. 15).

Engineering [3]

This section provides information about the use of soils for building sites, sanitary facilities, construction materials, and water management. Among those who can benefit from this section are engineers, landowners, community decision-makers and planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in tables in this section are based on

[3] VOLNEY H. SMITH, assistant state conservation engineer, Soil Conservation Service, assisted in preparation of this section.

TABLE 5.—*Recreational development*

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe"]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
27B: Terril	Slight	Slight	Moderate: slope	Slight.
41:				

TABLE 5.—*Recreational development*—Continued

Map symbol and [illegible]	Camp areas	Picnic areas	Playgrounds	Paths and trails

TABLE 5.—*Recreational development*—Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
183D2: Dubuque	Moderate: slope	Moderate: slope	Severe: slope, depth to rock.	Slight.
183E, 183E2, 183F: Dubuque	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Moderate: slope.
193: Camden	Slight	Slight	Slight	Slight.
198B: Floyd	Moderate: wetness	Moderate: wetness	Moderate: slope, wetness.	Moderate: wetness.
213: Rockton	Slight	Slight	Moderate: depth to rock.	Slight.
213B: Rockton	Slight	Slight	Moderate: depth to rock, slope.	Slight.
214: Rockton	Slight	Slight	Moderate: depth to rock.	Slight.
214B: Rockton	Slight	Slight	Moderate: depth to rock, slope.	Slight.
214C: Rockton	Slight	Slight	Severe: slope	Slight.
215E: Goss	Moderate: small stones, slope.	Moderate: small stones, slope.	Severe: small stones, slope.	Moderate: small stones.
221: Palms	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
225, 226: Lawler	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness.
265: Pishur	Slight	Slight	Slight	Slight.

TABLE 5.—*Recreational development*—Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
302B: Coggon	Moderate: percs slowly.	Slight	Moderate: slope	Slight.
302C: Coggon	Moderate: percs slowly.	Slight	Severe: slope	Slight.
315: Loamy alluvial land	Severe: floods	Severe: floods	Severe: floods	Moderate: floods.
354: Marsh	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
391B: Clyde part	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Floyd part	Moderate: wetness	Moderate: wetness	Moderate: slope, wetness.	Moderate: wetness.
394B: Ostrander	Slight	Slight	Moderate: slope	Slight.
394C, 394C2: Ostrander	Slight	Slight	Severe: slope	Slight.
398: Tripoli	Severe: wetness, percs slowly.	Severe: wetness	Severe: wetness	Severe: wetness.
399: Readlyn	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness.
399B: Readlyn	Moderate: wetness	Moderate: wetness	Moderate: wetness, slope.	Moderate: wetness.
407B: Schley	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness.
408B: Olin	Slight	Slight	Moderate: slope	Slight.
408C: Olin	Slight	Slight	Severe: slope	Slight.
409B: Dickinson	Slight	Slight	Moderate: slope	Slight.
409C: Dickinson	Slight	Slight	Severe: slope	Slight.
444B: Jacwin	Severe: percs slowly.	Moderate: wetness	Severe: percs slowly	Moderate: wetness.
444C: Jacwin	Severe: percs	Moderate: wetness	Severe: slope, percs	Moderate: wetness

TABLE 5.—*Recreational development*—Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
480C: Orwood	Slight	Slight	Severe: slope	Slight.
480D2: Orwood	Moderate: slope	Moderate: slope	Severe: slope	Slight.
480E2: Orwood	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
485: Spillville	Severe: floods	Severe: floods	Severe: floods	Moderate: floods.
487B: Otter part	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness.
Huntsville part	Severe: floods	Moderate: floods	Moderate: floods	Slight.
489: Ossian	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
490: Caneek	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
496B: Dorchester part	Severe: floods	Severe: floods	Severe: floods	Moderate: floods.
Volney part	Severe: floods	Severe: floods, small stones, large stones.	Severe: floods, large stones, depth to rock.	Moderate: floods, large stones, small stones.
497F: Fayette part	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
Dubuque part	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Moderate: slope.
Jacwin part	Severe: percs slowly.	Severe: slope, wetness.	Severe: slope, percs slowly.	Moderate: wetness.
497G: Fayette part	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Dubuque part	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Jacwin part	Severe: percs slowly.	Severe: slope, wetness.	Severe: slope, percs slowly.	Severe: wetness, slope.
499B: Nordness	Slight	Slight	Severe: depth to rock.	Slight.
499D: Nordness	Moderate: slope	Moderate: slope	Severe: depth to rock.	Slight.
499F: Nordness	Severe: slope	Severe: slope	Severe: depth to	Moderate: slope.

TABLE 5.—*Recreational development*—Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
536: Hanlon	Severe: floods, soil blowing.	Moderate: floods	Moderate: floods	Slight.
551: Calamine	Severe: wetness, percs slowly.	Severe: wetness	Severe: wetness, percs slowly.	Severe: wetness.
620B: Port Byron	Slight	Slight	Moderate: slope	Slight.
714, 714B: Winneshiek	Slight	Slight	Moderate: depth to rock.	Slight.
714C: Winneshiek	Slight	Slight	Severe: slope	Slight.
714D: Winneshiek	Moderate: slope	Moderate: slope	Severe: slope	Slight.
725: Hayfield	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness.
763D2: Exette	Moderate: slope	Moderate: slope	Severe: slope	Slight.
763E2, 763E3, 763F2, 763F3: Exette	Severe: slope	Severe: slope	Severe: slope	Moderate: slope

TABLE 5.—*Recreational development*—Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
926: Canoe	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness.
977: Richwood	Slight	Slight	Slight	Slight.
978: Festina	Slight	Slight	Slight	Slight.

test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

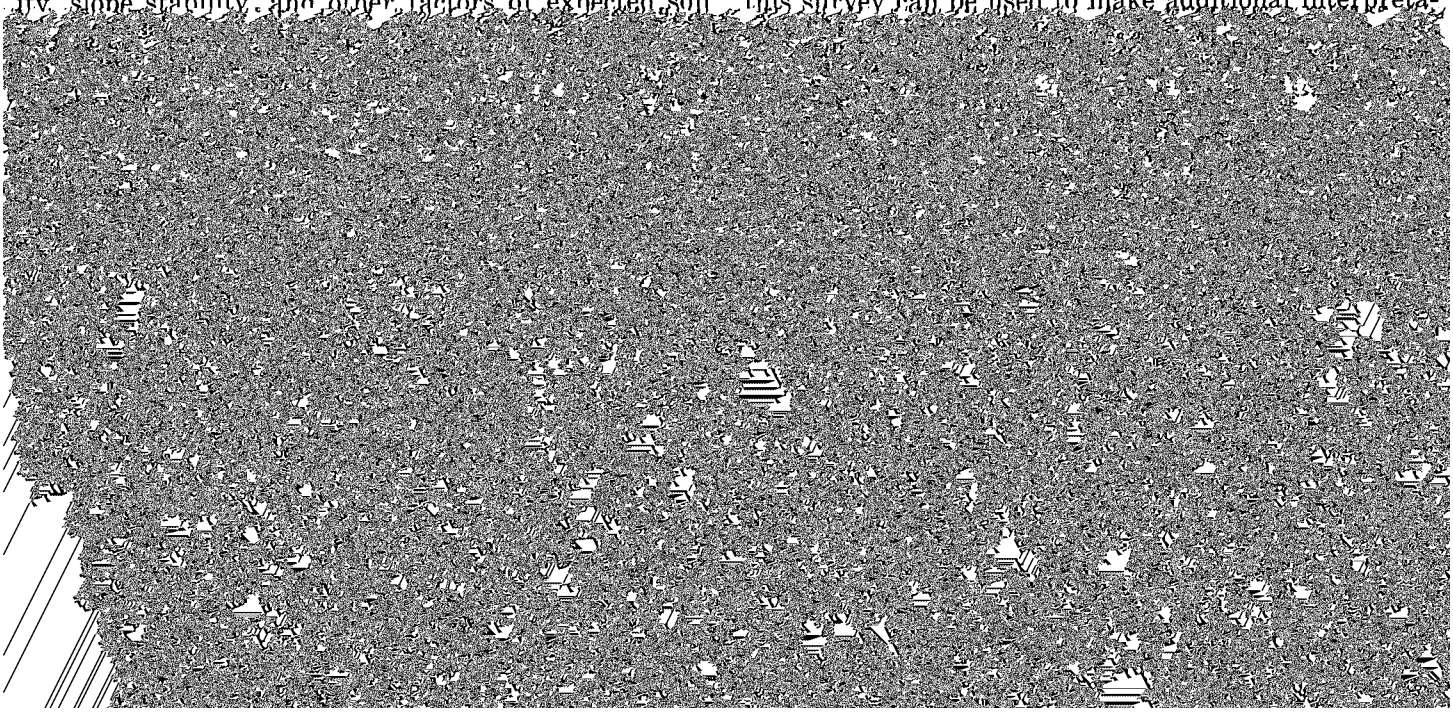
Among the soil properties and site conditions identified by the soil survey and used in determining the ratings in this section are grain-size distribution, liquid limit, plasticity index, soil reaction, depth to and hardness of bedrock within a depth of 5 or 6 feet, soil wetness characteristics, depth to a seasonal water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

Based on the information assembled about soil properties, ranges of values may be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations and testing.

The information is presented mainly in tables. Table 10 shows, for each kind of soil, ratings of the degree and kind of limitations for building site development; table 9, for sanitary facilities; and table 12, for water management. Table 11 shows the suitability of each kind of soil as a source of construction materials (See page 150).

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey can be used to make additional interpreta-



oratory to verify the field estimates of soil properties and to characterize key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many of the soil series are available from nearby areas.

Based on summaries of available field and laboratory data, and listed in tables in this section, are estimated ranges in engineering properties and classifications and in physical and chemical properties for each major horizon of each soil in the survey area. Also, pertinent soil and water features, engineering test data, and data obtained from laboratory analyses, both physical and chemical, are presented.

Engineering properties

Table 6 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area. These estimates are presented as ranges in value most likely to exist in areas where the soil is mapped.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Information is presented for each of these contrasting horizons. Depth to the upper and lower boundaries of each horizon in a typical profile of each soil is indicated. More information about the range in depth and in properties of each horizon is given for each soil series in "Descriptions of the soils."

Texture is described in table 6 in standard terms used by the United States Department of Agriculture (USDA). These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms used by the USDA are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified soil classification system (*2*) and the American Association of State Highway and Transportation Officials soil classification system (AASHTO) (*1*). In table 6 soils in the survey area are classified according to both systems.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example CL–ML.

The AASHTO system is used to classify soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified as one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A–1 are coarse grained and low in content of fines. At the other extreme, in group A–7, are fine-grained soils. Highly organic soils are classified as A–8 on the basis of visual inspection.

When laboratory data are available, the A–1, A–2, and A–7 groups are further classified 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 an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or more for the poorest. The AASHTO classification for soils tested in the survey area, with group index numbers in parentheses, is given in table 13. The estimated classification, without group index numbers, is given in table 6.

Also in table 6 the percentage, by weight, of cobbles or the rock fragments more than 3 inches in diameter are estimated for each major horizon. These estimates are determined largely by observing volume percentage in the field and then converting it, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four standard sieves is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistency of soil material. These indexes are used in both the Unified and the AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior.

Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

Physical and chemical properties

Table 7 (See page 130) shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the representative profile of each soil. The estimates are based on field observations and on test data for these and similar soils.

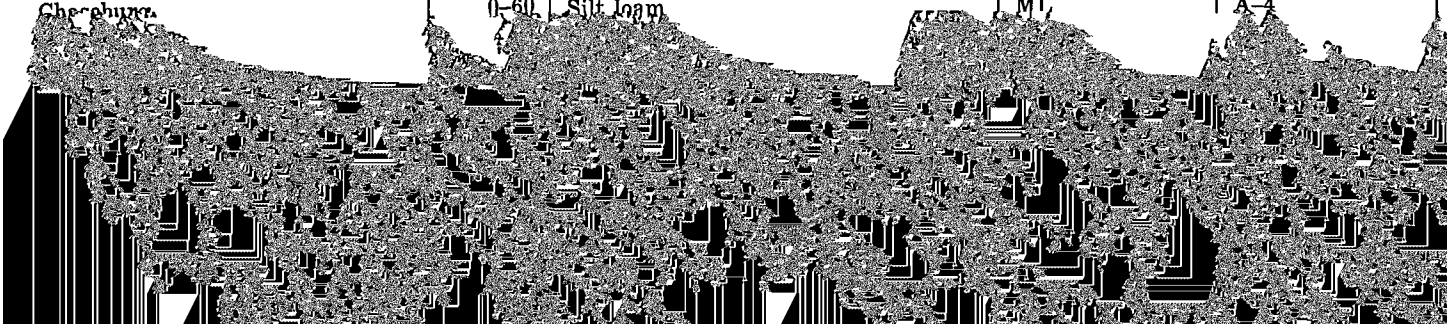
Permeability is estimated on the basis of known relationships between the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for water movement in a vertical direction when the soil is saturated. Not considered in the estimates are lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in the planning and design of drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil

TABLE 6.—*Engineering properties*

[The symbol < means less than; > means greater than.

Map symbol and soil name	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
27B:				
Terril	0–38	Loam	OL, CL	A–4, A–6
	38–60	Loam, clay loam	CL	A–4, A–6
41, 41B, 41C, 41D:				
Sparta	0–16	Loamy fine sand	SM, SP–SM	A–2
	16–60	Sand	SP	A–3
63C, 63E:				
Chelsea	0–5	Loamy fine sand	SM	A–2–4
	5–60	Fine sand	SP, SM	A–3, A–2–4
83B, 83C, 83C2:				
Kenyon	0–17	Loam	CL	A–6
	17–52	Loam, clay loam	CL	A–6
	52–60	Loam	CL	A–6
84:				
Clyde	0–17	Clay loam	OL, MH, CL	A–7
	17–29	Silty clay loam, clay loam	CL	A–6, A–7
	29–36	Sandy loam	SM, SM–SC	A–2
	36–60	Loam	CL, SC	A–6
98, 98B:				
Huntsville	0–30	Silt loam	CL, ML	A–6, A–4
	30–60	Silt loam	CL, ML	A–4, A–6
109B, 109C, 109D:				
Backbone	0–9	Fine sandy loam	SM, SM–SC	A–2, A–4
	9–24	Sandy loam	SM, SC	A–2, A–4
	24–30	Clay loam	CL	A–6, A–7
	30–34	Clay	CH	A–7
	34	Unweathered bedrock		
110B, 110C:				
Lamont	0–8	Fine sandy loam	SM–SC, SC	A–2, A–4
	8–30	Fine sandy loam, loam	SM–SC, SC	A–2, A–4
	30–65	Fine sand	SM, SP–SM	A–2, A–3
115F:				
Sandy escarpments	0–60	Variable		
135, C135:				
Coland	0–10	Clay loam	OL, CL	A–6, A–7
	10–49	Loam	CL, SC	A–6, A–4
	49–60	Loamy sand	SM	A–2
142B:				
Cheehuse	0–60	Silt loam	ML	A–4



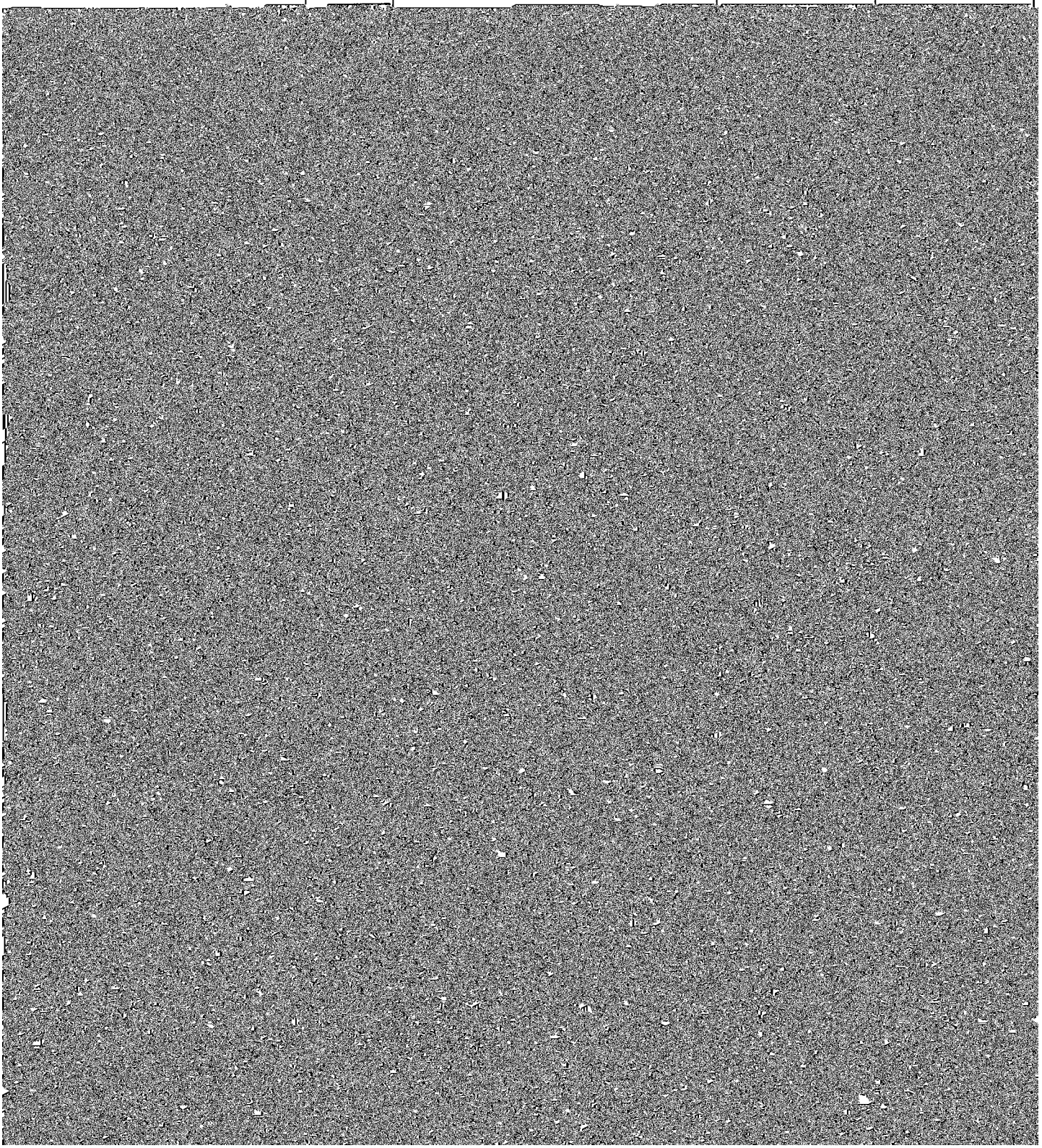
and classifications

Absence of an entry means data were not estimated]

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0–5	100	95–100	70–90	60–80	25–40	8–15
0–5	100	90–100	70–90	60–80	25–40	8–15
0	100	100	60–70	10–20	----------	[1] NP
0	100	100	65–75	1–5	----------	NP
0	100	100	65–80	10–35	----------	NP
0	100	100	65–80	3–15	----------	NP
0	100	95–100	85–95	65–75	30–40	10–20
0–5	90–95	85–95	80–90	50–65	30–40	10–20
0–5	90–95	85–95	80–90	50–65	25–35	10–20
0	100	100	80–90	55–75	45–60	15–25
0	95–100	90–95	75–90	50–75	30–50	10–20
0–5	80–95	75–90	50–80	15–35	15–20	NP–5
0–5	90–95	85–90	75–90	45–65	25–35	10–20
0	100	98–100	90–100	80–100	30–40	5–15
0	100	100	90–100	80–100	30–40	10–20
0	100	100	75–85	15–40	15–25	5–10
0–2	90–95	90–95	65–80	20–40	15–30	5–10
2–5	90–95	90–95	70–80	50–65	35–45	20–30
0–2	90–95	90–95	80–95	65–90	50–60	30–40
0	100	100	80–95	25–50	15–25	5–10
0	100	100	85–95	30–50	20–30	5–10
0	100	100	70–90	5–25	----------	NP
0	100	100	95–100	70–90	45–55	20–30
0	95–100	90–100	50–70	40–60	25–40	8–15
0	95–100	85–95	40–60	15–30	----------	NP
0	100	100	90–100	85–100	20–30	1–5
0	95–100	95–100	95–100	85–95	40–60	15–25
0	95–100	95–100	60–70	40–60	20–35	8–15
0–3	65–90	60–80	20–45	2–5	----------	NP
0	100	100	95–100	90–95	25–35	5–10
0	100	100	95–100	90–95	35–45	10–20
0	100	100	100	95–100	25–35	5–15
0	100	100	100	95–100	35–45	15–25
0	100	100	100	95–100	30–40	11–20

TABLE 6.—*Engineering properties*

Map symbol and soil name	Depth	USDA texture	Classification	
			Unified	AASHTO



and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	100	100	100	95–100	25–35	5–15
0	100	100	100	95–100	35–45	15–25
0	100	100	100	95–100	30–40	10–20
0	100	95–100	85–95	65–85	20–30	5–15
2–5	90–95	85–95	80–90	50–65	30–40	10–20
2–5	90–95	85–95	80–90	50–65	30–40	10–20
0	100	100	85–95	35–50	15–30	NP–10
0	100	100	80–95	5–20	10–30	NP–5
0	100	100	70–90	5–20		NP
0	100	90–100	70–90	50–75	25–35	10–15
0–5	85–95	80–95	70–85	36–60	20–30	5–15
2–10	50–90	50–85	20–40	3–25		NP
0	100	90–100	70–90	50–75	30–40	10–20
0–5	85–95	80–95	65–85	40–60	20–35	5–15
2–10	60–90	60–85	20–40	3–25		NP
0	100	100	100	95–100	25–35	5–15
0	100	100	100	95–100	35–45	15–25
2–10	85–95	80–90	70–85	65–85	50–70	30–45
0	100	95–100	90–100	80–95	25–35	5–15
0	95–100	90–100	90–100	60–90	30–40	10–20
0	100	90–95	65–85	35–50	20–35	5–15
0	100	100	80–90	55–75	45–60	15–20
2–8	90–95	70–80	50–70	50–65	25–35	5–15
2–5	90–95	70–80	50–70	15–35		NP
2–5	90–95	85–95	70–85	50–65	25–35	5–20
0	90–100	90–100	65–85	50–75	25–35	5–15
0	90–100	90–100	75–90	45–70	30–45	10–20
0–2	90–100	90–100	90–95	70–90	50–60	30–40
0						
0–10	65–90	65–90	60–70	55–65	20–30	5–15
10–40	40–60	35–55	30–50	25–35	20–30	2–10
10–45	20–40	20–40	20–30	20–30	30–40	8–20
0	95–100	85–95	40–90	15–65	<40	NP–20
0	100	90–100	70–90	55–75	35–45	10–25
0–5	85–95	80–95	70–85	45–65	25–40	10–20
2–10	50–90	50–85	20–40	3–10		NP
0	98–100	95–100	80–95	50–65	25–40	5–10
0	95–100	90–100	75–95	45–70	30–40	8–15
0	80–95	60–90	25–50	2–5		NP

TABLE 6.—*Engineering properties*

Map symbol and soil name	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
284, 284B, 284C: Flagler	0–20	Sandy loam	SC, SM–SC	A–2, A–4

and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	95–100	90–95	60–70	25–40	15–25	5–10
0	95–100	90–95	50–70	25–40	15–25	5–10
0–5	70–90	70–85	20–40	3–12		NP
0	95–100	95–100	60–70	30–40	<26	NP–4
0	75–85	60–85	20–35	1–5		NP
0	100	95–100	90–95	65–85	20–30	5–15
2–5	90–95	85–95	80–90	50–65	30–40	10–20
2–5	90–95	85–95	80–90	50–65	30–40	10–20
0	100	100	80–90	55–75	45–60	15–25
0	95–100	90–95	75–90	50–75	30–50	10–20
0–5	80–95	75–90	50–80	15–35	15–20	NP–5
0–5	90–95	85–90	75–90	45–65	25–35	10–20
0	100	100	80–90	55–75	45–60	15–20
2–8	90–95	70–80	50–70	50–65	25–35	5–15
2–5	90–95	70–80	50–70	15–35		NP
2–5	90–95	85–95	70–85	50–65	25–35	5–20
0	100	98–100	90–95	70–90	25–40	5–15
0–2	95–100	75–98	65–90	45–65	25–35	10–20
0–1	95–100	90–98	80–95	50–75	25–40	10–20
0	100	100	85–95	55–75	35–45	15–25
2–5	90–95	85–90	75–85	55–65	30–40	11–20
2–5	90–95	85–90	75–85	55–65	30–40	11–20
0	100	100	85–95	55–75	30–40	15–25
2–5	90–95	85–90	75–85	55–65	30–40	10–20
2–5	90–95	85–90	75–85	55–65	25–35	10–20
0	100	95–100	80–90	55–75	25–40	5–15
2–8	90–95	70–80	50–70	20–60	20–30	5–10
2–5	90–95	85–95	70–85	50–65	25–40	10–20
0	100	95–100	85–95	30–50	20–30	5–10
2–5	90–95	85–95	80–90	45–65	25–35	10–20
0	100	100	80–95	35–50	15–30	5–10
2–5	90–95	85–95	80–90	55–65	25–35	11–20
0	100	100	90–95	50–65	40–55	10–15
2–5	95–100	90–95	55–75	35–50	15–25	5–10
0	100	100	95–100	80–95	40–55	20–30

TABLE 6.—*Engineering properties*

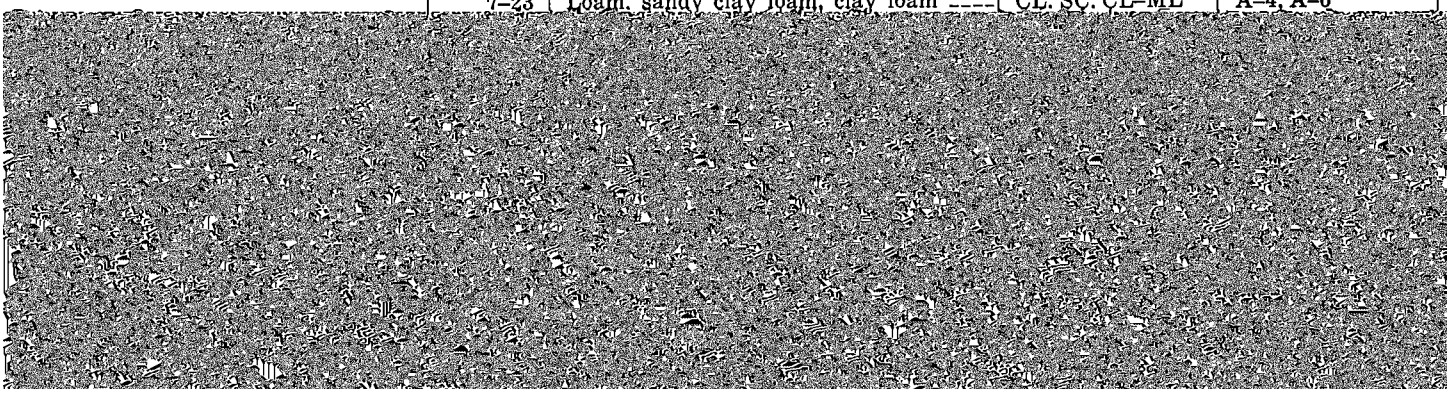
Map symbol and soil name	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
471:				
Oran	0–18	Loam	CL, CL–ML	A–4, A–6
	18–58	Loam, clay loam	CL	A–6
	58–74	Loam	CL	A–6
478G:				
Rock outcrop part				
Nordness part	0–11	Silt loam	CL, CL–ML	A–4
	11–16	Silty clay loam, clay, silty clay	CL, CH	A–7
	16	Unweathered bedrock		
480C, 480D2, 480E2:				
Orwood	0–8	Silt loam	ML, CL	A–4, A–6
	8–42	Silt loam, silty clay loam	CL	A–6
	42–60	Silt loam	CL	A–6
485:				
Spillville	0–54	Loam	CL, OL	A–6
	54–60	Sandy loam	SM	A–2
487B:				
Otter part	0–51	Silt loam	CL, ML	A–6, A–7

and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	100	100	85–95	55–75	25–35	5–15
2–5	90–95	85–90	75–85	55–65	30–40	10–20
2–5	90–95	85–90	75–85	55–65	30–40	10–20
0	100	100	90–100	70–90	20–30	5–10
2–10	85–95	80–90	70–85	65–85	45–65	30–40
0	100	100	90–100	80–90	30–40	8–15
0	100	100	85–95	60–80	30–40	10–20
0	100	100	85–95	70–90	30–40	10–20
0	100	95–100	85–95	60–80	25–40	10–20
0	95–100	85–95	40–60	15–30	NP	NP–20
0	100	98–100	90–100	80–100	30–50	10–20
0	100	95–100	90–100	80–100	30–50	10–20
0	100	98–100	90–100	80–100	36–50	10–25
0	100	100	90–100	80–100	20–40	10–20

TABLE 6.—*Engineering properties*

Map symbol and soil name	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
497G—Con.				
Jacwin part	0–24	Loam	OL, ML, OH	A–7, A–6
	24–31	Loam, sandy loam	SC, SM–SC	A–4
	31–38	Silty clay, clay	CL, CH	A–7
	38	Weathered bedrock		
499B, 499D, 499F:				
Nordness	0–11	Silt loam	CL, CL–ML	A–4
	11–16	Silty clay loam, clay, silty clay	CH	A–7
	16	Unweathered bedrock		
512B, 512D:				
Marlean	0–15	Loam	CL, CL–ML	A–4, A–6
	15–52	Fragmental material	GP, GP–GM	A–1
	52	Unweathered bedrock		
536:				
Hanlon	0–65	Fine sandy loam	SM–SC, SC	A–4
	65–72	Loamy fine sand	SM, SM–SC	A–2, A–4
551:				
Calamine	0–17	Silty clay loam	CL	A–6
	17–29	Silty clay loam	CL	A–6
	29–40	Silty clay	CH	A–7
	40–60	Weathered bedrock	CH	A–7
620B:				
Port Byron	0–15	Silt loam	CL	A–4, A–6
	15–60	Silt loam	CL	A–4, A–6
714, 714B, 714C, 714D:				
Winneshiek	0–11	Loam	CL, CL–ML	A–4, A–6
	11–18	Clay loam	CL	A–6
	18–24	Clay, silty clay	CH	A–7
	24	Unweathered bedrock		
725:				
Hayfield	0–8	Loam	ML, CL	A–6
	8–28	Loam, silt loam	ML, CL	A–4, A–6
	28–60	Coarse sand, gravelly loamy sand, loamy sand.	SM, SP–SM	A–1, A–2
763D2, 763E2, 763E3, 763F2, 763F3:				
Exette	0–6	Silt loam	ML, CL–ML	A–4
	6–33	Silt loam	ML, CL	A–6
	33–60	Silt loam	CL, ML	A–4, A–6
777, 777B, 777C:				
Wapsie	0–7	Loam	CL	A–4
	7–23	Loam, sandy clay loam, clay loam	CL, SC, CL–ML	A–4, A–6



and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	100	100	90–95	50–65	35–50	10–15
2–5	95–100	90–95	55–75	35–50	15–30	5–10
0	100	100	95–100	80–95	40–55	20–30
0	100	100	90–100	70–90	20–30	5–10
2–10	85–95	80–90	70–85	65–85	45–65	30–40
5–15	75–85	70–80	60–70	50–65	20–30	5–15
20–50	15–30	5–25	5–15	3–5		NP
0	100	100	75–80	35–50	20–30	5–10
0	100	100	75–80	25–40	10–20	2–5
0	100	100	95–100	90–100	40–50	20–30
0	100	100	95–100	90–100	40–50	20–30
0	100	100	95–100	90–100	50–60	25–35
0	100	100	95–100	90–100	50–60	25–35
0	100	100	100	95–100	25–40	7–18
0	100	100	100	95–100	25–40	7–18
0	100	95–100	85–95	55–70	20–30	5–15
2–5	90–95	80–95	80–90	50–65	25–40	11–20
2–10	85–95	80–95	80–90	70–90	55–70	30–45
0	100	100	90–98	70–90	30–40	10–20
0	98–100	95–100	70–90	65–80	25–40	5–15
0–3	85–100	75–98	20–45	5–25		NP
0	100	100	100	95–100	25–35	5–10
0	100	100	100	95–100	30–40	11–15
0	100	100	100	95–100	30–40	8–15
0	100	90–100	70–90	50–75	25–35	5–10
0	85–95	80–95	70–85	40–60	20–35	5–15
0	60–90	60–85	20–40	3–25		NP
0	100	100	90–95	65–80	35–45	11–20
0	100	95–100	80–90	50–70	30–40	11–20
2–5	90–95	85–95	80–90	55–70	35–40	15–25
2–5	90–95	85–95	80–90	55–70	35–40	15–25
0	100	100	85–95	65–80	30–40	5–20
0–5	95–100	90–95	80–90	60–75	35–50	15–30
0–5	95–100	90–95	80–90	60–75	55–70	30–40
2–5	95–100	85–95	80–90	55–75	35–45	15–25
0	100	100	90–100	70–80	35–50	10–20
2–5	95–100	85–95	80–90	55–70	35–40	15–25

TABLE 6.—*Engineering properties*

Map symbol and soil name	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
784B:				
Riceville	0–7	Loam	OL, ML, CL	A–6, A–7
	7–14	Loam, clay loam	CL	A–6
	14–60	Clay loam	CL	A–6
798B:				
Protivin	0–18	Loam	MH, OL, CL	A–7
	18–28	Loam	CL	A–6
	28–60	Clay loam	CL	A–6
926:				
Canoe	0–8	Silt loam	CL–ML, CL	A–4, A–6
	8–17	Silt loam	CL–ML, CL	A–4
	17–60	Silt loam	CL	A–6
977:				
Richwood	0–18	Silt loam	ML, CL–ML	A–4
	18–60	Silt loam, silty clay loam	CL	A–4, A–6
978:				
Festina	0–14	Silt loam	CL–ML, CL	A–4, A–6
	14–60	Silt loam, silty clay loam	CL	A–6

[1] NP means nonplastic.

horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops and ornamental or other plants to be grown, in evaluating soil amendments for fertility and stabilization, and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25° C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is largely affected by the quality of the irrigation water and the irrigation practices. Hence, the salinity of individual fields can differ greatly from the value given in table 7. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others it was estimated on the basis of the kind of clay and on measurements of similar soils. Size of imposed loadings and the magnitude of changes in soil moisture content are also important factors that influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A *high* shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion, as used in table 7, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rating of soils for corrosivity to concrete is based mainly on the sulfate content, soil texture, and acidity. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely within one kind of soil or within one soil horizon.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to pre-

and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	100	100	85–95	60–75	35–45	15–20
2–5	90–95	85–90	75–85	55–65	30–40	15–20
2–5	90–95	85–90	75–85	55–65	35–40	15–25
0	100	100	85–95	60–75	45–55	15–20
2–5	90–95	85–90	75–85	55–65	35–40	15–20
2–5	90–95	85–90	75–85	55–65	35–40	15–25
0	100	100	100	95–100	25–35	5–15
0	100	100	100	95–100	20–30	5–10
0	100	100	100	95–100	30–40	10–20
0	100	100	90–100	85–95	25–35	5–15
0	100	100	90–100	85–95	30–40	10–20
0	100	100	100	95–100	25–35	5–15
0	100	100	100	95–100	30–40	10–20

dict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbo-

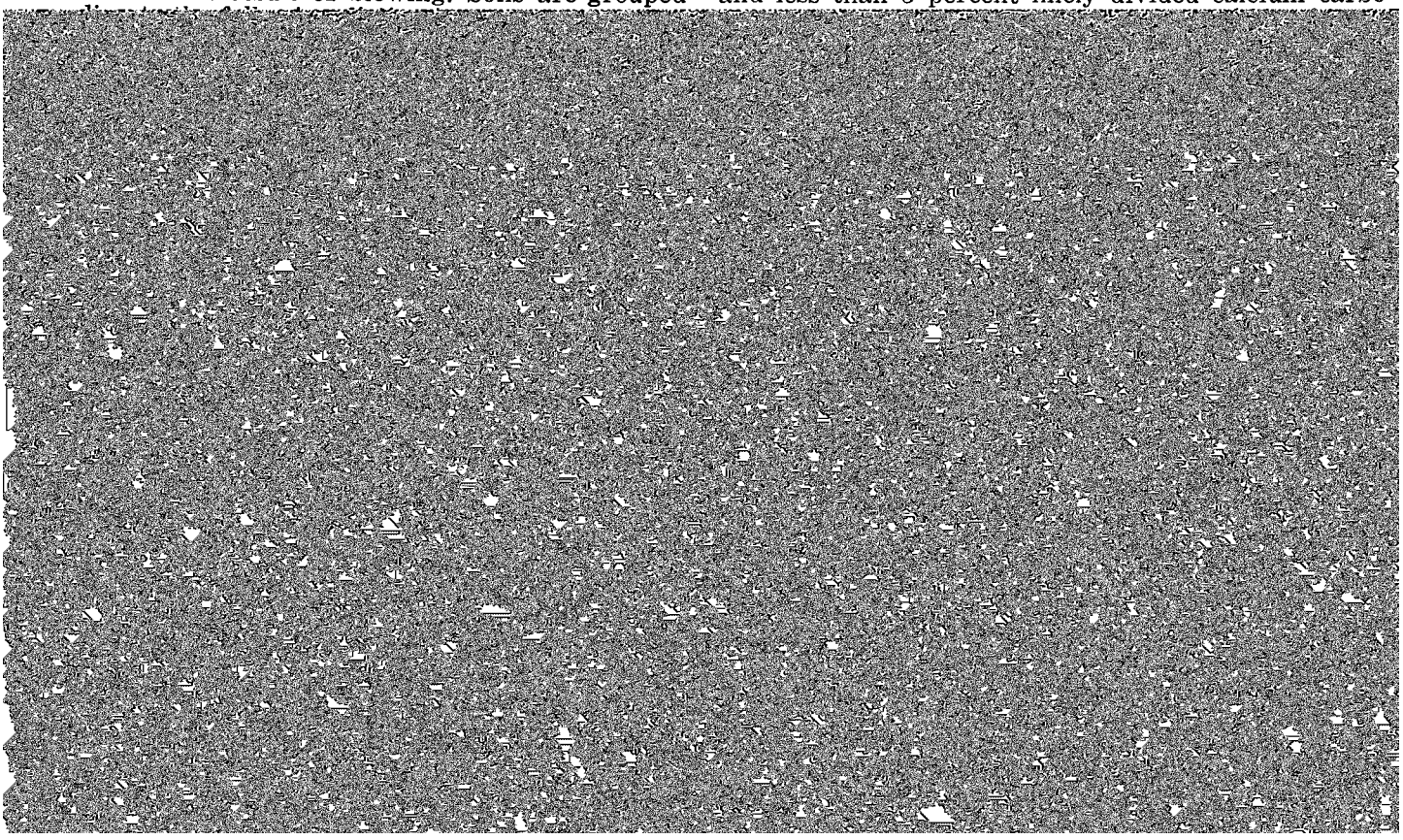


TABLE 7.—*Physical and chemical*

[Dashes indicate data were not available. The symbol < means less than; > means greater than. The

Map symbol and soil name	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
27B:				
Terril	0–38	0.6–2.0	0.20–0.22	6.1–7.3
	38–60	0.6–2.0	0.16–0.18	6.1–7.3
41, 41B, 41C, 41D:				
Sparta	0–16	6.0–20	0.06–0.08	5.6–6.0
	16–60	6.0–20	0.06–0.08	5.6–6.0
63C, 63E:				
Chelsea	0–5	6.0–20	0.10–0.15	6.1–6.5
	5–60	6.0–20	0.06–0.08	5.1–5.5
83B, 83C, 83C2:				
Kenyon	0–17	0.6–2.0	0.20–0.22	5.6–6.5
	17–52	0.2–0.6	0.17–0.19	5.1–7.3
	52–60	0.2–0.6	0.17–0.19	7.4–8.4
84:				
Clyde	0–17	0.6–2.0	0.21–0.23	6.6–7.3
	17–29	0.6–2.0	0.18–0.20	6.6–7.3
	29–36	2.0–6.0	0.11–0.13	6.6–7.3
	36–60	0.2–0.6	0.17–0.19	6.6–8.4
98, 98B:				
Huntsville	0–30	0.6–2.0	0.22–0.24	6.1–7.3
	30–60	0.6–2.0	0.20–0.22	6.1–7.8
109B, 109C, 109D:				
Backbone	0–9	2.0–6.0	0.12–0.14	6.6–7.3
	9–24	2.0–6.0	0.11–0.13	6.6–7.3
	24–30	0.2–0.6	0.14–0.16	5.1–7.3
	30–34	<0.06	0.11–0.14	5.1–5.5
	34			
110B, 110C:				
Lamont	0–8	2.0–6.0	0.16–0.18	5.1–7.3
	8–30	2.0–6.0	0.14–0.16	5.6–6.0
	30–65	>20	0.09–0.11	5.1–6.0
115F:				
Sandy escarpments	0–60			
135, C135:				
Coland	0–10	0.2–0.6	0.20–0.22	6.1–6.5
	10–49	0.2–0.6	0.20–0.22	6.1–6.5
	49–60	2.0–6.0	0.10–0.12	6.1–6.5
142B:				
Chaseburg	0–60	0.6–2.0	0.20–0.24	6.1–7.3
151, 152:				
Marshan	0–24	0.6–2.0	0.20–0.22	6.1–7.3
	24–30	0.6–2.0	0.20–0.22	6.1–7.3
	30–60	6.0–20	0.02–0.05	6.1–7.3
158, C158:				
Dorchester	0–38	0.6–2.0	0.20–0.22	7.9–8.4
	38–70	0.6–2.0	0.22–0.24	6.6–7.3
162B, 162C, 162C2, 162D, 162D2, 162E2:				
Downs	0–13	2.0–6.0	0.21–0.23	5.1–6.5
	13–30	0.6–2.0	0.18–0.20	5.1–5.5
	30–60	0.6–2.0	0.18–0.20	5.6–6.0

properties of soils

erosion tolerance factor (T) is for the entire profile. Absence of an entry means data were not estimated]

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
		Uncoated steel	Concrete	K	T	
Mmhos/cm						
<2	Low	Moderate	Low	0.24	5	6
<2	Low	Moderate	Low	0.32		
<2	Low	Low	Low	0.17	5	2
<2	Low	Low	Low	0.17		
<2	Low	Low	Low	0.17	5	2
<2	Low	Low	Low	0.17		
<2	Low	Moderate	Moderate	0.28	5–4	6
<2	Low	Moderate	Moderate	0.28		
<2	Low	Moderate	Moderate	0.37		
<2	Moderate	High	Low			7
<2	Moderate	High	Low			
<2	Low	High	Low			
<2	Moderate	High	Low			
<2	Moderate	Low	Low			6
<2	Moderate	Low	Low			
<2	Low	Low	Low	0.24	4–3	3
<2	Low	Low	Low	0.24		
<2	Moderate	Low	Low	0.24		
	High	Low	Low	0.24		
<2	Very low	Low	Moderate	0.24	5–4	3
<2	Very low	Low	Moderate	0.24		
<2	Very low	Low	Moderate	0.17		
<2	High	High	Low			7
<2	High	High	Low			
<2	Low	High	Low			
<2	Low	Moderate	Low	0.37	5	5
<2	Moderate	High	Moderate			7
<2	Moderate	High	Moderate			
<2	Low	High	Low			
<2	Low	High	Low			6
<2	Moderate	High	Low			
<2	Low	Moderate	Moderate	0.32	5–4	6
<2	Moderate	Moderate	Moderate	0.43		
<2	Moderate	Moderate	Moderate	0.43		

TABLE 7.—*Physical and chemical*

Map symbol and soil name	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
163B, 163C, 163C2, 163D, 163D2, 163D3, 163E, 163E2, 163E3, 163F, 163F2, 163F3, 163G:				
Fayette	0–11	2.0–6.0	0.20–0.22	5.1–6.0
	11–47	0.6–2.0	0.18–0.20	4.5–5.5
	47–73	0.6–2.0	0.18–0.20	5.1–5.5
171B, 171C, 171C2, 171D2, 171E2:				
Bassett	0–14	0.6–2.0	0.19–0.21	5.1–6.5
	14–51	0.2–0.6	0.17–0.19	4.5–5.5
	51–60	0.2–0.6	0.17–0.19	5.1–7.8
175B, 175C, 175D:				
Dickinson	0–20	2.0–6.0	0.12–0.15	5.6–6.5
	20–35	6.0–20	0.08–0.10	5.6–6.5
	35–60	6.0–20	0.02–0.04	5.6–6.5
177, 177B, 177C:				
Saude	0–18	0.6–2.0	0.20–0.22	5.6–6.5
	18–32	0.6–6.0	0.15–0.19	5.6–6.0
	32–60	>20	0.02–0.06	5.1–6.0
178, 178B:				
Waukee	0–21	0.6–2.0	0.20–0.22	5.6–6.5
	21–37	0.6–2.0	0.15–0.19	5.6–6.0
	37–60	>20	0.02–0.06	5.6–6.0
183C, 183D2, 183E, 183E2, 183F:				
Dubuque	0–12	0.6–2.0	0.20–0.22	5.6–6.5
	12–20	0.6–2.0	0.18–0.20	5.6–6.0
	20–25	0.06–0.2	0.12–0.15	5.6–6.0
	25			
193:				
Camden	0–15	0.6–2.0	0.22–0.24	5.1–6.0
	15–40	0.6–2.0	0.16–0.20	5.1–6.0
	40–60	0.6–6.0	0.12–0.18	5.6–7.3
198B:				
Floyd	0–19	0.6–2.0	0.20–0.22	6.6–7.3
	19–27	0.6–2.0	0.11–0.18	6.6–7.3
	27–32	2.0–6.0	0.11–0.13	6.6–7.3
	32–60	0.2–0.6	0.16–0.18	6.6–7.8
213, 213B, 214, 214B, 214C:				
Rockton	0–17	0.6–2.0	0.20–0.22	5.1–6.5
	17–31	0.6–2.0	0.17–0.19	5.1–6.5
	31–33	0.06–0.2	0.10–0.14	5.6–7.3
	33			
215E:				
Goss	0–6	2.0–6.0	0.06–0.17	5.1–6.0
	6–13	2.0–6.0	0.06–0.10	5.1–6.0
	13–70	0.6–2.0	0.04–0.09	5.1–6.0
221:				
Palms	0–28	0.2–6.0	0.35–0.45	5.1–7.8
	28–60	0.2–6.0	0.05–0.19	6.1–8.4
225, 226:				
Lawler	0–20	0.6–2.0	0.20–0.22	5.6–6.0
	20–30	0.6–2.0	0.16–0.18	5.6–6.5
	30–60	6.0–20	0.02–0.04	6.1–6.5
265, 265B:				
Bixby	0–9	0.6–2.0	0.16–0.19	5.6–6.5
	9–30	0.6–2.0	0.14–0.18	4.5–6.0
	30–60	6.0–20	0.02–0.04	6.1–7.8

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
		Uncoated steel	Concrete	K	T	
Mmhos/cm						
<2	Low	Moderate	Moderate	0.37	5–4	6
<2	Moderate	Moderate	Moderate	0.37		
<2	Moderate	Moderate	Moderate	0.37		
<2	Low	Moderate	Moderate	0.28	5–4	6
<2	Low	Moderate	Moderate	0.28		
<2	Low	Moderate	Moderate	0.37		
<2	Low	Low	Moderate	0.20	4–3	3
<2	Low	Low	Moderate	0.20		
<2	Low	Low	Moderate	0.15		
<2	Low	Low	Moderate	0.28	4–3	5
<2	Low	Low	Moderate	0.28		
<2	Very low	Low	Moderate	0.10		
<2	Low	Low	Moderate	0.24	4–3	6
<2	Low	Low	Moderate	0.32		
<2	Very low	Low	Moderate	0.10		
<2	Low	Moderate	Moderate	0.37	4–3	6
<2	Moderate	Moderate	Moderate	0.37		
<2	Moderate	Moderate	Moderate	0.37		
<2	Low	Low	Moderate	0.37	5–4	6
<2	Moderate	Low	Moderate	0.37		
<2	Low	Low	Low	0.37		
<2	Moderate	High	Low	0.24	5	6
<2	Low	High	Low	0.32		
<2	Low	High	Low	0.32		
<2	Low	High	Low	0.32		
<2	Low	Low	Low	0.28	4–3	6
<2	Moderate	Low	Low	0.28		
<2	High	Low	Low	0.28		
<2	Low	Low	Moderate	0.24	2	7
<2	Low	Low	Moderate	0.24		
<2	Moderate	Low	Moderate	0.24		
<2		High	Moderate			8

TABLE 7.—*Physical and chemical*

Map symbol and soil name	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
284, 284B, 284C:				
Flagler	0–20	2.0–6.0	0.12–0.14	6.1–7.3
	20–28	2.0–6.0	0.11–0.13	5.1–6.5
	28–60	>20	0.02–0.04	5.1–7.3
285, 285B, 285C2, 285E2:				
Burkhardt	0–15	2.0–6.0	0.13–0.15	5.1–6.5
	15–60	6.0–20	0.02–0.04	5.6–6.0
302B, 302C:				
Coggon	0–16	0.6–2.0	0.18–0.20	5.1–6.5
	16–38	0.2–0.6	0.17–0.19	5.1–5.5
	38–60	0.2–0.6	0.17–0.19	5.1–7.8
315:				
Tarpon alluvial land	0–60			

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
		Uncoated steel	Concrete	K	T	
Mmhos/cm						
<2	Low	Moderate	Low	0.20	4–3	3
<2	Low	Moderate	Low	0.20		

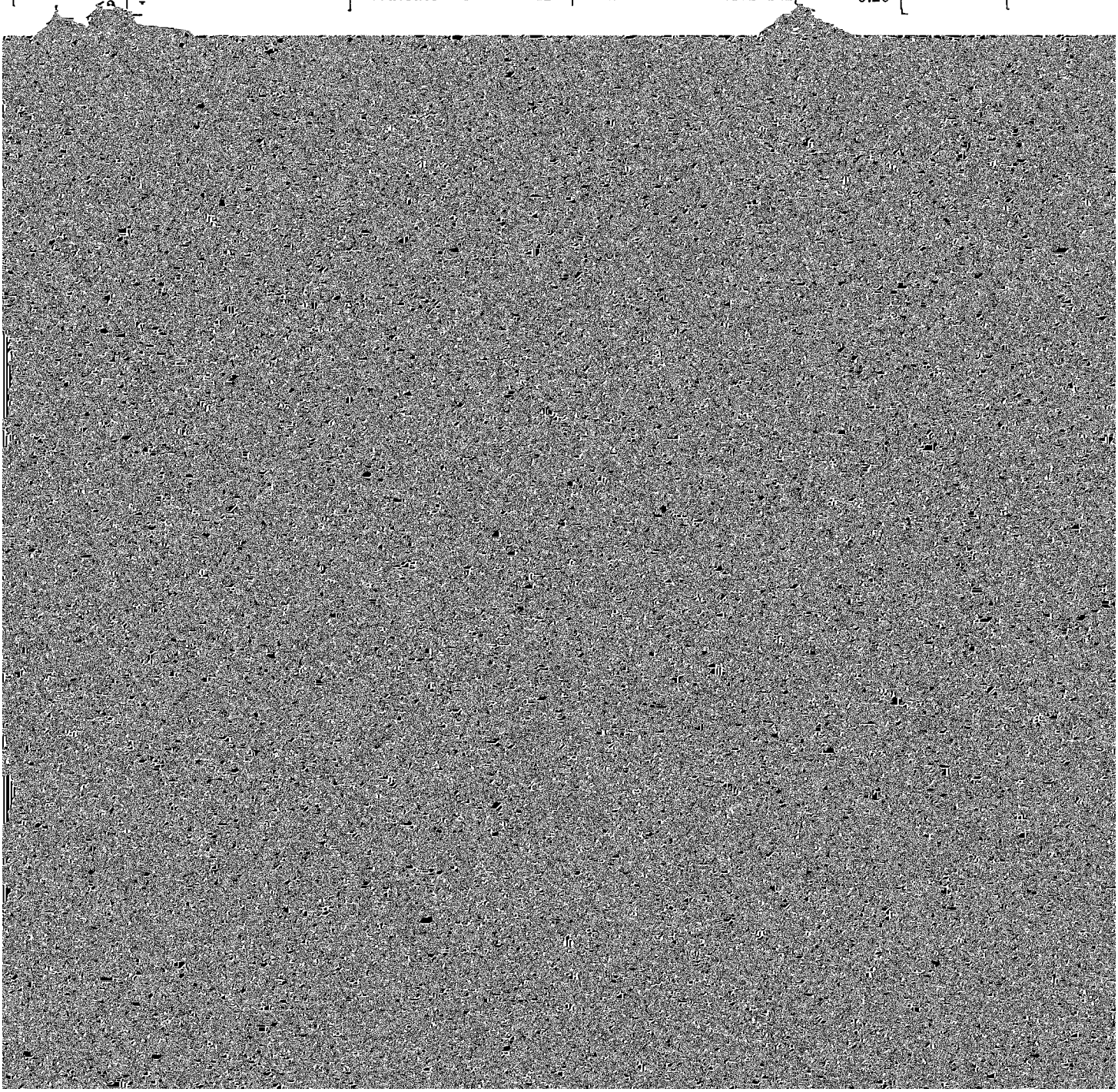


TABLE 7.—*Physical and chemical*

Map symbol and soil name	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
478G:				
Rock outcrop part.				
Nordness part	0–11	0.6–2.0	0.20–0.22	5.6–7.3
	11–16	0.06–0.2	0.12–0.15	6.6–7.3
	16			
480C, 480D2, 480E2:				
Orwood	0–8	0.6–2.0	0.20–0.22	6.6–7.3
	8–42	0.6–2.0	0.18–0.22	5.1–7.3
	42–60	0.6–2.0	0.20–0.22	5.6–7.3
485:				
Spillville	0–54	0.6–2.0	0.19–0.21	6.1–7.3
	54–60	2.0–6.0	0.08–0.10	6.1–7.3
487B:				
Otter part	0–51	0.6–2.0	0.22–0.24	6.1–7.8
	51–60	0.6–2.0	0.12–0.21	6.6–8.4
Huntsville part	0–30	0.6–2.0	0.22–0.24	6.1–7.3
	30–60	0.6–2.0	0.20–0.22	6.1–7.8
489:				
Ossian	0–18	0.6–2.0	0.22–0.24	6.6–7.3
	18–60	0.6–2.0	0.20–0.22	6.6–7.8
490:				
Caneek	0–23	0.6–2.0	0.20–0.22	7.9–8.4
	23–60	0.6–2.0	0.22–0.24	6.6–7.3
496B:				
Dorchester part	0–38	0.6–2.0	0.20–0.22	7.9–8.4
	38–70	0.6–2.0	0.22–0.24	6.6–7.3
Volney part	0–30	2.0–6.0	0.20–0.22	7.9–8.4
	30–50	>20	0.02–0.04	7.9–8.4
497F:				
Fayette part	0–11	2.0–6.0	0.20–0.22	5.1–6.0
	11–47	0.6–2.0	0.18–0.20	4.5–5.5
	47–73	0.6–2.0	0.18–0.20	5.1–5.5
Dubuque part	0–12	0.6–2.0	0.20–0.22	5.6–6.5
	12–20	0.6–2.0	0.18–0.20	5.6–6.0
	20–25	0.06–0.2	0.12–0.15	5.6–6.0
	25			
Jacwin part	0–24	0.6–2.0	0.20–0.22	6.6–7.3
	24–31	0.6–2.0	0.17–0.19	6.6–7.3
	31–38	<0.06	0.12–0.14	7.4–8.4
	38			
497G:				
Fayette part	0–11	2.0–6.0	0.20–0.22	5.1–6.0
	11–47	0.6–2.0	0.18–0.20	4.5–5.5
	47–73	0.6–2.0	0.18–0.20	5.1–5.5
Dubuque part	0–12	0.6–2.0	0.20–0.22	5.6–6.5
	12–20	0.6–2.0	0.18–0.20	5.6–6.0
	20–25	0.06–0.2	0.12–0.15	5.6–6.0
	25			
Jacwin part	0–24	0.6–2.0	0.20–0.22	6.6–7.3
	24–31	0.6–2.0	0.17–0.19	6.6–7.3
	31–38	<0.06	0.12–0.14	7.4–8.4
	38			

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
		Uncoated steel	Concrete	K	T	
Mmhos/cm						
<2	Moderate	Low	Low	0.43	2–1	6
<2	High	Low	Low	0.43		
<2	Low	Low	Moderate	0.32	5–4	5
<2	Moderate	Low	Moderate	0.43		
<2	Moderate	Low	Moderate	0.43		

TABLE 7.—*Physical and chemical*

Map symbol and soil name	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
499B, 499D, 499F:				
Nordness	0–11	0.6–2.0	0.20–0.22	5.6–7.3
	11–16	0.06–0.2	0.12–0.15	6.6–7.3
	16			
512B, 512D:				
Marlean	0–15	0.6–2.0	0.17–0.19	6.1–7.3
	15–52	>20.0	0.02–0.06	7.4–7.8
	52			
536:				
Hanlon	0–65	2.0–6.0	0.16–0.18	6.6–7.3
	65–72	2.0–20	0.09–0.13	6.6–7.3
551:				
Calamine	0–17	0.6–2.0	0.18–0.23	6.1–7.8
	17–29	0.06–0.6	0.18–0.20	7.4–8.4
	29–40	<0.06	0.08–0.12	7.4–8.4
	40–60			
620B:				
Port Byron	0–15	0.6–2.0	0.22–0.24	5.6–7.3
	15–60	0.6–2.0	0.20–0.22	5.6–8.4
714, 714B, 714C, 714D:				
Winneshiek	0–11	0.6–2.0	0.19–0.21	5.6–7.3
	11–18	0.6–2.0	0.17–0.19	5.6–7.3
	18–24	0.06–0.2	0.12–0.15	5.6–7.3
	24			
725:				
Hayfield	0–8	0.6–2.0	0.20–0.24	5.6–6.5
	8–28	0.6–2.0	0.17–0.22	5.1–6.0
	28–60	6.0–20	0.02–0.04	5.6–7.8
763D2, 763E2, 763E3, 763F2, 763F3:				
Exette	0–6	0.6–2.0	0.21–0.23	6.6–7.3
	6–33	0.6–2.0	0.20–0.22	5.6–6.5
	33–60	0.6–2.0	0.20–0.22	6.6–7.8
777, 777B, 777C:				
Wapsie	0–7	0.6–2.0	0.18–0.20	5.6–6.0
	7–23	0.6–2.0	0.15–0.17	5.6–6.0
	23–60	>20.0	0.02–0.06	5.1–6.0
781B, 781C:				
Lourdes	0–8	0.6–2.0	0.18–0.20	5.6–6.0
	8–15	0.6–2.0	0.16–0.18	4.5–5.5
	15–44	0.06–0.2	0.15–0.17	4.5–6.5
	44–60	0.06–0.2	0.15–0.17	7.4–7.8
782, 782B, 782C:				
Donnan	0–13	0.6–2.0	0.20–0.22	5.1–7.3
	13–24	0.6–2.0	0.17–0.19	5.1–5.5
	24–48	<0.06	0.11–0.14	5.6–6.5
	48–60	0.2–0.6	0.17–0.19	5.6–6.5
783B, 783C:				
Cresco	0–17	0.6–2.0	0.20–0.22	5.1–6.5
	17–60	0.06–0.2	0.17–0.19	5.1–7.8
784B:				
Riceville	0–7	0.6–2.0	0.18–0.20	4.5–5.5
	7–14	0.2–0.6	0.17–0.19	4.5–5.0
	14–60	0.06–0.2	0.15–0.17	4.5–7.8

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
		Uncoated steel	Concrete	K	T	
Mmhos/cm						
<2	Moderate	Low	Low	0.43	2–1	6
<2	High	Low	Low	0.43		
<2	Low	Low	Low	0.24	2–1	6
<2	Very low	Low	Low			
<2	Low	Moderate	Low			3
<2	Low	Moderate	Low			
<2	Moderate	High	Low			8
<2	High	High	Moderate			
<2	High	High	Moderate			
<2	Low	Low	Moderate	0.32	5–4	6
<2	Low	Low	Moderate	0.43		
<2	Low	Moderate	Moderate	0.28	4–3	6
<2	Low	Moderate	Moderate	0.28		
<2	High	Moderate	Moderate	0.28		
<2	Moderate	Low	Moderate			6
<2	Moderate	Low	Moderate			
<2	Low	Low	Moderate			
<2	Moderate	Low	Low	0.37	5–4	6
<2	Moderate	Low	Low	0.37		
<2	Moderate	Low	Low	0.37		
<2	Low	Low	High	0.28	4–3	6

TABLE 7.—*Physical and chemical*

Map symbol and soil name	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
798B:				
Protivin	0–18	0.6–2.0	0.18–0.20	5.1–5.5
	18–28	0.2–0.6	0.17–0.19	5.1–6.0
	28–60	0.06–0.2	0.15–0.17	6.1–7.8
926:				
Canoe	0–8	0.6–2.0	0.22–0.24	5.6–6.5
	8–17	0.6–2.0	0.20–0.22	5.1–6.0
	17–60	0.6–2.0	0.20–0.22	5.1–6.5
977:				
Richwood	0–18	0.6–2.0	0.22–0.24	5.6–7.3
	18–60	0.6–2.0	0.18–0.22	5.6–7.3
978:				
Festina	0–14	0.6–2.0	0.22–0.24	5.6–6.0
	14–60	0.6–2.0	0.20–0.22	5.6–6.0

tion of each soil to historic floods. Most soils in low positions on the landscape where flooding is likely to occur are classified as fluvents at the suborder level or as fluventic subgroups. See the section "Formation and classification of the soils."

The generalized description of flood hazards is of value in land use planning and provides a valid basis for land use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

A high water table is the highest level of a saturated zone more than 6 inches thick in soils for a continuous period of more than 2 weeks during most years. The depth to a high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed during the course of the soil survey. Indicated are the depth to the high water table; the kind of water table, whether perched, artesian, or the upper part of the ground water table; and the months of the year that the high water commonly is present. Only those saturated zones above a depth of 5 or 6 feet are indicated.

Information about the high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not to construct basements and to determine how septic tank absorption fields and other underground installations will function. Also, a high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at depths of 5 to 6 feet or less. For many soils, limited ranges in depth to bedrock is a part of the definition of the soil series. The depths ping. The kind of bedrock and its relative hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200 horsepower tractor, but hard bedrock generally requires blasting.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action is defined as freezing temperatures in the soil and movement of soil moisture into the freezing zone, which causes the formation of ice lenses. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or sandy soils are the least susceptible.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that deal with the ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 9 shows the degree and kind of limitations of each soil for these uses and for use of the soil as daily cover for landfills.

If the degree of soil limitation is indicated by the rating *slight,* soils are favorable for the specified use and limitations are minor and easily overcome; if *moderate,* soil properties or site features are unfavor-

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
		Uncoated steel	Concrete	K	T	
Mmhos/cm						
<2	Moderate	High	Moderate	0.28	3–2	6
<2	Moderate	High	Moderate	0.28		
<2	Moderate	High	Moderate	0.37		
<2	Low	High	Moderate			6
<2	Low	High	Moderate			
<2	Moderate	High	Moderate			
<2	Low	Moderate	Moderate	0.32	5–4	5
<2	Low	Moderate	Moderate	0.43		
<2	Low	Moderate	Moderate	0.32	5	6
<2	Moderate	Moderate	Moderate	0.43		

soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance are required.

hold sewage while bacteria decompose the solid and liquid wastes. Lagoons have a nearly level flow area surrounded by cut slopes or embankments of com-

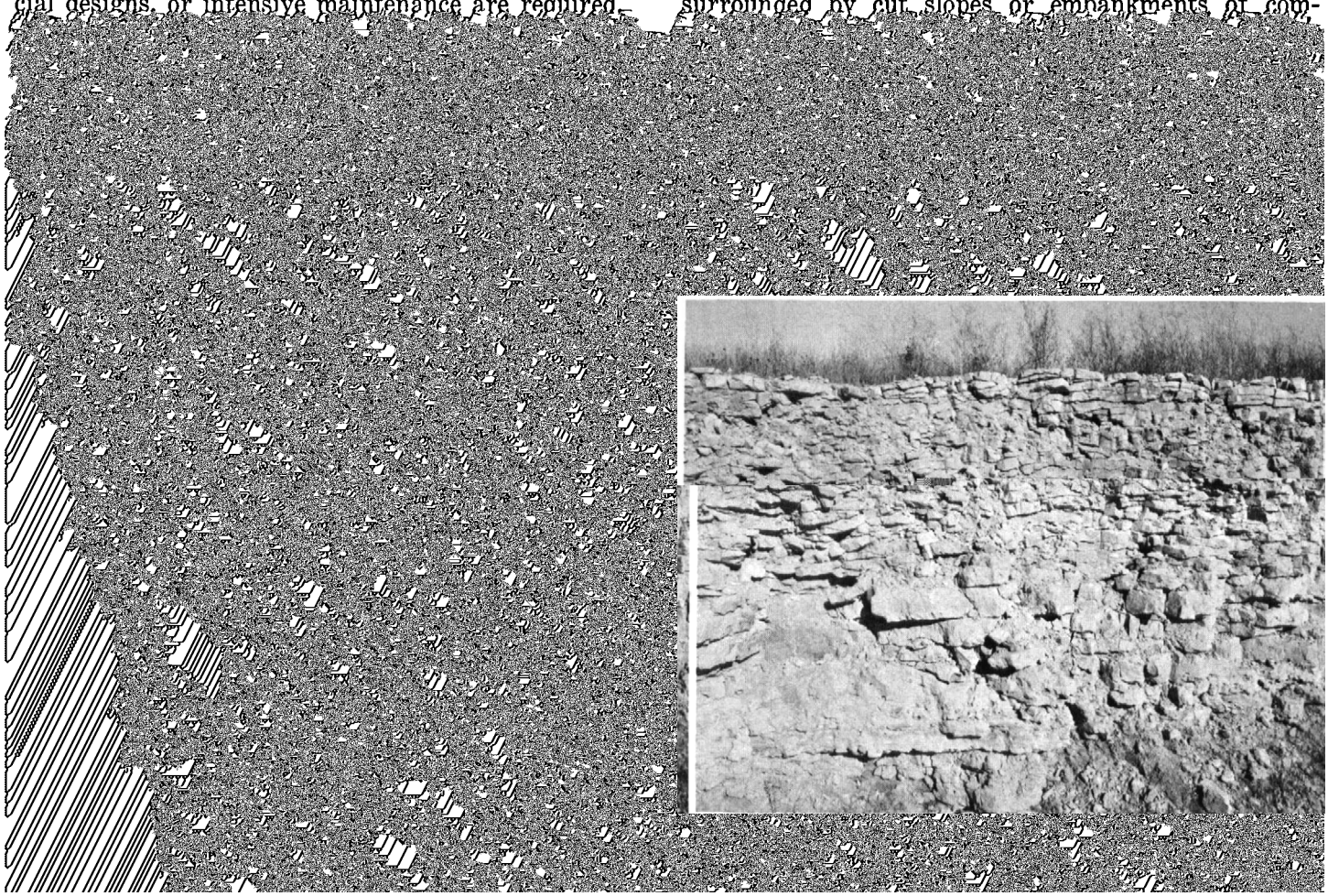


TABLE 8.—*Soil and*

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols

Map symbol and soil name	Hydrologic group	Flooding		
		Frequency	Duration	Months
27B: Terril	B	None		
41, 41B, 41C, 41D: Sparta	A	None		
63C, 63E: Chelsea	A	None		
83B, 83C, 83C2: Kenyon	B	None		
84: Clyde	B/D	Frequent	Very brief	Feb-Nov
98, 98B: Huntsville	B	Occasional	Very brief	Feb-Nov
109B, 109C, 109D: Backbone	B	None		
110B, 110C: Lamont	B	None		
115F: Sandy escarpments	A	None		
135, C135: Coland	B/D	Common	Brief	Feb-Nov
142B: Chaseburg	B	Frequent	Very brief	Feb-Nov
151, 152: Marshan	B/D	Rare to occasional	Very brief	Feb-Nov
158, C158: Dorchester	B	Frequent	Very brief	Feb-Nov
162B, 162C, 162C2, 162D, 162D2, 162E2: Downs	B	None		
163B, 163C, 163C2, 163D, 163D2, 163D3, 163E, 163E2, 163E3, 163F, 163F2, 163F3, 163G: Fayette	B	None		
171B, 171C, 171C2, 171D2, 171E2: Bassett	B	None		
175B, 175C, 175D: Dickinson	B	None		
177, 177B, 177C: Saude	B	None		
178, 178B: Waukee	B	None		
183C, 183D2, 183E, 183E2, 183F: Dubuque	B	None		
193: Camden	B	None		
198B: Floyd	B	None		

water features

and such terms as "rare," "brief," and "perched." The symbol < means less than; > means greater than]

High water table			Bedrock		Potential frost action
Depth	Kind	Months	Depth	Hardness	
Ft			*In*		
>6.0			>60		Moderate.
>6.0			>60		Low.
>6.0			>60		Low.
>6.0			>60		Moderate.
1.0–3.0	Apparent	Nov-Jun	>60		High.
>6.0			>60		High.
>6.0			20–40	Hard	Low.
>6.0			>60		Low.
>6.0			>60		Low.
1.0–3.0	Apparent	Nov-Jun	>60		High.
3.0–6.0	Apparent	Nov-Jun	>60		High.
1.0–3.0	Apparent	Nov-Jun	>60		High.
>6.0			>60		High.
>6.0			>60		High.
>6.0			>60		High.
>6.0			>60		Moderate.
>6.0			>60		Low.
>6.0			>60		Low.
>6.0			>60		Low.
>6.0			20–40	Hard	High.
>6.0			>60		High.
2.0–4.0	Apparent	Nov-Jun	>60		High.

TABLE 8.—*Soil and*

Map symbol and soil name	Hydrologic group	Flooding		
		Frequency	Duration	Months
213, 213B, 214, 214B, 214C: Rockton	B	None		
215E: Goss	B	None		
221: Palms	A/D	Rare		
225, 226: Lawler	B	None		
265, 265B: Bixby	B	None		
284, 284B, 284C: Flagler	B	None to rare		
285, 285B, 285C2, 285E2: Burkhardt	B	None		
302B, 302C: Coggon	B	None		
315: Loamy alluvial land	B	Frequent	Brief	Feb-Nov
354: Marsh		Frequent	Very long	Jan-Dec
391B: Clyde part	B/D	Frequent	Very brief	Feb-Nov
Floyd part	B	None		
394B, 394C, 394C2: Ostrander	B	None		
398: Tripoli	B/D	None		
399, 399B: Readlyn	B	None		
407B: Schley	B	None		
408B, 408C: Olin	B	None		
409B, 409C: Dickinson	A	None		
444B, 444C, 444D: Jacwin	B	None		
471: Oran	B	None		
478G: Rock outcrop part.				
Nordness part	B	None		
480C, 480D2, 480E2: Orwood	B	None		
485: Spillville	B	Common	Very brief	Feb-Nov

water features—Continued

High water table			Bedrock		Potential frost action
Depth	Kind	Months	Depth	Hardness	
Ft			*In*		
>6.0			20–40	Hard	Low.
>6.0			>60		Moderate.
0–1.0	Apparent	Jan-Dec	>60		High.
3.0–5.0	Apparent	Nov-Jun	>60		High.
>6.0			>60		Low.
>6.0			>60		Low.
>6.0			>60		Low.
>6.0			>60		Moderate.
0–4.0	Apparent	Nov-Jun	>60		Moderate.
0–1.0	Apparent	Jan-Dec	>60		
1.0–3.0	Apparent	Nov-Jun	>60		High.

TABLE 8.—*Soil and*

Map symbol and soil name	Hydrologic group	Flooding		
		Frequency	Duration	Months
487B:				
Otter part	B/D	Frequent	Very brief	Feb-Nov
Huntsville part	B	Occasional	Very brief	Feb-Nov
489:				
Ossian	B/D	Frequent	Very brief	Feb-Nov
490:				
Caneek	B	Frequent	Very brief	Feb-Nov
496B:				
Dorchester part	B	Frequent	Very brief	Feb-Nov
Volney part	B	Frequent	Very brief	Feb-Nov
497F:				
Fayette part	B	None		
Dubuque part	B	None		
Jacwin part	B	None		
497G:				
Fayette part	B	None		
Dubuque part	B	None		
Jacwin part	B	None		
499B, 499D, 499F:				
Nordness	B	None		
512B, 512D:				
Marlean	B	None		
536:				
Hanlon	B	Frequent	Very brief	Feb-Nov
551:				
Calamine	D	None		
620B:				
Port Byron	B	None		
714, 714B, 714C, 714D:				
Winneshiek	B	None		
725:				
Hayfield	B	None		
763D2, 763E2, 763E3, 763F2, 763F3:				
Exette	B	None		
777, 777B, 777C:				
Wapsie	B	None		
781B, 781C:				
Lourdes	C	None		
782, 782B, 782C:				
Donnan	C	None		
783B, 783C:				
Cresco	C	None		
784B:				
Riceville	C	None		

water features—Continued

High water table			Bedrock		Potential frost action
Depth	Kind	Months	Depth	Hardness	
Ft			*In*		
0–2.0	Apparent	Apr-Jun	>60		High.
>6.0			>60		High.
1.0–3.0	Apparent	Nov-Jun	>60		High.
1.0–3.0	Apparent	Nov-Jun	>60		High.
[illegible]			[illegible]		[illegible]

TABLE 8.—*Soil and*

Map symbol and soil name	Hydrologic group	Flooding		
		Frequency	Duration	Months
798B: Protivin	C	None		
926: Canoe	B	Rare		
977: Richwood	B	None		
978: Festina	B	None		

where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce its capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the location of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soils affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste, either in excavated trenches or on the surface of the soil. The waste is spread, compacted in layers, and covered with thin layers of soil. Landfill areas are subject to heavy vehicular traffic. Ease of excavation, risk of polluting ground water, and trafficability affect the suitability of a soil for this purpose. The best soils have a loamy or silty texture, have moderate or slow permeability, are deep to bedrock and a seasonal water table, are free of large stones and boulders, and are not subject to flooding. In areas where the seasonal water table is high, water seeps into the trenches and causes difficulty in excavating and filling the trenches. Also, seepage into the refuse increases the risk of pollution of ground water. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability that might plants. In comparison with other horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas, such as slope, erodibility, and potential for plant growth.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 10. A *slight* limitation indicates that soil properties are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized

water features—Continued

High water table			Bedrock		Potential frost action
Depth	Kind	Months	Depth	Hardness	
Ft			*In*		
2.0–4.0	Apparent	Nov-Jun	>60		High.
3.0–5.0	Apparent	Nov-Jun	>60		High.
>6.0			>60		High.
>6.0			>60		High.

Dwellings and small commercial buildings referred to in table 10 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence from settling or shear failure of the foundation do not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and the large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious limitation.

Local roads and streets referred to in table 10 have an all-weather surface that can carry light to medium traffic all year. They consist of subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The AASHTO and Unified classifications of the soil and soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones, all of which affect stability and ease of excavation, were also considered.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 11 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed and described as the survey is made, generally about 6 feet.

Roadfill is soil material used in embankments for roads. The ratings reflect the ease of excavating and working the material and the expected performance of the material after it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about soil properties that determine such performance is given in the descriptions of soil series.

The ratings apply to the soil profile between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within the profile. The estimated engineering properties in table 6 provide more specific information about the nature of each horizon that can help determine its suitability for roadfill.

Soils rated *good* have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as high shrink-swell potential, high potential frost action, steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor,* regardless of the quality of the suitable material.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 11 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of

TABLE 9.—*Sanitary facilities*

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. Absence of an entry means soil was not rated]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
27B: Terril	Slight	Moderate: seepage, excess humus.	Slight	Slight	Good.
41, 41B: Sparta	Slight[1]	Severe: seepage	Severe: seepage	Severe: seepage	Fair: too sandy.
41C: Sparta	Slight[1]	Severe: seepage	Severe: seepage	Severe: seepage	Fair: too sandy

TABLE 9.—*Sanitary facilities*—Continued

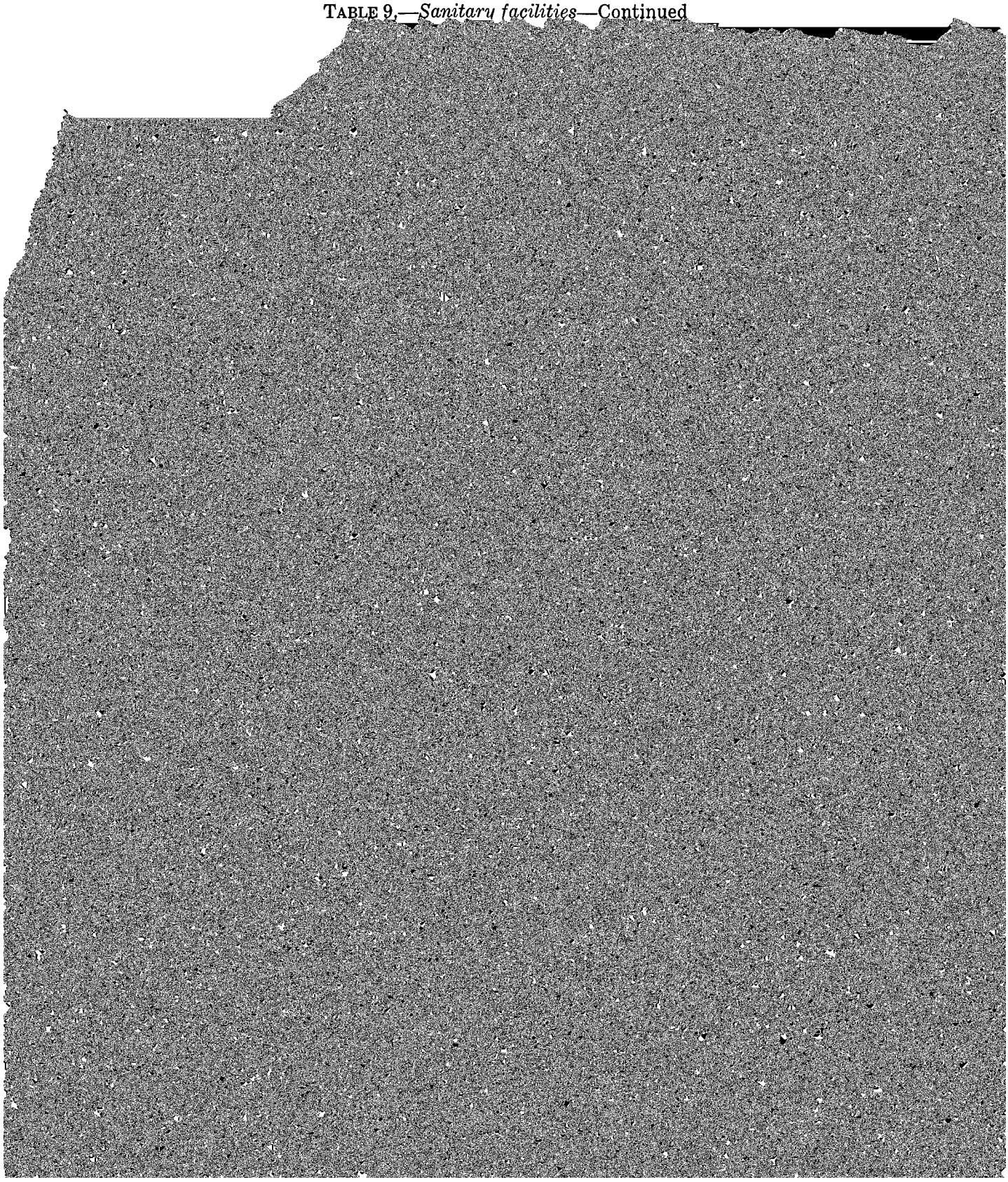


TABLE 9.—*Sanitary facilities*—Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
177, 177B: Saude	Slight[4]	Severe: seepage	Severe: seepage	Severe: seepage	Fair: thin layer.
177C: Saude	Slight[4]	Severe: seepage, slope.	Severe: seepage	Severe: seepage	Fair: thin layer.
178, 178B: Waukee	Slight[4]	Severe: seepage	Severe: seepage	Severe: seepage	Fair: thin layer.
183C, 183D2: Dubuque	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: seepage	Poor: area reclaim.
183E, 183E2, 183F: Dubuque	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: seepage, slope.	Poor: area reclaim, slope.
193: Camden	Slight	Severe: seepage	Severe: seepage	Slight	Good.
198B: Floyd	Severe: wetness	Moderate: slope, wetness, excess humus.	Severe: wetness	Moderate: wetness.	Good.
213, 213B, 214, 214B: Rockton	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: seepage	Fair: thin layer.
214C: Rockton	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: seepage	Fair: thin layer.
215E: Goss	Moderate: slope.	Severe: slope	Slight	Moderate: slope.	Poor: small stones, area reclaim.
221: Palms	Severe: wetness	Severe: wetness, excess humus, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: excess humus, hard to pack.
225, 226: Lawler	Severe: wetness	Severe: seepage	Severe: seepage, wetness.	Severe: seepage	Fair: thin layer.
265, 265B: Bixby	Slight[4]	Severe: seepage	Severe: seepage	Severe: seepage	Fair: thin layer.
284, 284B: Flagler	Slight[1]	Severe: seepage	Severe: seepage	Severe: seepage	Fair: thin layer.
284C: Flagler	Slight[1]	Severe: slope, seepage.	Severe: seepage	Severe: seepage	Fair: thin layer.
285, 285B: Burkhardt	Slight[1]	Severe: seepage	Severe: seepage	Severe: seepage	Poor: thin layer.
285C2: Burkhardt	Slight[1]	Severe: seepage, slope.	Severe: seepage	Severe: seepage	Poor: thin layer.
285E2: Burkhardt	Moderate: slope.[1]	Severe: seepage, slope.	Severe: seepage	Severe: seepage	Poor: thin layer.
302B: Coggon	Severe: percs slowly.[3]	Moderate: slope.	Slight	Slight	Good.

TABLE 9.—*Sanitary facilities*—Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
302C: Coggon	Severe: percs slowly.[a]	Severe: slope	Slight	Slight	Good.
315: Loamy alluvial land	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Poor: wetness.
354: Marsh	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness.

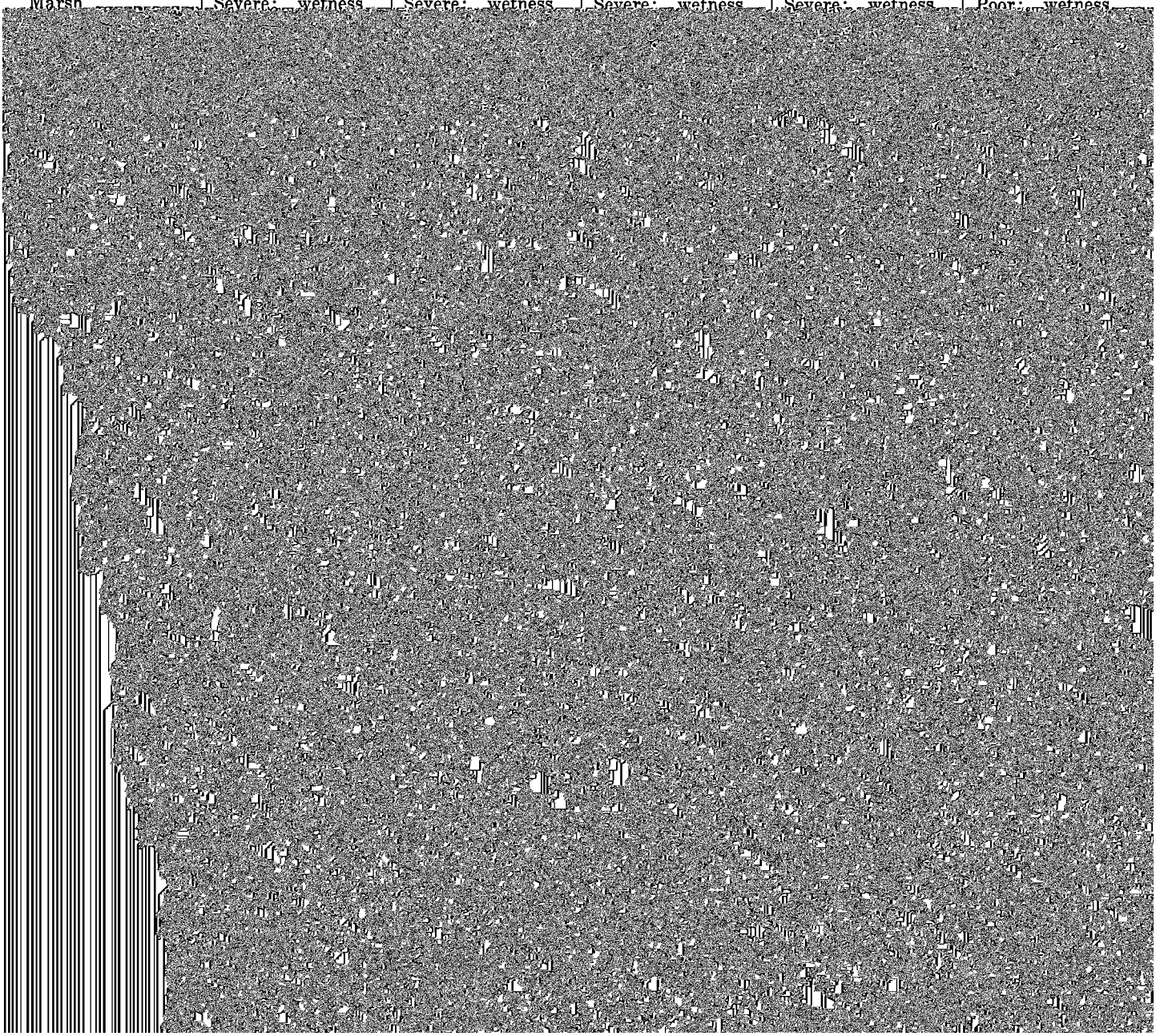


TABLE 9.—*Sanitary facilities*—Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
478G: Rock outcrop part					
Nordness part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: seepage, slope.	Poor: thin layer, area reclaim, slope.
480C: Orwood	Slight[3]	Severe: slope	Slight[3]	Slight[3]	Good.
480D2: Orwood	Moderate: slope.[3]	Severe: slope	Slight[3]	Moderate: slope.[3]	Fair: slope.
480E2: Orwood	Severe: slope[3]	Severe: slope	Moderate: slope.[3]	Severe: slope	Poor: slope.
485: Spillville	Severe: floods, wetness.	Severe: floods, wetness, excess humus.	Severe: floods, wetness.	Severe: floods, wetness.	Good.
487B: Otter part	Severe: wetness, floods.	Severe: floods	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Huntsville part	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Good.
489: Ossian	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
490: Caneek	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
496B: Dorchester part	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Good.
Volney part	Severe: floods, large stones.	Severe: floods, large stones, seepage.	Severe: floods, large stones, seepage.	Severe: floods, large stones.	Poor: large stones, area reclaim.
497F: Fayette part	Severe: slope	Severe: slope, seepage.	Moderate: slope.	Severe: slope	Poor: slope.
Dubuque part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: seepage, slope.	Poor: area reclaim, slope.
Jacwin part	Severe: wetness, percs slowly.	Severe: slope	Severe: wetness, too clayey.	Severe: wetness	Poor: area reclaim.
497G: Fayette part	Severe: slope	Severe: slope, seepage.	Severe: slope	Severe: slope	Poor: slope.
Dubuque part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: seepage, slope.	Poor: area reclaim, slope.
Jacwin part	Severe: wetness, percs slowly.	Severe: slope	Severe: wetness, too clayey.	Severe: wetness	Poor: area reclaim.
499B: Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: seepage	Poor: thin layer, area reclaim.
499D: Nordness	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: seepage	Poor: thin layer, area reclaim.

TABLE 9.—*Sanitary facilities*—Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
499F: Nordness	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: seepage, slope.	Poor: thin layer, area reclaim, slope.
512B: Marlean	Severe: large stones.	Severe: seepage, large stones.	Severe: seepage, large stones.	Severe: seepage	Poor: thin layer, small stones.
512D: Marlean	Severe: large stones.	Severe: slope, seepage, large stones.	Severe: seepage, large stones.	Severe: seepage	Poor: thin layer, small stones.
536: Hanlon	Severe: floods	Severe: floods, seepage.	Severe: floods, seepage.	Severe: floods, seepage.	Good.
551: Calamine	Severe: wetness, percs slowly.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness	Poor: wetness.
620B: Port Byron	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
714, 714B: Winneshiek	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: seepage	Poor: area reclaim, thin layer.
714C: Winneshiek	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: seepage	Poor: area reclaim, thin layer.
714D: Winneshiek	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: seepage	Poor: area reclaim, thin layer.
725: Hayfield	Severe: wetness	Severe: seepage	Severe: seepage	Moderate: wetness, seepage.	Fair: thin layer.
763D2: Exette	Moderate: slope.	Severe: slope	Slight	Moderate: slope.	Fair: slope.
763E2, 763E3, 763F2, 763F3: Exette	Severe: slope	Severe: slope	Moderate: slope.	Severe: slope	Poor: slope.
777, 777B:					

TABLE 9.—*Sanitary facilities*—Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
782: Donnan	Severe: percs slowly.	Slight	Severe: too clayey, wetness.	Moderate: wetness.	Poor: area reclaim, thin layer.
782B: Donnan	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, wetness.	Moderate: wetness.	Poor: area reclaim, thin layer.
782C: Donnan	Severe: percs slowly.	Severe: slope	Severe: too clayey, wetness.	Moderate: wetness.	Poor: area reclaim, thin layer.
783B: Cresco	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Fair: thin layer.
783C: Cresco	Severe: percs slowly.	Severe: slope	Slight	Slight	Fair: thin layer.
784B: Riceville	Severe: percs slowly, wetness.	Moderate: slope.	Severe: wetness	Moderate: wetness.	Fair: too clayey.
798B: Protivin	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey.
926: Canoe	Severe: wetness.[5]	Moderate: seepage, wetness.	Severe: wetness	Moderate: seepage, wetness.[5]	Good.
977: Richwood	Slight[5]	Severe: seepage	Severe: seepage	Slight[5]	Good.
978: Festina	Slight[5]	Moderate: seepage.	Slight	Slight[5]	Good.

[1] Excessive permeability may cause pollution of ground water.
[2] Perched water table is generally for short periods during extended wet periods and may not be continuous.
[3] Many areas are underlain by limestone bedrock at a depth of 6 to 10 feet. Seepage through fractures may cause pollution of ground water.
[4] Coarse material below a depth of 2 to 3 feet is poor filtering material and excessive permeability may cause pollution of ground water.
[5] Some areas may be underlain by sand and gravel at a depth below 6 feet.

the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 6.

naturally fertile or respond well to fertilization. They are not so wet that excavation is difficult during most of the year.

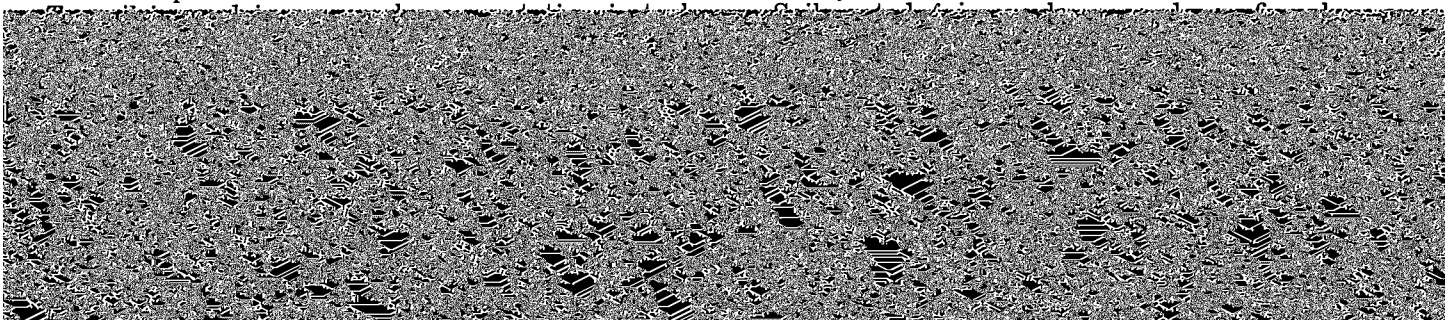


TABLE 10.—*Building site development*

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
27B: Terril	Moderate: wetness.[1]	Slight	Moderate: wetness.	Slight	Moderate: low strength, frost action.
41, 41B: Sparta	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
41C: Sparta	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
41D: Sparta	Severe: cutbanks cave.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
63C: Chelsea	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
63E: Chelsea	Severe: cutbanks cave, slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
83B: Kenyon	Moderate:	Moderate: low	Moderate:	Moderate: low	Moderate:

TABLE 10.—*Building site development*—Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
142B: Chaseburg	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods, frost action.
151, 152: Marshan	Severe: wetness, cutbanks cave.	Severe: wetness	Severe: wetness, cutbanks cave.	Severe: wetness	Severe: wetness, frost action.
158, C158: Dorchester	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods, low strength, frost action.
162B: Downs	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
162C, 162C2: Downs	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.
162D, 162D2: Downs	Moderate: slope	Moderate: slope, low strength, shrink-swell.	Moderate: slope, low strength, shrink-swell.	Severe: slope	Severe: frost action, low strength.
162E2: Downs	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope, frost action, low strength.
163B: Fayette	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
163C, 163C2: Fayette	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.
163D, 163D2, 163D3: Fayette	Moderate: slope	Moderate: slope, shrink-swell, low strength.	Moderate: slope, low strength, shrink-swell.	Severe: slope	Severe: frost action, low strength.
163E, 163E2, 163E3, 163F, 163F2, 163F3, 163G: Fayette	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: frost action, low strength, slope.
171B: Bassett	Moderate: wetness.[2]	Moderate: low strength.	Moderate: wetness.	Moderate: low strength.	Moderate: frost action, low strength.
171C, 171C2: Bassett	Moderate: wetness.[2]	Moderate: low strength.	Moderate: wetness.	Moderate: low strength.	Moderate: frost action, low strength.
171D2: Bassett	Moderate: slope, wetness.[2]	Moderate: slope, low strength.	Moderate: slope, wetness.	Severe: slope	Moderate: slope, frost action, low strength.

TABLE 10.—*Building site development*—Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
171E2: Bassett	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope, frost action, low strength.
175B: Dickinson	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
175C: Dickinson	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
175D: Dickinson	Severe: cutbanks cave.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
177, 177B: Saude	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
177C: Saude	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
178, 178B: Waukee	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
183C: Dubuque	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: low strength, frost action.
183D2: Dubuque	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: low strength, frost action.
183E, 183E2, 183F: Dubuque	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: low strength, frost action, slope.
193: Camden	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: frost action, low strength.
198B: Floyd	Severe: wetness	Moderate: wetness, low strength.	Severe: wetness	Moderate: wetness, low strength.	Severe: frost action, excess humus, low strength.
213, 213B, 214, 214B: Rockton	Severe: depth to rock.	Slight	Moderate: depth to rock.	Slight	Moderate: depth to rock.
214C: Rockton	Severe: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope	Moderate: depth to rock.
215E: Goss	Moderate: slope	Moderate: shrink-swell, slope.	Moderate: shrink-swell slope.	Severe: slope	Moderate: shrink-swell, frost action, slope.
221: Palms	Severe: wetness, excess humus, cutbanks cave.	Severe: wetness, frost action, excess humus.	Severe: wetness	Severe: wetness	Severe: wetness, frost action, low strength.

TABLE 10.—*Building site development*—Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets

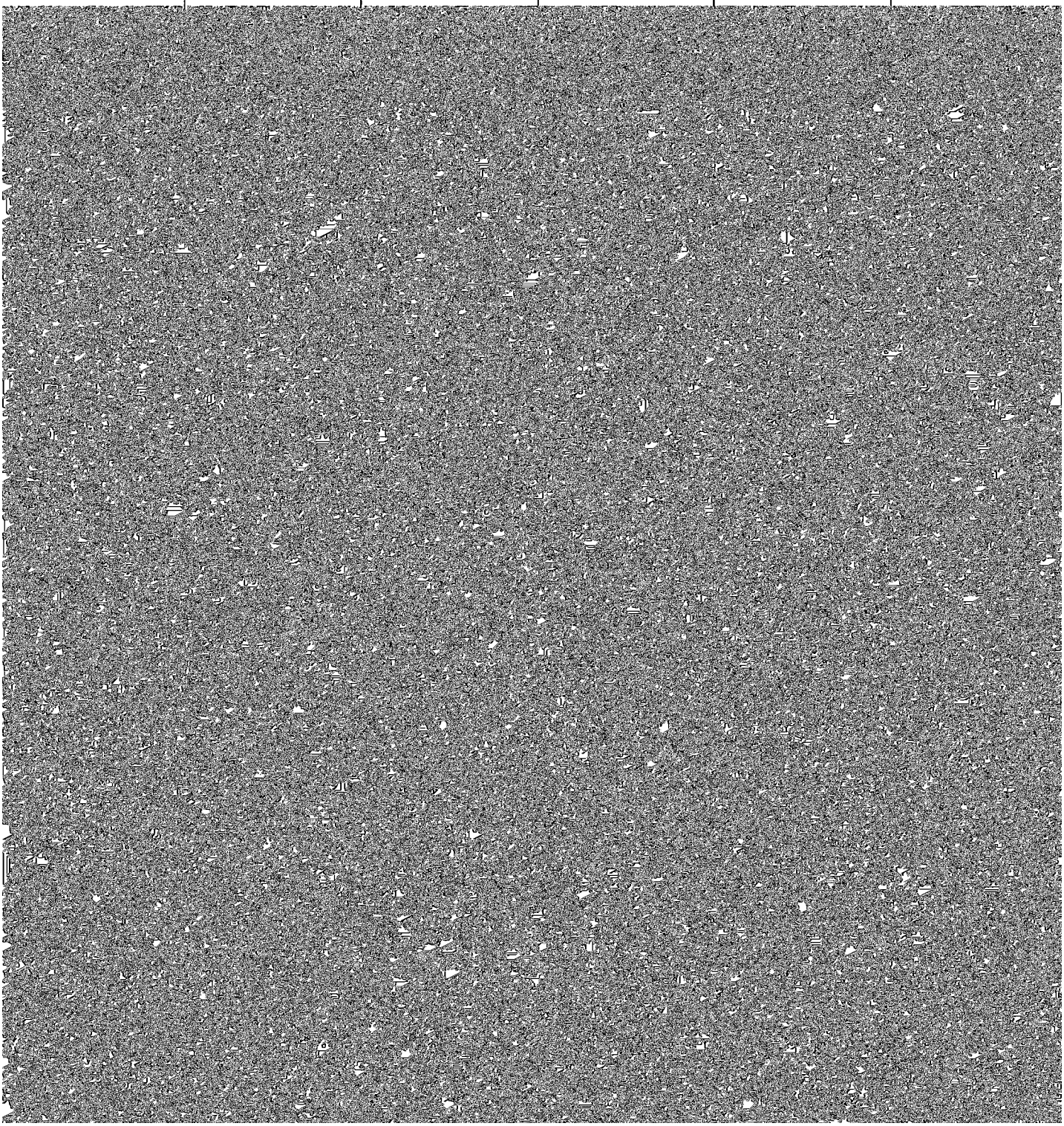


TABLE 10.—*Building site development*—Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
399, 399B: Readlyn	Moderate: wetness.	Moderate: wetness, low strength.	Severe: wetness	Moderate: wetness, low strength.	Severe: frost action.
407B: Schley	Severe: wetness, cutbanks cave.	Moderate: low strength.	Severe: wetness	Moderate: low strength.	Severe: frost action.
408B: Olin	Slight	Slight	Slight	Slight	Moderate: frost action, low strength.
408C: Olin	Slight	Slight	Slight	Moderate: slope	Moderate:

TABLE 10.—*Building site development*—Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
487B: Otter part	Severe: wetness, floods.	Severe: floods	Severe: floods	Severe: floods	Severe: wetness, floods, frost action.
Huntsville part	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods, frost action.
489: Ossian	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, frost action.
490: Caneek	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, frost action.
496B: Dorchester part	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods, low strength, frost action.
Volney part	Severe: floods, large stones.	Severe: floods, large stones.	Severe: floods, large stones.	Severe: floods, large stones.	Severe: floods, large stones.
497F: Fayette part	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: frost action, low strength, slope.
Dubuque part	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: low strength, frost action, slope.
Jacwin part	Severe: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: slope, shrink-swell.	Severe: shrink-swell, frost action, low strength.
497G: Fayette part	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: frost action, low strength, slope.
Dubuque part	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: low strength, frost action, slope.
Jacwin part	Severe: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: slope, shrink-swell.	Severe: shrink-swell, frost action, low strength.
499B: Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
499D: Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
499F: Nordness	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
512B: Marlean	Severe: small stones.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.
512D: Marlean	Severe: small stones.	Moderate: slope, depth to rock.	Moderate: slope, depth to rock.	Severe: slope	Moderate: slope, depth to rock.

TABLE 10.—*Building site development*—Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
536: Hanlon	Severe: floods, cutbanks cave.	Severe: floods	Severe: floods	Severe: floods	Severe: floods.
551: Calamine	Severe: wetness, too clayey.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.
620B: Port Byron	Slight	Slight	Slight	Slight	Severe: frost action.
714, 714B: Winneshiek	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.
714C: Winneshiek	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.
714D: Winneshiek	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Moderate: slope, depth to rock.
725: Hayfield	Severe: cutbanks	Severe: frost	Moderate:	Severe: frost	Severe: frost

TABLE 10.—*Building site development*—Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
784B: Riceville	Severe: wetness	Moderate: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.
798B: Protivin	Moderate: too clayey, wetness.	Moderate: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.
926: Canoe	Moderate:	Moderate:	Severe: wetness,	Moderate:	Severe: wetness.

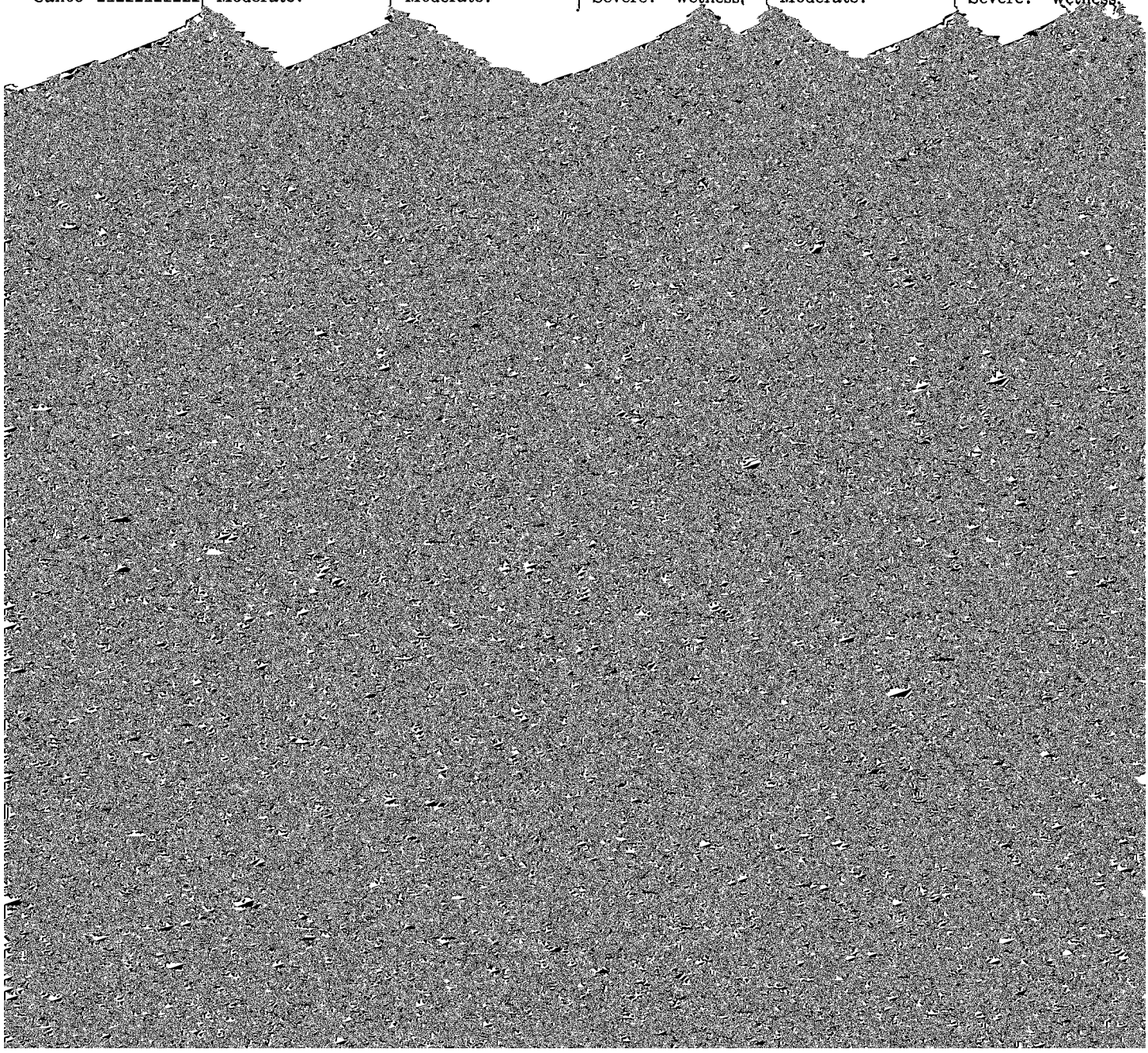


TABLE 11.—*Construction materials*

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
27B: Terril	Fair: low strength, frost action.	Unsuited	Unsuited	Good.
41, 41B, 41C, 41D: Sparta	Good	Good	Unsuited	Poor: too sandy.
63C: Chelsea	Good	Fair: excess fines	Unsuited	Poor: too sandy.
63E: Chelsea	Fair: slope	Fair: excess fines	Unsuited	Poor: too sandy, slope.
83B, 83C, 83C2: Kenyon	Fair: low strength, frost action.	Unsuited	Unsuited	Good.
84: Clyde	Poor: excess humus, frost action, wetness.	Unsuited	Unsuited	Poor: wetness.[1]
98, 98B: Huntsville	Poor: frost action	Unsuited	Unsuited	Good.
109B, 109C: Backbone	Poor: thin layer[2]	Unsuited	Unsuited	Good.[3]
109D: Backbone	Poor: thin layer[2]	Unsuited	Unsuited	Fair: slope.
110B: Lamont	Fair: low strength	Fair: excess fines	Unsuited	Good.[4]
110C: Lamont	Fair: low strength	Fair: excess fines	Unsuited	Fair: slope.
115F: Sandy escarpments	Fair: slope	Good	Fair: excess fines	Poor: slope, too sandy.

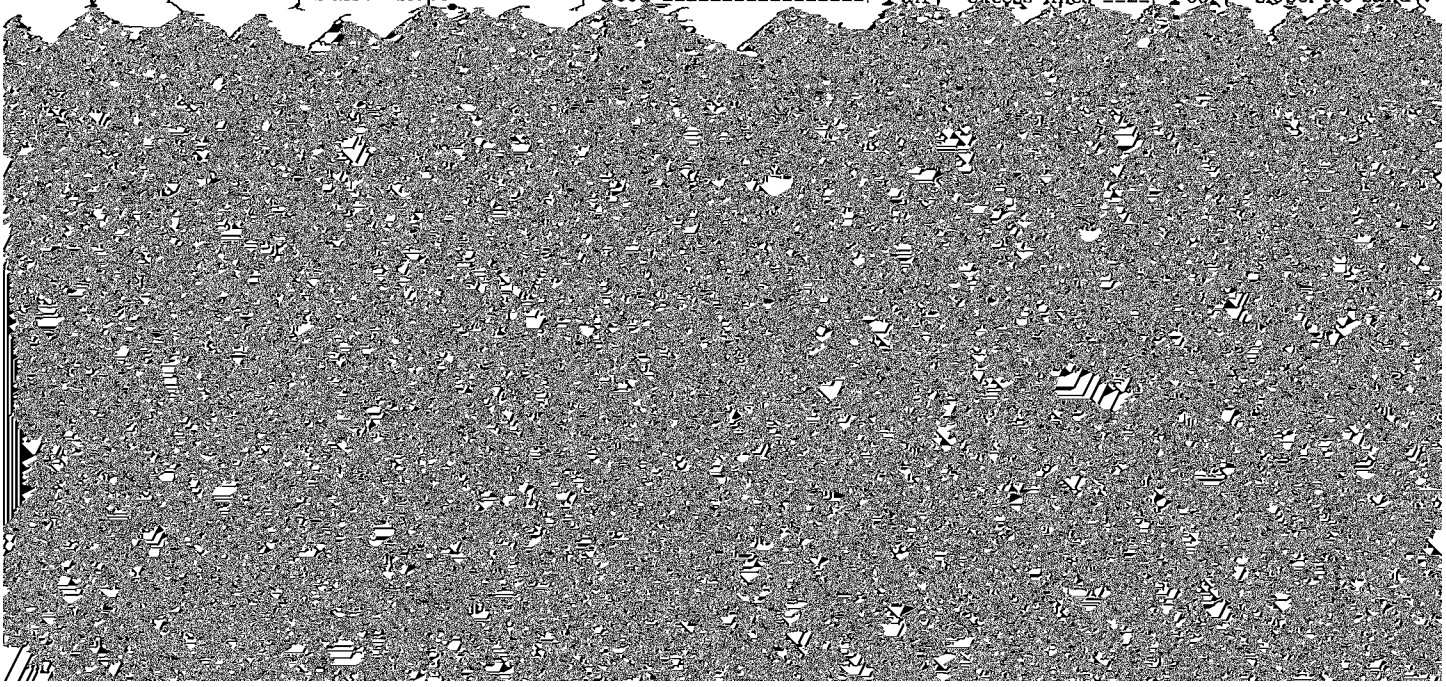


TABLE 11.—*Construction materials*—Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
163E, 163E2, 163E3, 163F, 163F2, 163F3: Fayette	Poor: low strength	Unsuited	Unsuited	Poor: slope.
163G: Fayette	Poor: low strength, slope.	Unsuited	Unsuited	Poor: slope.
171B, 171C, 171C2: Bassett	Fair: low strength, frost action.	Unsuited	Unsuited	Good.[3]
171D2: Bassett	Fair: low strength, frost action.	Unsuited	Unsuited	Fair: slope.
171E2: Bassett	Fair: slope, frost action, low strength.	Unsuited	Unsuited	Poor: slope.
175B, 175C: Dickinson	Good	Fair: excess fines	Unsuited	Good.
175D: Dickinson	Good	Fair: excess fines	Unsuited	Fair: slope.
177, 177B, 177C: Saude	Good	Good	Fair: excess fines	Good.
178, 178B: Waukee	Good	Good	Fair: excess fines	Good.
183C, 183D2: Dubuque	Poor: low strength, area reclaim.[2]	Unsuited	Unsuited	Poor: area reclaim.
183E, 183E2, 183F: Dubuque	Poor: low strength, area reclaim.[2]	Unsuited	Unsuited	Poor: area reclaim, slope.
193: Camden	Poor: frost action, low strength.	Unsuited: excess fines.	Unsuited	Fair: thin layer.
198B: [illegible]	[illegible]	[illegible]	Unsuited	Good

TABLE 11.—*Construction materials*—Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
302B, 302C: Coggon	Fair: low strength, frost action.	Unsuited	Unsuited	Good.[2]
315: Loamy alluvial land	Poor: wetness, frost action.	Fair	Fair	Good.
354: Marsh	Poor: wetness	Unsuited	Unsuited	Poor: wetness.
391B: Clyde part	Poor: excess humus, frost action, wetness.	Unsuited	Unsuited	Poor: wetness.[1]
Floyd part	Poor: excess humus, frost action, low strength.	Unsuited	Unsuited	Good.
394B, 394C, 394C2: Ostrander	Fair: frost action	Unsuited	Unsuited	Good.
398: Tripoli	Poor: wetness, frost action.	Unsuited	Unsuited	Poor: wetness.[1]
399, 399B: Readlyn	Poor: frost action	Unsuited	Unsuited	Good.
407B: Schley	Poor: frost action	Unsuited	Unsuited	Good.[3]
408B, 408C: Olin	Fair: low strength, frost action.	Poor: excess fines, thin layer.	Unsuited	Good.
409B, 409C: Dickinson	Good	Fair: excess fines	Unsuited	Good.
444B, 444C, 444D: Jacwin	Poor: shrink-swell, frost action, low strength.	Unsuited	Unsuited	Poor: area reclaim.
471: Oran	Poor: frost action	Unsuited	Unsuited	Good.[3]
478G: Rock outcrop part				
Nordness part	Poor: area reclaim, thin layer, slope.[3]	Unsuited	Unsuited	Poor: thin layer, area reclaim, slope.
480C: Orwood	Fair: low strength, frost action, shrink-swell.	Unsuited	Unsuited	Good.[3]
480D2: Orwood	Fair: low strength, frost action,	Unsuited	Unsuited	Fair: slope.

TABLE 11.—*Construction materials*—Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
487B:				
Otter part	Poor: frost action, wetness.	Unsuited	Unsuited	Poor: wetness.[1]
Huntsville part	Poor: frost action	Unsuited	Unsuited	Good.
489:				
Ossian	Poor: low strength, excess humus, frost action.	Unsuited	Unsuited	Good.
490:				
Caneek	Poor: low strength, frost action, wetness.	Unsuited	Unsuited	Poor: wetness, excess lime.
496B:				

TABLE 11.—*Construction materials*—Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
763D2: Exette	Poor: frost action	Unsuited	Unsuited	Fair: slope.[4]
763E2, 763E3, 763F2, 763F3: Exette	Poor: frost action	Unsuited	Unsuited	Poor: slope.
777, 777B, 777C: Wapsie	Good	Good	Fair: excess fines	Good.[3]
781B, 781C: Lourdes	Poor: frost action, low strength.	Unsuited	Unsuited	Fair: thin layer.
782, 782B, 782C: Donnan	Poor: wetness, shrink-swell, frost action.	Unsuited	Unsuited	Poor: area reclaim, thin layer, too clayey.
783B, 783C: Cresco	Fair: low strength, shrink-swell, frost action.	Unsuited	Unsuited	Fair: area reclaim.
784B: Riceville	Poor: frost action	Unsuited	Unsuited	Fair: thin layer, area

TABLE 12.—*Water management*

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry means soil was not evaluated]

Map symbol and soil name	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
27B: Terril	Seepage	Low strength, compressible.	Not needed	Slope	Favorable	Favorable.
41, 41B, 41C, 41D: Sparta	Seepage	Piping	Not needed	Seepage, droughty.	Too sandy	Droughty.
63C, 63E: Chelsea	Seepage	Piping, erodes easily, seepage.	Not needed	Droughty, erodes easily, seepage.	Complex slope, piping, too sandy.	Droughty, erodes easily, slope.
83B, 83C, 83C2: Kenyon	Favorable	Favorable	Not needed [1]	Slope	Favorable	Percs slowly, wetness.
84: Clyde	Favorable	Low strength, compressible, hard to pack.	Favorable	Wetness, floods.	Not needed	Wetness, large stones.
98, 98B: Huntsville	Seepage	Low strength, piping.	Not needed	Favorable	Not needed	Not needed.
109B, 109C, 109D: Backbone	Depth to rock, seepage.	Thin layer	Not needed	Seepage, fast intake, rooting depth.	Depth to rock	Droughty, rooting depth.
110B, 110C: Lamont	Seepage	Piping, erodes easily, seepage.	Not needed	Droughty, soil blowing, seepage.	Erodes easily, piping, too sandy.	Droughty, erodes easily.
115F: Sandy escarpments	Seepage	Seepage, erodes easily.	Not needed	Slope, seepage.	Slope, too sandy, piping.	Slope, rooting depth.
135, C135: Coland	Seepage	Compressible, low strength, excess humus.	Floods, wetness.	Wetness, floods.	Wetness	Wetness.
142B:						

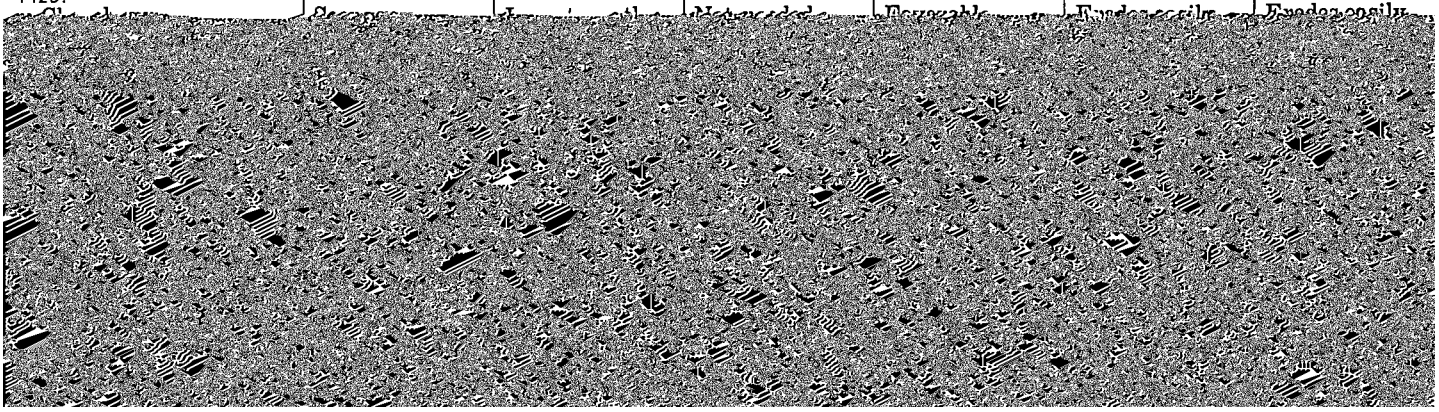


TABLE 12.—*Water management*—Continued

Map symbol and soil name	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
163B, 163C, 163C2, 163D, 163D2, 163D3, 163E, 163E2, 163E3, 163F, 163F2, 163F3, 163G: Fayette	Seepage, slope.	Compressible, low strength, erodes easily.	Not needed	Erodes easily, slope.	Complex slope, erodes easily, piping.	Favorable.
171B, 171C, 171C2, 171D2, 171E2: Bassett	Favorable	Low strength, compressible.	Not needed [1]	Slope	Percs slowly	Percs slowly, wetness.
175B, 175C, 175D: Dickinson	Seepage	Seepage, piping.	Not needed	Soil blowing, droughty, fast intake.	Too sandy, soil blowing, complex slope.	Droughty.
177, 177B, 177C: Saude	Seepage	Seepage, piping.	Not needed	Droughty	Complex slope, piping.	Droughty.
178, 178B: Waukee	Seepage	Piping, seepage.	Not needed	Favorable	Complex slope	Favorable.
183C, 183D2, 183E, 183E2, 183F: Dubuque	Depth to rock, slope.	Compressible, low strength.	Not needed	Erodes easily, slope, rooting depth.	Depth to rock, erodes easily, rooting depth.	Erodes easily, slope, rooting depth.
193: Camden	Seepage	Low strength, piping.	Not needed	Favorable	Favorable	Favorable.
198B: Floyd	Favorable	Low strength, piping.	Favorable	Wetness	Wetness, piping.	Wetness.
213, 213B, 214, 214B, 214C: Rockton	Depth to rock	Thin layer	Not needed	Rooting depth	Depth to rock	Depth to rock.
215E: Goss	Slope, seepage.	Compressible, hard to pack.	Not needed	Complex slope, droughty.	Complex slope	Droughty, slope.
221: Palms	Seepage	Compressible, hard to pack, low strength.	Wetness, cutbanks cave.	Wetness, fast intake, soil blowing.	Not needed	Not needed.
225, 226: Lawler	Seepage	Piping, seepage.	Cutbanks cave	Wetness	Wetness, rooting depth.	Rooting depth, wetness.
265, 265B: Bixby	Seepage	Seepage	Not needed	Favorable	Rooting depth	Rooting depth.
284, 284B, 284C: Flagler	Seepage	Seepage, piping.	Not needed	Droughty, fast intake.	Too sandy, piping.	Droughty.
285, 285B, 285C2, 285E2: Burkhardt	Seepage	Piping, seepage.	Not needed	Rooting depth, droughty, seepage.	Rooting depth, complex slope.	Rooting depth, droughty.
302B, 302C: Coggon	Favorable	Favorable	Not needed [1]	Slope	Favorable	Percs slowly, wetness.

TABLE 12.—*Water management*—Continued

Map symbol and soil name	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
315: Loamy alluvial land	Favorable	Piping, seepage.	Floods	Floods	Not needed	Not needed.
354: Marsh	Favorable	Unstable fill	Poor outlets	Floods, wetness.	Not needed	Wetness.
391B: Clyde part	Favorable	Low strength, compressible, hard to pack.	Favorable	Wetness, floods.	Not needed	Wetness, large stones.
Floyd part	Favorable	Low strength, piping.	Favorable	Wetness	Wetness, piping.	Wetness.
394B, 394C, 394C2: Ostrander	Favorable	Low strength	Not needed	Slope	Favorable	Favorable.
398: Tripoli	Favorable	Favorable	Favorable	Wetness	Not needed	Not needed.
399, 399B: Readlyn	Favorable	Favorable	Favorable	Wetness	Wetness	Not needed.
407B:						

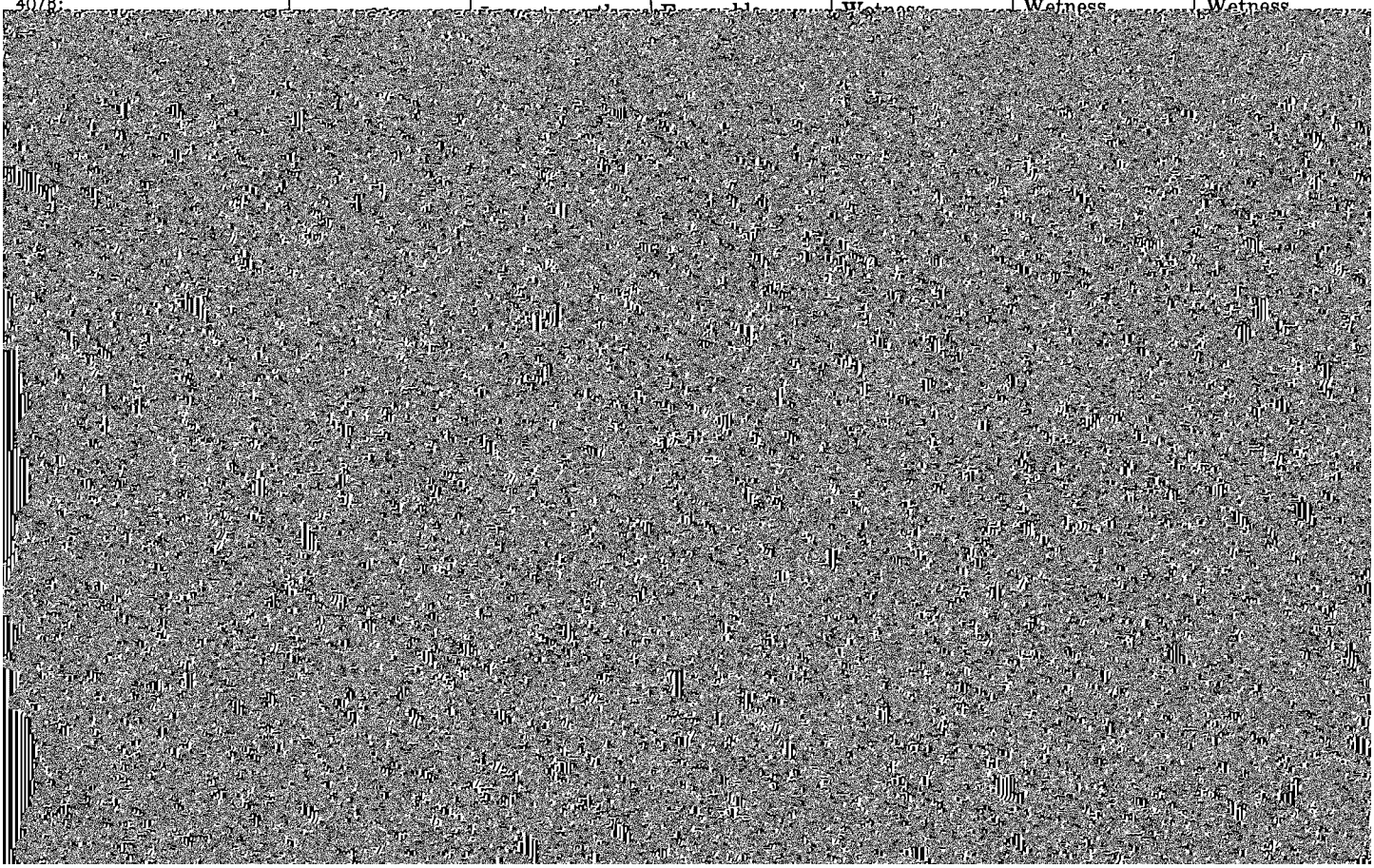


TABLE 12.—*Water management*—Continued

Map symbol and soil name	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
489: Ossian	Seepage	Compressible, low strength, excess humus.	Floods, wetness.	Floods, wetness.	Not needed	Wetness.
490: Caneek	Seepage	Compressible, low strength, piping.	Floods, wetness.	Floods, wetness.	Wetness	Not needed.
496B: Dorchester part	Seepage	Compressible, low strength, piping.	Floods	Floods, excess lime.	Favorable	Erodes easily.
Volney part	Seepage	Large stones,	Not needed	Floods	Large stones.	Large stones,

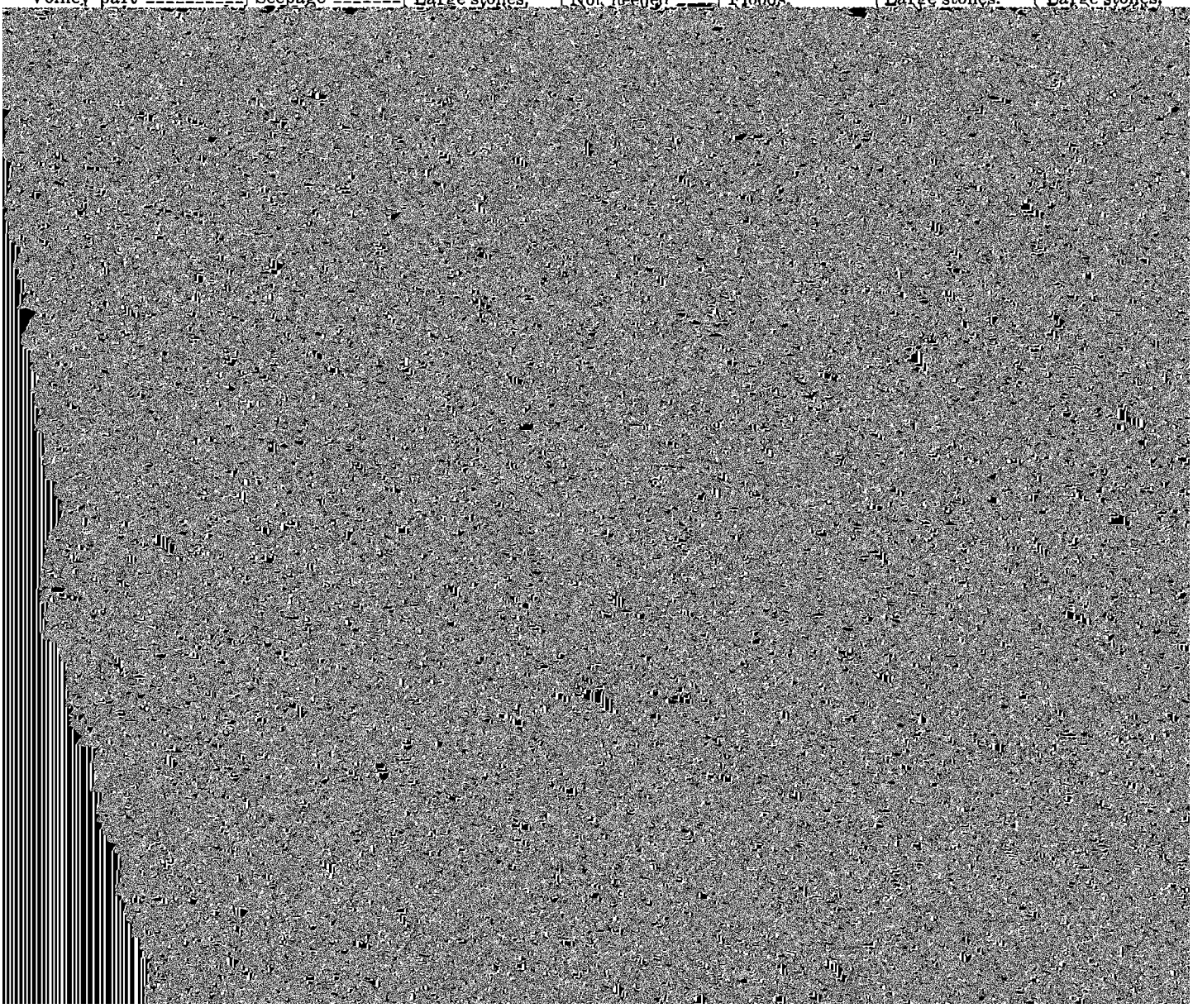


TABLE 12.—*Water management*—Continued

Map symbol and soil name	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
725:						
[redacted]	Seepage	Seepage	Not needed	Favorable	Favorable	Favorable

Parent material and geology

The accumulation of parent material is the first step in the development of a soil. Some of the soils in the county formed as the result of weathering of the bedrock. Most of the soils, however, formed in material that was transported from the site of the parent rock and redeposited at a new location through the action of glacial ice, water, wind, and gravity.

The principal parent materials in Fayette County are glacial drift, loess, alluvium, and eolian or wind-deposited sand. Much less extensive parent materials are organic deposits and residuum.

Glacial drift is all rock material in transport by glacial ice, all deposits made by glacial ice, and all deposits of dominantly glacial origin made in the sea or in bodies of glacial melt water. It includes glacial till, which is unsorted sediment whose particles range in size from boulders to clay. Glacial drift is the most important parent material in the formation of the soils of Fayette County. At least twice during the glacial period, continental ice, or glaciers, moved over the land. The record of these ice invasions is contained in the unconsolidated rock material that was deposited by the melting ice and melt water streams. The older ice sheet, known as the Nebraskan, occurred some 750,000 years ago (*5, 6, 8*). It was followed by the Aftonian interglacial period. The Kansan glaciation is thought to have started about 500,000 years ago. A more recent glaciation was recognized by Leighton (*6*) as the Iowan substage of the Wisconsin glaciation, but recent studies of the presence and identification of Iowa's glacial till indicates that the conclusions formed from studies made before 1950 are questionable. Intensive, detailed geomorphic and stratigraphic work shows that the landscape is a multi-level sequence of erosion surfaces, and that many of the levels are cut into Kansan and Nebraskan till (*9*). Ruhe's study demonstrated that the Iowan till does not exist, but that an erosion-surface complex does exist in the Iowan region. The Iowan erosion surface is multi-level and is arranged in a series of steps from major drainageways toward bounding divides. The Iowan erosion surface is marked where it cuts Kansan and Nebraskan till by a stone line. The stone line occurs on all levels of the stepped surfaces where they occur, and it passes under the alluvium along the drainageways (fig. 17).

The soils formed in the glacial drift and glacial till on the Iowan erosion surface are Bassett, Clyde, Coggon, Cresco, Donnan, Floyd, Kenyon, Lourdes, Oran, Ostrander, Protivin, Readlyn, Riceville, Schley, and Tripoli soils. They have a loamy surface sediment about 1 to 2 feet thick over the glacial material. However, this is deeper in the lower concave slopes and waterways in such soils as the Clyde, Floyd, and Schley. A stone line or pebble band commonly separates the friable loamy surficial sediment from the firm loam or clay loam glacial till. Donnan soils formed in loamy material and clayey material derived from glacial till.

Loess is the second most important parent material in Fayette County. The loess is of Wisconsin age, and it consists of accumulated particles of silt and clay that have been deposited by wind. The base of the Wisconsin Loess in Iowa ranges in age from 16,500 to 29,000 years (*10*). The thickness of loess varies from about 16 feet on the more stable divides to a very thin mantle over limestone on the steep side slopes along the Turkey and Volga Rivers and their tributaries. The loess is in the northeastern part of the county. In the remainder of the county there is no loess mantling the glacial till. There is a sharp break from the thickly loess-covered areas to the less sloping areas formed in glacial till.

Soils that formed in loess more than 40 inches thick are the Downs, Exette, Fayette, and Port Byron series. Dubuque and Nordness soils developed in areas where the loess is less than 30 inches thick over limestone.

Alluvium consists of sediment that has been transported and laid down by water. Alluvial deposits of Late Wisconsin age occur under the flood plains and terraces of water courses in Fayette County. These materials occur as lenses and layers of sand, gravel, silt, and clay. The thickness of alluvial materials varies. These materials are as much as 95 feet thick along major streams; along small streams they are less than 5 feet thick. Waukee soils formed in loamy alluvium

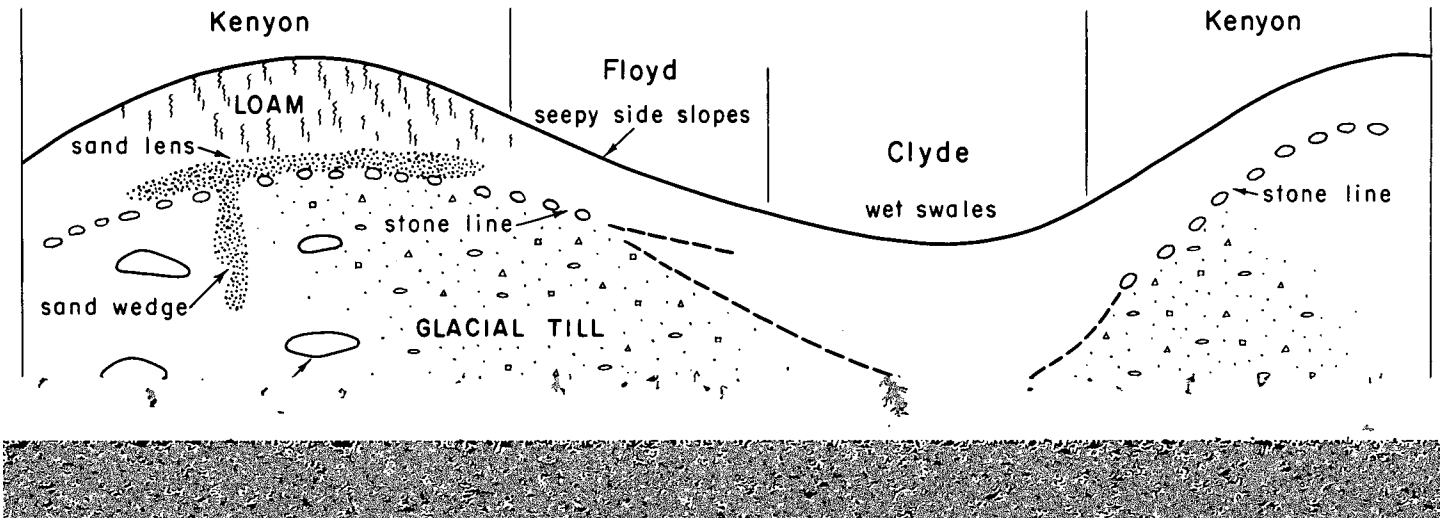


TABLE 13.—*Engineering*

Soil name and location	Parent material	Report number AAD4—	Depth	Moisture density [1]	
				Maximum dry density	Optimum moisture
			In	*lb/ft³*	*Pct*
Exette silt loam: 460 feet north and 79 feet west of SE corner of NE¼NE¼, sec. 7, T. 93 N., R. 7 W. (Modal)	Deoxidized, leached Wisconsin loess.	3166	0–6	102	20
		3167	24–33	107	18
		3168	41–54	109	17

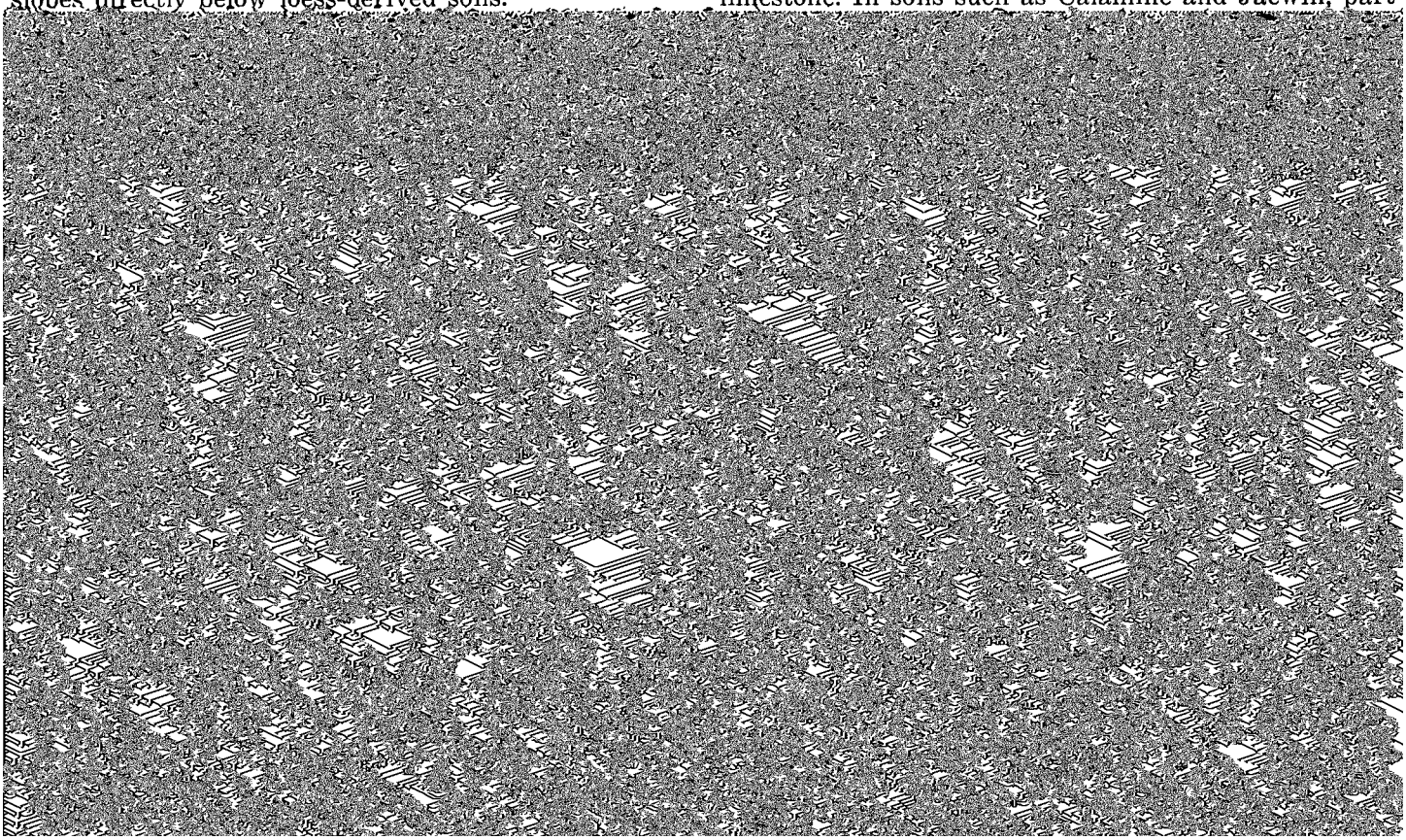
[1] Based on AASHTO Designation T99, Method A.

[2] Mechanical analyses according to the AASHTO Designation T88. Results by this procedure frequently may differ somewhat from results that would have been 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 calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

over sand and gravel, whereas Camden soils formed in silty material with some stratified sands at a depth of about 4 feet.

Some of the alluvial material has been transported only a short distance and has accumulated at the foot of the slope on which it originated. This material is called "local" alluvium and retains many characteristics of the soils in the areas from which it has eroded. Huntsville soil is an example. It is at the foot of the slopes directly below loess-derived soils.

parent material in this county. Limestone and shale are the types of sedimentary rock in Fayette County. In most places a deposit of loess or glacial drift covers the residuum, and in only a few areas does residuum make up the entire solum. Residuum makes up nearly all of the solum, however, in some Jacwin soils. In this county, the layer of residuum is generally less than 6 inches thick over bedrock. In the Dubuque soils, a deposit of loess covers the thin layer of residuum from limestone. In soils such as Calamine and Jacwin, part



test data

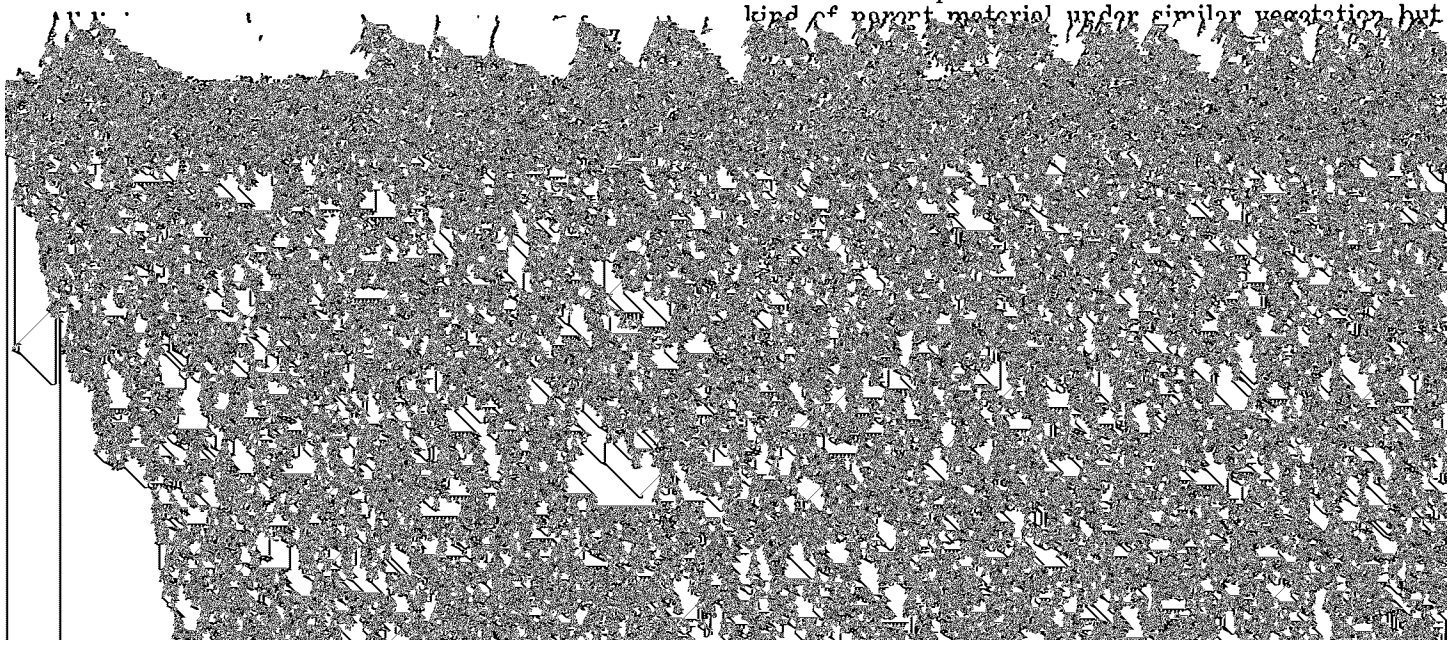
Percentage passing sieve—[3]			Percentage smaller than—[3]				Liquid limit	Plasticity index	Classification	
No. 10	No. 40	No. 200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO [3]	Unified [4]
							Pct			
---	---	99	79	46	27	22	39	14	A-6(10)	CL
---	---	99	82	48	23	20	34	11	A-6(8)	CL
---	---	99	76	40	22	18	30	10	A-4(8)	CL

[3] Based on AASHTO Designation M 145-49.
[4] Based on the Unified soil classification system.

Climate is a major factor in determining which soils develop from the various parent materials. The rate and intensity of hydrolysis, carbonation, oxidation, and other important chemical reactions in the soil are influenced by climate. Temperature, rainfall, relative humidity, and length of the frost-free period are important in determining the vegetation.

The influence of the general climate of the region is somewhat modified by the local conditions in or near the developing soil. For example, south-facing, dry, sandy soils have a local climate or microclimate that is warmer and less humid than the average climate of nearby areas. Low-lying, poorly drained areas are wetter and colder than most areas around them. These contrasts account for some of the differences in soils within the same general climatic regions.

Plant and animal life



grasses and those under forest. Downs and Bassett soils are examples.

The Fort Byron, Downs, and Fayette soils are members of a group of soils that formed from the same parent material and under comparable environment except for native vegetation. Differences in native vegetation account for the main differences in morphology in the soils of this group.

Relief

Relief, or topography, influences soil development mainly through its effect on drainage, runoff, and erosion. In Fayette County the relief ranges from nearly level to very steep. Water soaks into the nearly level areas that are not flooded. Where the slope is steeper, more water runs off the surface and less penetrates into the soil. Tripoli, Readlyn, and Kenyon soils are examples of soils that formed in the same kind of parent material under similar vegetation, but

horizons. Some of the soils that developed in alluvium show little or no profile development because fresh material is deposited periodically. The materials have not been in place long enough for the climate and vegetation to develop well defined genetic horizons in the profile. Dorchester soil is an example of a very young soil. In steep areas, soil material is removed before it has had time to develop into a deep soil profile. Nordness soil is an example.

Another factor that may modify the effect of time is the resistant materials. Soils that formed in material resistant to weathering, such as quartz sand, do not change much with time. Examples of this are the Chelsea and Sparta soils.

in plant nutrients and to make the soil more productive than the virgin soil. In many places dark colored, low lying soils have received lighter colored deposition.

In Fayette County a soil developed in recent alluvium that shows the influence of man is Dorchester silt loam. There are strata of light and dark colored materials washed from the hillsides and deposited by floods. This erosion has taken place since man began cultivating the hillsides.

Classification of the soils

This section defines the current system of classifi-

TABLE 14.—*Classification of the soils*

[An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics of this taxadjunct that are outside the range of the series]

Soil name	Family or higher taxonomic class
Backbone	Coarse-loamy, mixed, mesic Mollic Hapludalfs
Bassett	Fine-loamy, mixed, mesic Mollic Hapludalfs
Bixby	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludalfs
Burkhardt	Sandy, mixed, mesic Typic Hapludolls
*Calamine	Fine, mixed, mesic Typic Argiaquolls
Camden	Fine-silty, mixed, mesic Typic Hapludalfs
Caneek	Fine-silty, mixed (calcareous), mesic Typic Fluvaquents
Canoe	Fine-silty, mixed, mesic Udollic Ochraqualfs
Chaseburg	Coarse-silty, mixed, nonacid, mesic Typic Udifluvents
Chelsea	Mixed, mesic Alfic Udipsamments
Clyde	Fine-loamy, mixed, mesic Typic Haplaquolls
Coggon	Fine-loamy, mixed, mesic Typic Hapludalfs
Coland	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Cresco	Fine-loamy, mixed, mesic Typic Argiudolls
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
Donnan	Fine-loamy over clayey, mixed, mesic Aquollic Hapludalfs
Dorchester	Fine-silty, mixed (calcareous), mesic Typic Udifluvents
Downs	Fine-silty, mixed, mesic Mollic Hapludalfs
Dubuque	Fine-silty, mixed, mesic Typic Hapludalfs
Exette	Fine-silty, mixed, mesic Dystric Eutrochrepts
Fayette	Fine-silty, mixed, mesic Typic Hapludalfs
Festina	Fine-silty, mixed, mesic Mollic Hapludalfs
Flagler	Coarse-loamy, mixed, mesic Typic Hapludolls
Floyd	Fine-loamy, mixed, mesic Aquic Hapludolls
Goss	Clayey-skeletal, mixed, mesic Typic Paleudalfs
Hanlon	Coarse-loamy, mixed, mesic Cumulic Hapludolls
Hayfield	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquollic Hapludalfs
Huntsville	Fine-silty, mixed, mesic Cumulic Hapludolls
Jacwin	Fine-loamy over clayey, mixed, mesic Aquic Hapludolls
Kenyon	Fine-loamy, mixed, mesic Typic Hapludolls
Lamont	Coarse-loamy, mixed, mesic Typic Hapludalfs
Lawler	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls
Loamy alluvial land	Loamy, mixed, mesic Typic Udifluvents
Lourdes	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Marlean	Loamy-skeletal, mixed, mesic Typic Hapludolls
Marsh	Aquolls
Marshan	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls
Nordness	Loamy, mixed, mesic Lithic Hapludalfs
Olin	Coarse-loamy, mixed, mesic Typic Hapludolls
Oran	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Orwood	Fine-loamy, mixed, mesic Mollic Hapludalfs
Ossian	Fine-silty, mixed, mesic Typic Haplaquolls
Ostrander	Fine-loamy, mixed, mesic Typic Hapludolls
Otter	Fine-silty, mixed, mesic Cumulic Haplaquolls
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Port Byron	Fine-silty, mixed, mesic Typic Hapludolls
Protivin	Fine-loamy, mixed, mesic Aquic Argiudolls
Readlyn	Fine-loamy, mixed, mesic Aquic Hapludolls
Riceville	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Richwood	Fine-silty, mixed, mesic Typic Argiudolls
Rockton	Fine-loamy, mixed, mesic Typic Argiudolls
Sandy escarpments	Coarse-loamy, mixed, mesic Udolls And Udalfs
Saude	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Schley	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Sparta	Sandy, mixed, mesic Entic Hapludolls
Spillville	Fine-loamy, mixed, mesic Cumulic Hapludolls
Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Tripoli	Fine-loamy, mixed, mesic Typic Haplaquolls
Volney	Loamy-skeletal, mixed, mesic Cumulic Hapludolls
Wapsie	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Mollic Hapludalfs
Waukee	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Winneshiek	Fine-loamy, mixed, mesic Mollic Hapludalfs

of subgroups are derived by placing one or more adjectives before the name of the great group. The adjective *Typic* is used for the subgroup that is thought to typify the great group. An example is Typic Haplaquolls.

FAMILIES. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activ-

considerably on calm clear nights, when the rural lowlands have temperatures that are usually a few degrees colder than temperatures in other parts of the county. Rainfall also tends to vary somewhat in quantity over the county, particularly during the warm season.

About 70 percent of the annual precipitation falls during the warm part of the year, April through September. On the average, Fayette County receives a trace or more of precipitation on 185 days per year.

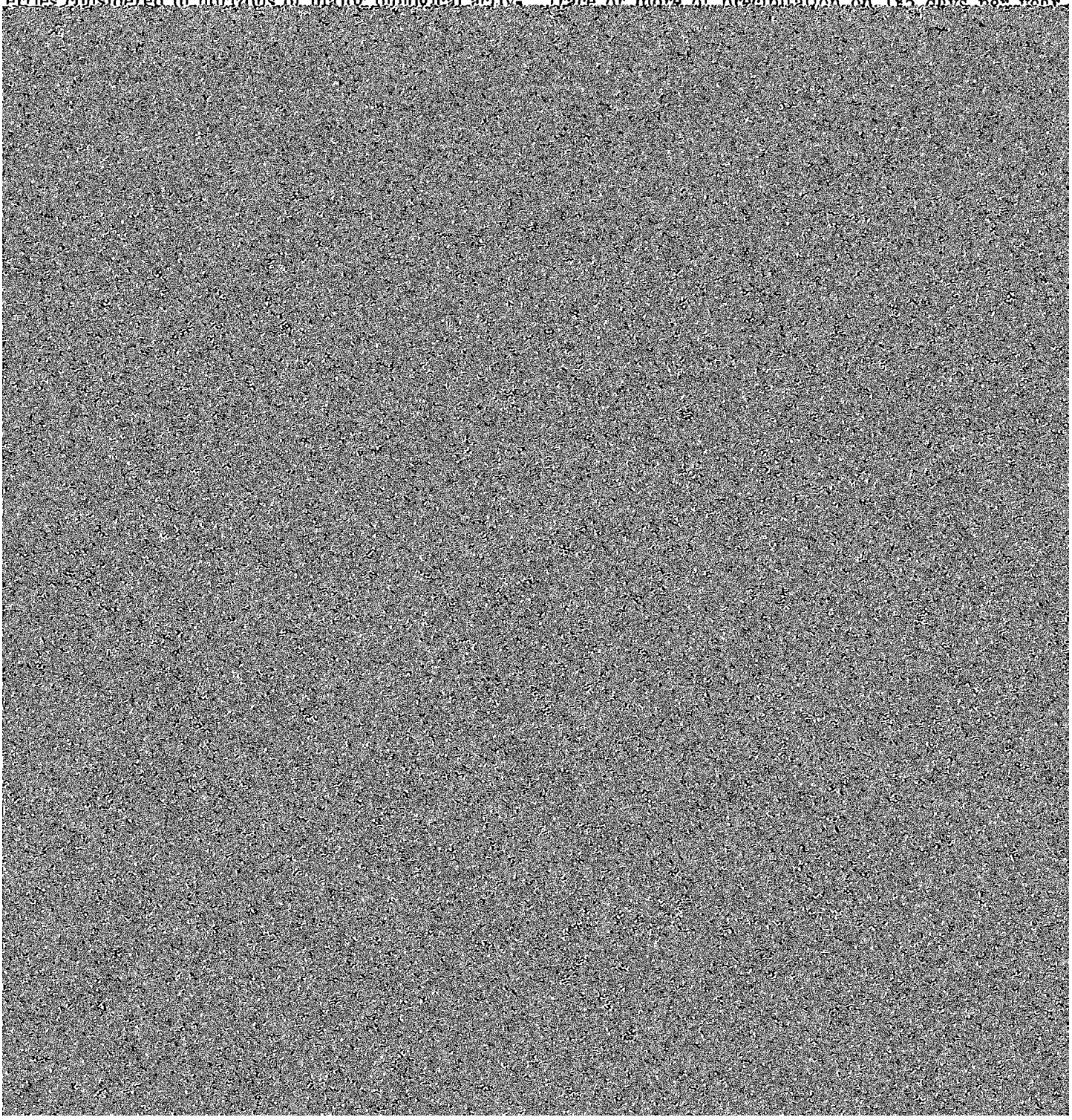


TABLE 15.—*Temperature and precipitation*

[Data from Fayette, near the center of Fayette County, 1915–72]

Month	Temperature				Precipitation			
	Average	Average	Average monthly	Average monthly		1 year in 10 will have—	Number of days with	Average depth of

Fayette County had 136,685 acres in corn, 28,625 acres in oats, 45,321 acres in soybeans, 46,122 acres in hay, and 102,381 acres in pasture.

The principal livestock produced in Fayette County is hogs, but beef cow and fed cattle production is also important. In Fayette County in 1971, 26,395 fed cattle were marketed, 223,633 hogs were marketed, and 1,427 fed lambs were marketed. There were 13,165 beef cows and 19,140 milk cows. Also, there were 149,754 hens and pullets of laying age.

Transportation, industries, and markets

Federal, State, and county highways through the county provide routes for automobile traffic and for transportation of farm products to market. U.S. Highway 18 crosses the county from west to northeast, and Iowa Highway 3 crosses the southern part of the county from west to east. Iowa Highway 150 crosses the county from north to south. Bus transportation is available daily on a north-south route. Motor freight lines serve every trading center in the county. Rail service is available to Oelwein and the surrounding area.

Businesses in Fayette County are predominantly small, mostly retail stores. Examples of small industries in the county are packing plants, dairy products, plastic tile, feed concentrate, and a railroad car repair center.

Farm livestock markets are scattered throughout the county, which is some distance from large cen-

(13) United States Department of Agriculture. 1960. Soil classification, a comprehensive system, 7th approximation. Soil Conserv. Serv., 265 pp., illus. [Supplements issued March 1967, September 1968, April 1969.]

(14) United States Department of Agriculture. 1961. Land capability classification. U.S. Dept. Agric. Handb. 210, 21 pp.

(15) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dept. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173–188 issued May 1962]

(16) United States Department of Health, Education, and Welfare. 1957. Manual of septic tank practices. Public Health Serv. Publ. 526, 93 pp., illus.

Glossary

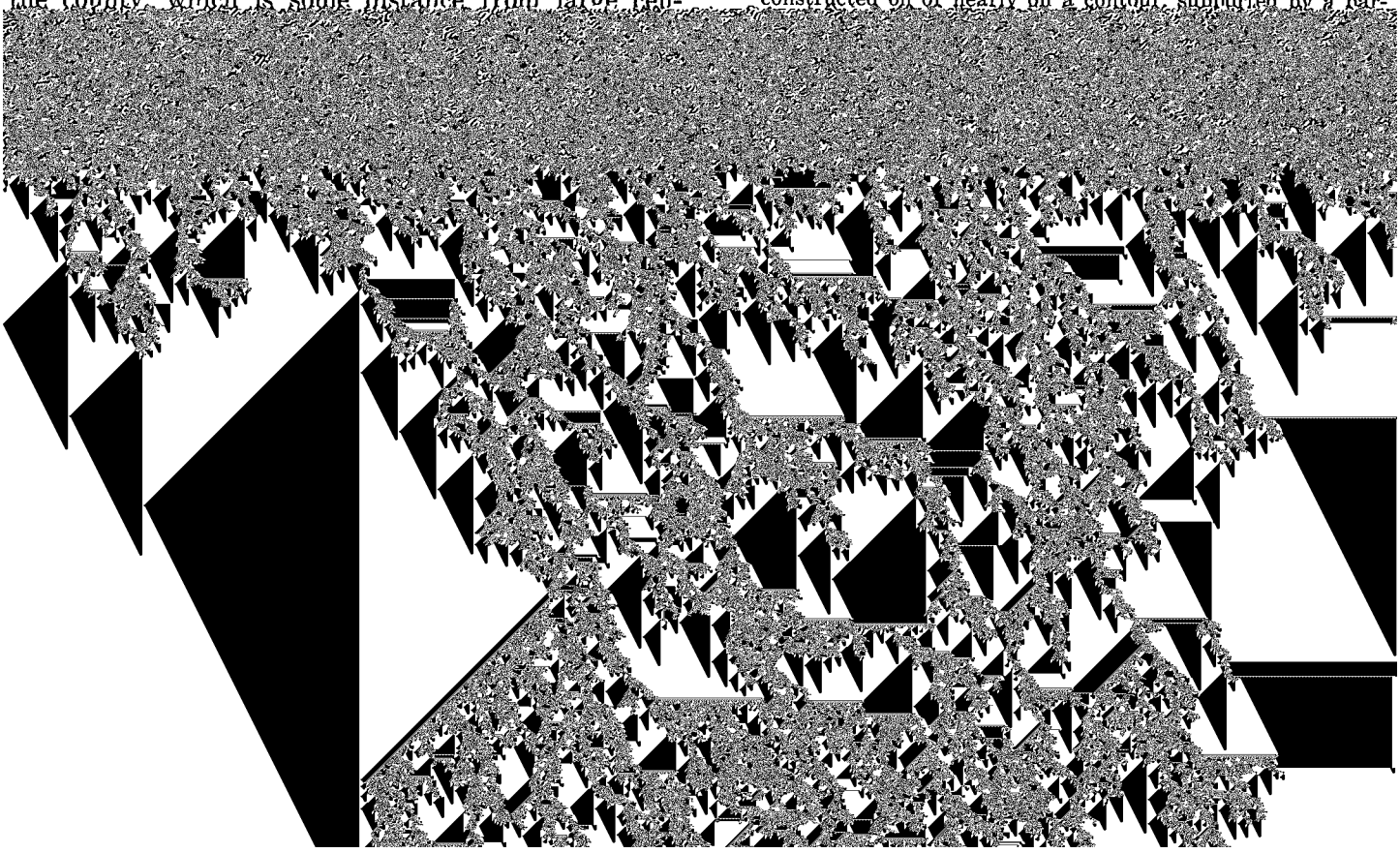
Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a bar-



Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drain-

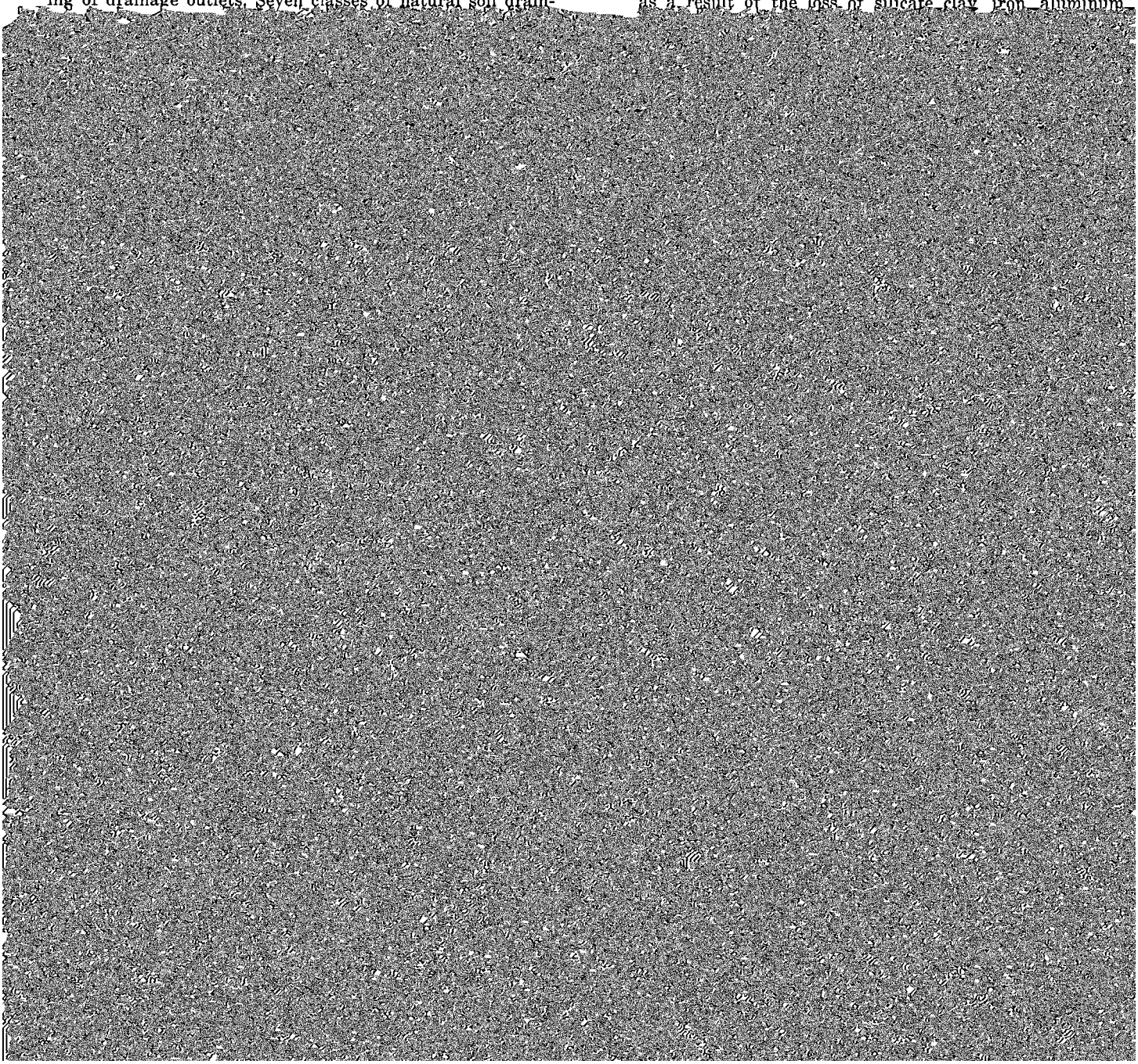
yellow and gray mottles as a result of intermittent waterlogging.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral 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,



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		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

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.

Stone line. A concentration of coarse fragments in soils that generally marks an old weathering surface. In a cross section, the line may be one fragment or more thick. The line generally overlies material that weathered in place and

cesses of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

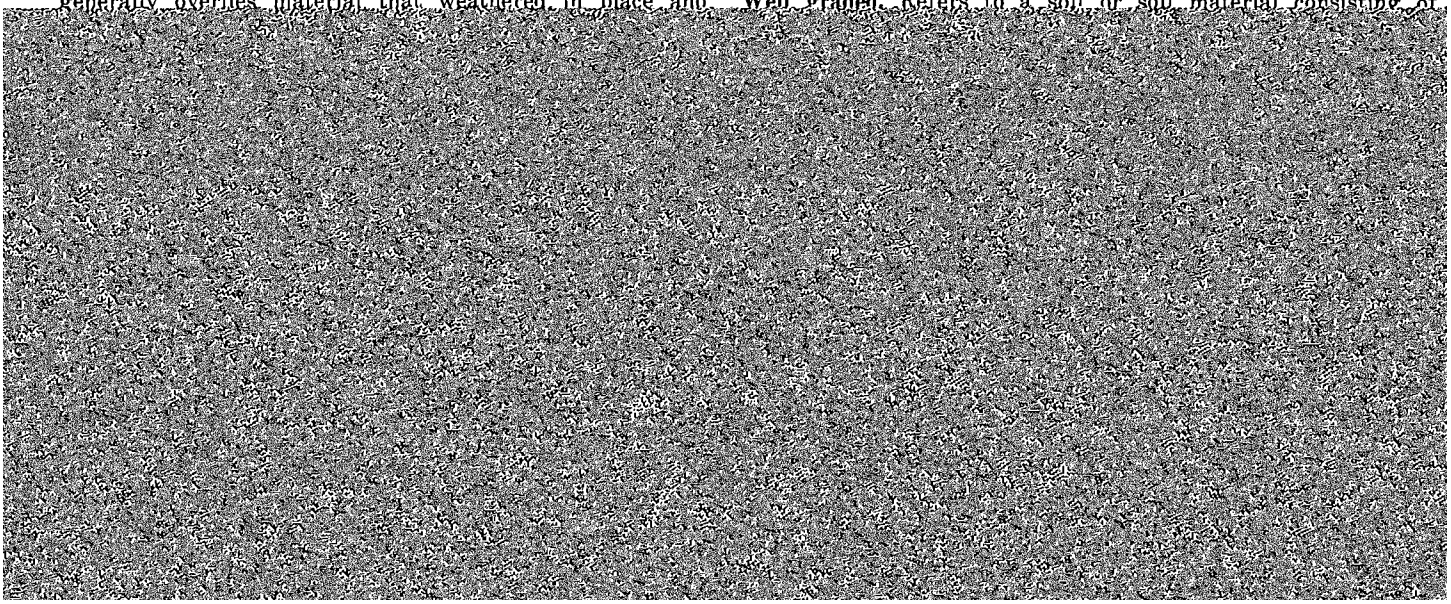
Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Well graded. Refers to a soil or soil material consisting of



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