SOIL SURVEY OF

Johnson County, Indiana

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Purdue University
Agricultural Experiment Station

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 1970 to 1974. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1974. This survey was made cooperatively by the Soil Conservation Service and the Purdue University Agricultural Experiment Station. It is part of the technical assistance furnished to the Johnson County Soil and Water Conservation District. Some funds were provided by Johnson County through the Johnson County Soil and Water Conservation District with approval of the Johnson County Council and the Soil and Water Conservation Committee, Indiana Department of National Resources.

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

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, woodlands, and wildlife areas; 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 Johnson County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

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

Finding and using information

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

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

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

Foresters and others can refer to the sections "Woodland management and productivity" and "Windbreaks and environmental plantings," where the soils of the county are grouped according to their suitability for trees.

Wildlife managers and others can find information about soils and wildlife in the section "Wildlife habitat."

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

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

Scientists and others can read about the soils in the section "Formation and classification of the soils."

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

Contents

	Page
Index to mapping units	ii
Summary of tables	iii
How this survey was made	1
General soil map for broad land use planning	2
Well drained to somewhat poorly drained, nearly level soils on bottom lands, subject to flooding	2
1. Genesee-Shoals-Ross association	2
2. Genesee-Eel association	3
Well drained, nearly level to moderately sloping soils on terraces	4
3. Fox-Ockley-Nineveh association	4
4. Ockley-Fox association	5
Very poorly drained and somewhat poorly drained, nearly level and gently sloping soils on terraces and uplands	5
5. Rensselaer-Whitaker association	5
6. Westland-Sleeth association	6
7. Crosby-Brookston association	7
Well drained and somewhat poorly drained, nearly level to moderately steep soils on uplands	8
8. Miami-Fincastle association	8
9. Crosby-Miami association	9
Well drained, gently sloping to very steep soils on uplands	10
10. Miami-Hennepin association	10
11. Hickory-Parke association	10
12. Muskingum-Wellston association	11
Descriptions of the soils	11
Brookston series	12
Crosby series	13
Eel series	14
Fincastle series	15
Fox series	16
Genesee series	17
Hennepin series	18
Hickory series	18
Miami series	19
Muren series	22
Muskingum series	22
Nineveh series	23
Ockley series	24
Palms series	25
Parke series	25
Rensselaer series	26
Ross series	27
Shoals series	28
Sleeth series	28
Sloan series	29
Wellston series	30
Westland series	30
Whitaker series	31
Use and management of the soils	32
Use of the soils for crops	32
Capability grouping	33
Yields per acre	38
Woodland management and productivity	39
Windbreaks and environmental plantings	39
Engineering	43
Building site development	44
Sanitary facilities	46
Construction materials	51
Water management	52
Recreation	52
Wildlife habitat	53
Soil properties	57
Engineering properties	58
Physical and chemical properties	58
Soil and water features	64
Formation and classification of the soils	66
Factors of soil formation	66
Parent material	66
Plant and animal life	67
Climate	67
Relief	67
Time	67
Processes of soil formation	68
Laboratory data	68
Methods of sampling and analysis	68
Classification	68
Environmental factors affecting soil use	69
Relief, physiography, and drainage	69
Water supply	69
Climate	71
Transportation	73
Trends in population and land use	73
References	73
Glossary	73
Guide to mapping units Following	76

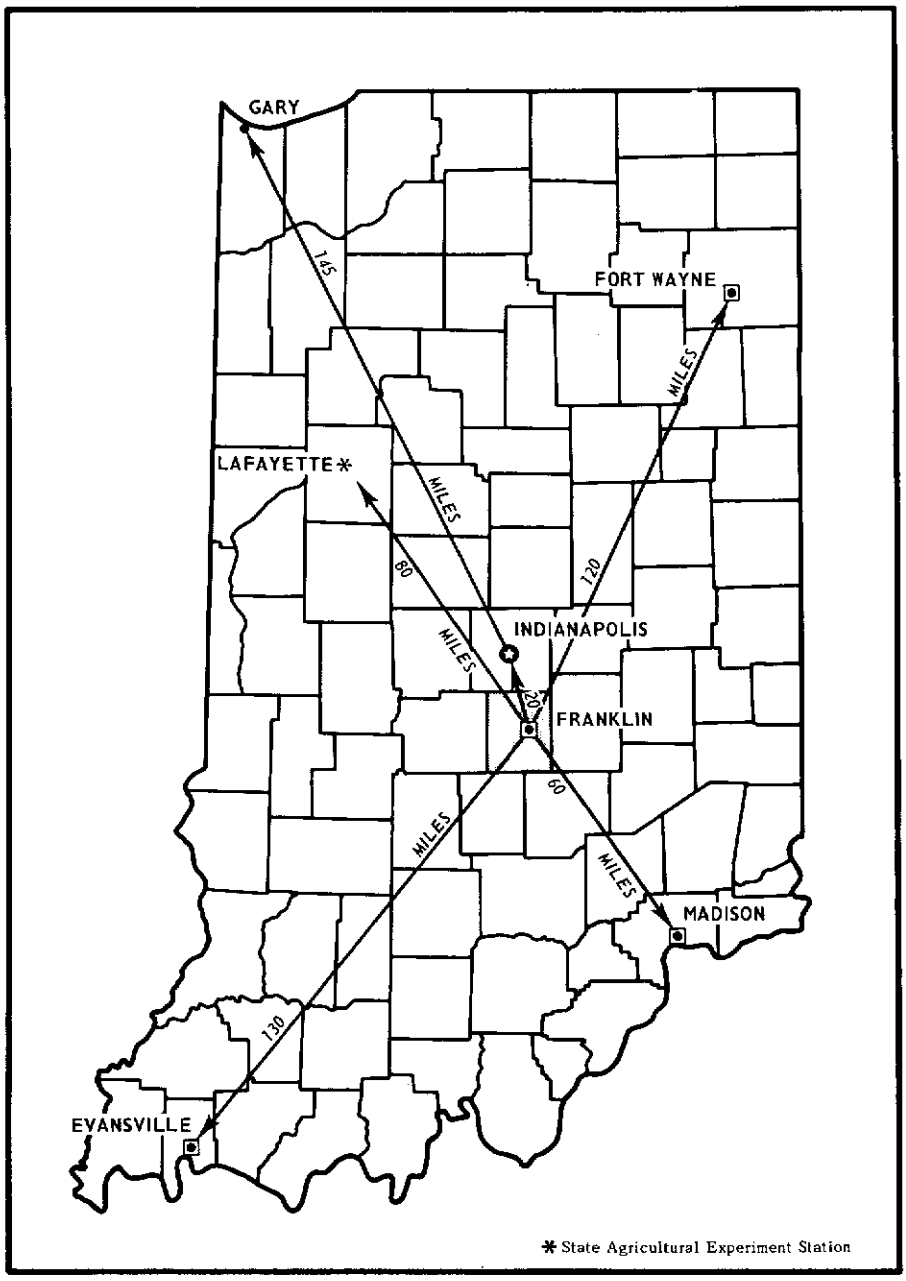
Issued January 1979

Index to mapping units

	Page
Br—Brookston silty clay loam	13
CrA—Crosby silt loam, 0 to 2 percent slopes	14
CsB2—Crosby-Miami silt loams, 2 to 4 percent slopes, eroded	14
Ee—Eel silt loam	15
FnA—Fincastle silt loam, 0 to 3 percent slopes	15
FoA—Fox loam, 0 to 2 percent slopes	16
FoB2—Fox loam, 2 to 6 percent slopes, eroded	17
FxC2—Fox complex, 6 to 12 percent slopes, eroded	17
Ge—Genesee loam	18
HeF—Hennepin loam, 25 to 50 percent slopes	18
HkD2—Hickory silt loam, 12 to 18 percent slopes, eroded	19
HkF—Hickory silt loam, 18 to 40 percent slopes	19
MnB2—Miami silt loam, 2 to 6 percent slopes, eroded	20
MnC2—Miami silt loam, 6 to 12 percent slopes, eroded	20
MnD2—Miami silt loam, 12 to 18 percent slopes, eroded	20
MnE—Miami silt loam, 18 to 25 percent slopes	21
MtB3—Miami clay loam, 2 to 6 percent slopes, severely eroded	21
MtC3—Miami clay loam, 6 to 12 percent slopes, severely eroded	21
MtD3—Miami clay loam, 12 to 18 percent slopes, severely eroded	21
MuA—Muren silt loam, 0 to 3 percent slopes	22
MxG—Muskingum silt loam, 25 to 50 percent slopes	23
NnA—Nineveh loam, 0 to 2 percent slopes	24
OcA—Ockley loam, 0 to 2 percent slopes	24
OcB2—Ockley loam, 2 to 6 percent slopes, eroded	24
Pa—Palms muck	25
PkB2—Parke silt loam, 2 to 6 percent slopes, eroded	26
PkC2—Parke silt loam, 6 to 12 percent slopes, eroded	26
Re—Rensselaer silty clay loam	27
Rs—Ross loam	27
Sh—Shoals silt loam	28
Sk—Sleeth loam	29
Sn—Sloan clay loam	30
WdC2—Wellston silt loam, 6 to 12 percent slopes, eroded	30
We—Westland clay loam	31
Wh—Whitaker silt loam	32

Summary of tables

	Page
Descriptions of the soils	
Acreage and proportionate extent of the soils (table 1)	12
Yields per acre	
Yields per acre of crops and pasture (table 2)	40
Woodland management and productivity	
Woodland management and productivity (table 3)	41
Engineering	
Building site development (table 4)	45
Sanitary facilities (table 5)	47
Construction materials (table 6)	49
Water management (table 7)	50
Recreation	
Recreational development (table 8)	55
Wildlife habitat	
Wildlife habitat potentials (table 9)	56
Soil properties	
Engineering properties and classifications (table 10)	59
Physical and chemical properties of soils (table 11)	62
Soil and water features (table 12)	65
Laboratory data	
Physical and chemical properties of selected soils (table 13)	70
Classification	
Classification of the soils (table 14)	72
Climate	
Probabilities of last freezing temperatures in spring and first in fall (table 15)	72
Temperature and precipitation data (table 16)	73



Location of Johnson County in Indiana.

SOIL SURVEY OF JOHNSON COUNTY, INDIANA

By Ralph H. Sturm, Soil Conservation Service

Fieldwork by Ralph H. Sturm, Earl E. Voss, and
Shelby H. Brownfield, Soil Conservation Service

United States Department of Agriculture, Soil Conservation
Service, in cooperation with the Purdue University
Agricultural Experiment Station

JOHNSON COUNTY is in the central part of Indiana. It has an area of 315 square miles, or 201,600 acres. The county is rectangular and extends 20 miles from north to south and 16 miles from east to west. Franklin, the county seat and second largest city, is located near the center of the county.

Farming is the leading occupation. Cash-grain and livestock farming are the major types of farming. The main livestock program is hog and beef cattle feeding, but there are also several dairy farms.

Many large and small tracts of land are being developed for nonfarm uses around the cities of Franklin and Greenwood and along Interstate Highway 65, U.S. Highway 31, State Highway 37, and all four-lane highways. The use of soils for farming is emphasized in this survey, but attention is also given to nonfarm uses.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in Johnson County, where they are, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they already knew something about and perhaps some they had never seen before. They observed the steepness, length, and shape of slopes, the size of streams and the general pattern of drainage, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared these profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles that are almost alike make up a soil series. Except for allowable differences in texture of the surface layer, or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. Nineveh and Brookston, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristic that affects their use. On the basis of such differences, a soil series is divided into phases. The name of a soil phase commonly indicates a feature that affects use or management. For example, Miami silt loam, 2 to 6 percent slopes, eroded, is one of several phases within the Miami series.

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

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

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

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. The name of a soil com-

plex consists of the names of the dominant soils, joined by a hyphen. Crosby-Miami silt loams, 2 to 4 percent slopes, eroded, is an example.

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

But only part of a soil survey is done when the soils have been named, described, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

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

General soil map for broad land use planning

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. Typically it consists of one or more major soils and some minor soils. It is named for the major soils. The soils in an association can occur in other associations but in a different pattern.

A map showing soil associations is useful to people who want to compare different parts of that area, or who want to find suitable sites for a certain kind of land use. Such a map is a useful general guide for broad planning on a watershed, a wooded tract, or a wildlife area or for broad planning of recreation facilities, community developments, and engineering works. It is not a suitable map for detailed planning for management of a farm or field or for selecting a site for a road or building or other structure, because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

Soil associations and delineations on the general soil map in this soil survey do not fully agree with those of the general soil maps of adjacent counties previously published. Differences in the maps are a result of improvements in the classification of soils, particularly in the modifications or refinements in soil series concepts. In addition, the maps have become more precise and detailed because their use has expanded in recent years. Still another difference is caused by the range in slope that occurs in the soil associations of different surveys.

The soil associations in this survey area have been grouped into general kinds of landscapes for broad interpretative purposes. Each of the broad groups and the soil associations in it are described on the following pages.

Well drained to somewhat poorly drained, nearly level soils on bottom lands, subject to flooding

The two associations in this group are along the major streams and creeks in the county. These are nearly level soils that formed in loamy alluvium. They are subject to flooding.

1. Genesee-Shoals-Ross association

Well drained and somewhat poorly drained, deep, nearly level soils that formed in loamy alluvium

This association is on flood plains of rivers and creeks. It occupies about 4 percent of the county. This association is approximately 40 percent Genesee soils, 20 percent Shoals soils, 6 percent Ross soils, and 34 percent minor soils.

Genesee soils are nearly level and well drained. They are mostly adjacent to river or creek channels. The surface layer is dark grayish brown loam about 8 inches thick. The underlying material is dark brown friable silt loam in the upper 9 inches; in the next 13 inches it is dark yellowish brown friable heavy silt loam; and in the 10 inches below that it is brown friable heavy silt loam. Below a depth of 40 inches it is yellowish brown stratified loam, loamy sand, and sandy loam.

Shoals soils are nearly level and somewhat poorly drained. They are in low swales, pockets, or narrow drainageways of bottom lands. The surface layer is dark grayish brown silt loam about 8 inches thick. The underlying material is mottled, grayish brown, friable silt loam in the upper 5 inches; in the next 12 inches it is mottled, pale brown, friable heavy silt loam; and in the 10 inches below that it is mottled, grayish brown, friable loam. Below a depth of 35 inches it is mottled, yellowish brown, stratified silt loam, loam, and sandy loam.

Ross soils are nearly level and well drained. They are mostly between Genesee soils and upland or terrace soils. The surface layer is about 36 inches thick. It is very dark grayish brown friable loam in the upper 22 inches and very dark brown friable light sandy clay loam in the lower 14 inches. The underlying material is stratified dark yellowish brown light sandy clay loam in the upper 13 inches; below that it is brown sandy loam.

The minor soils in this association are Eel and Sloan soils. The moderately well drained Eel soils are adjacent to, but slightly lower than, Genesee soils, and the

very poorly drained Sloan soils are in ponded old channels.

Genesee and Ross soils are well suited to farming. If adequately drained, Shoals soils are also well suited to farming. All crops are subject to damage from flooding. Because of flooding, soils of this association have severe limitations for most nonfarm uses.

This association is used mainly for farming. Corn and soybeans are the principal crops. Small grain is subject to water damage unless the areas where it is grown are protected from flooding or are only occasionally flooded. Some narrow areas adjacent to the streams, some low and wet areas along channels of meandering streams, and some irregularly shaped small areas are in woodland or grass.

2. *Genesee-Eel association*

Well drained and moderately well drained, deep, nearly level soils that formed in loamy alluvium

This association is on flood plains of rivers and creeks (fig. 1). It occupies about 4 percent of the county.

This association is approximately 50 percent Genesee soils, 30 percent Eel soils, and 20 percent minor soils.

Genesee soils are nearly level and well drained. They are mostly on bottom lands of rivers and the larger creeks. The surface layer is dark grayish brown loam about 8 inches thick. The underlying material is dark brown, friable silt loam in the upper 9 inches; in the next 13 inches it is dark yellowish brown, friable heavy silt loam; and in the 10 inches below that it is brown, friable heavy silt loam. Below a depth of 40 inches it is yellowish brown stratified loam, loamy sand, and sandy loam.

Eel soils are nearly level and moderately well drained. They are mostly in narrow drainageways of the bottom lands of large rivers and narrow meandering creeks. The surface layer is dark grayish brown silt loam about 8 inches thick. The underlying material is brown friable silt loam in the upper 9 inches; in the next 9 inches it is mottled, brown, friable loam; and in the 14 inches below that it is mottled, brown, friable silt loam. Below a depth of 40 inches it is mottled, dark grayish brown, stratified loam and sandy loam.

The minor soils in this association are Shoals and Sloan soils. The somewhat poorly drained Shoals soils and the very poorly drained Sloan soils are in low areas of bottom lands, farthest from river and creek channels.

Genesee and Eel soils are well suited to farming, but crops are subject to damage from flooding. Because of flooding, these soils have severe limitations for most nonfarm uses.

This association is used mainly for farming. Corn and soybeans are the principal crops. Cash-grain farming is the major farm enterprise. Small grain is subject to water damage unless the areas where it is grown are protected from flooding or are only occasionally

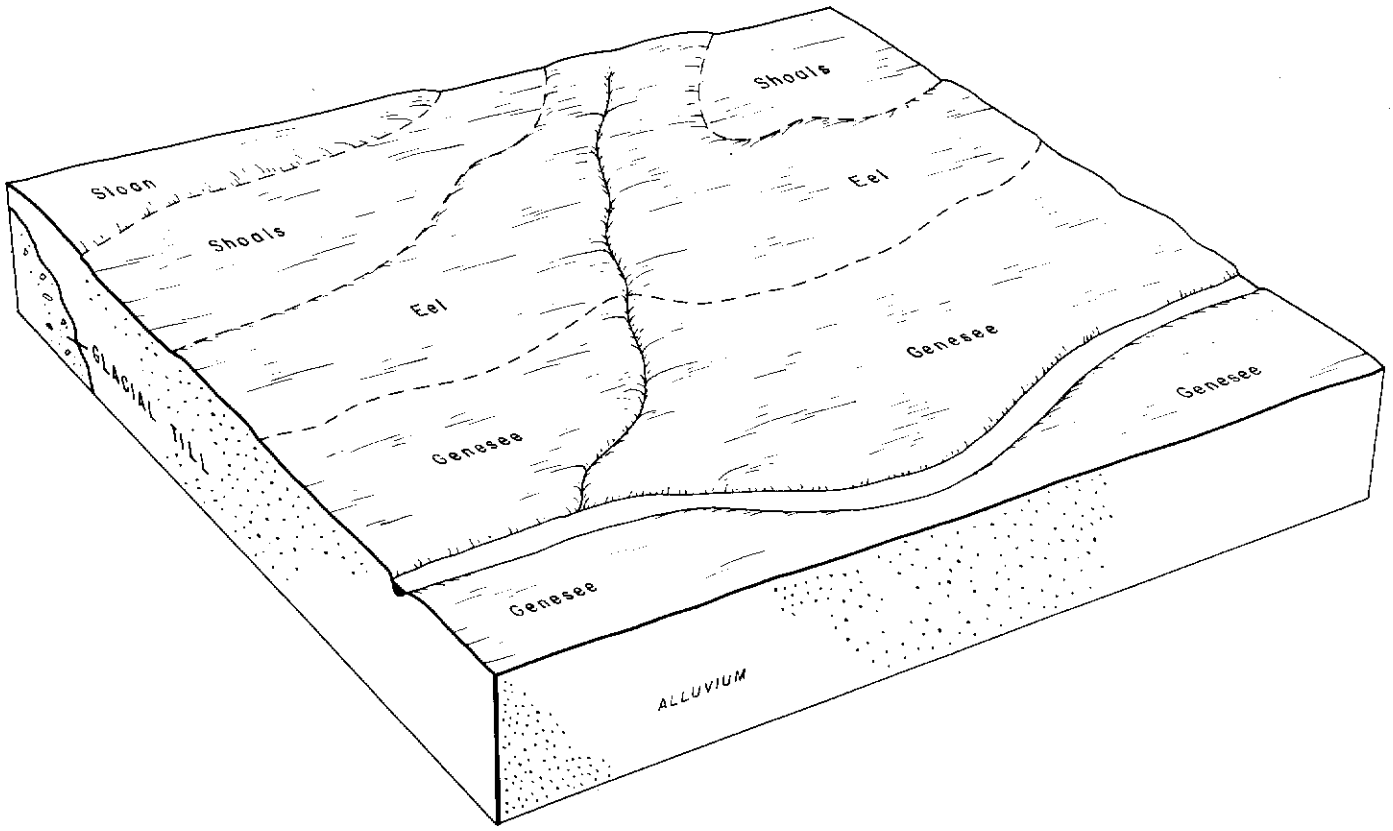


***Figure 1.*—Typical pattern of soils and underlying material in the Genesee-Eel association.**

flooded. Some small narrow areas adjacent to the streams, some low and wet areas along channels of meandering streams, and some irregularly shaped small areas are in woodland or grass.

Well drained, nearly level to moderately sloping soils on terraces

The two associations in this group are scattered throughout the county. Most areas are adjacent to nearly level soils on bottom lands. The soils formed in loamy outwash over gravelly sand and sand. Slope is dominantly nearly level and gently sloping but ranges to moderately sloping along terrace breaks.

3. Fox-Ockley-Nineveh association

Well drained, nearly level to moderately sloping soils that formed in loamy outwash; moderately deep and deep over stratified sand and gravel

This association is on broad outwash plains and terraces adjacent to larger bottom lands. It occupies about 2 percent of the county. This association is approximately 50 percent Fox soils, 20 percent Ockley soils, 10 percent Nineveh soils, and 20 percent minor soils.

Fox soils are nearly level to moderately sloping, moderately deep over sand and gravelly sand, and well drained. They are on broad, irregularly shaped flats and on the side slopes of drainageways, on knolls, and on breaks onto bottom lands. The surface layer is dark grayish brown loam about 8 inches thick. The subsoil is 26 inches thick. In the upper 7 inches it is dark brown, firm sandy clay loam; in the 5 inches below that it is dark brown, firm gravelly sandy clay loam; and in the lower 7 inches it is reddish brown, firm gravelly sandy clay loam. The underlying material, to a depth of 60 inches, is pale brown and very pale brown stratified gravelly loamy sand and sand.

Ockley soils are nearly level and gently sloping, deep, and well drained. They are on broad irregularly shaped flats, on short side slopes, and on low knolls. The surface layer is dark grayish brown and dark brown loam about 11 inches thick. The subsoil is 39 inches thick. In the upper 6 inches it is dark brown, friable heavy loam; in the next 5 inches it is dark brown, firm clay loam; in the 14 inches below that it is dark brown, firm sandy clay loam; in the next 7 inches it is brown, friable light sandy clay loam; and in the lower 7 inches it is dark brown, firm gravelly loam. The underlying material, to a depth of 60 inches, is brown stratified gravelly sand and fine sand.

Nineveh soils are nearly level, moderately deep over sands and gravel, and well drained. They are on broad irregularly shaped flats. The surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is dark brown friable light clay loam 7 inches thick. The subsoil is 21 inches thick. In the

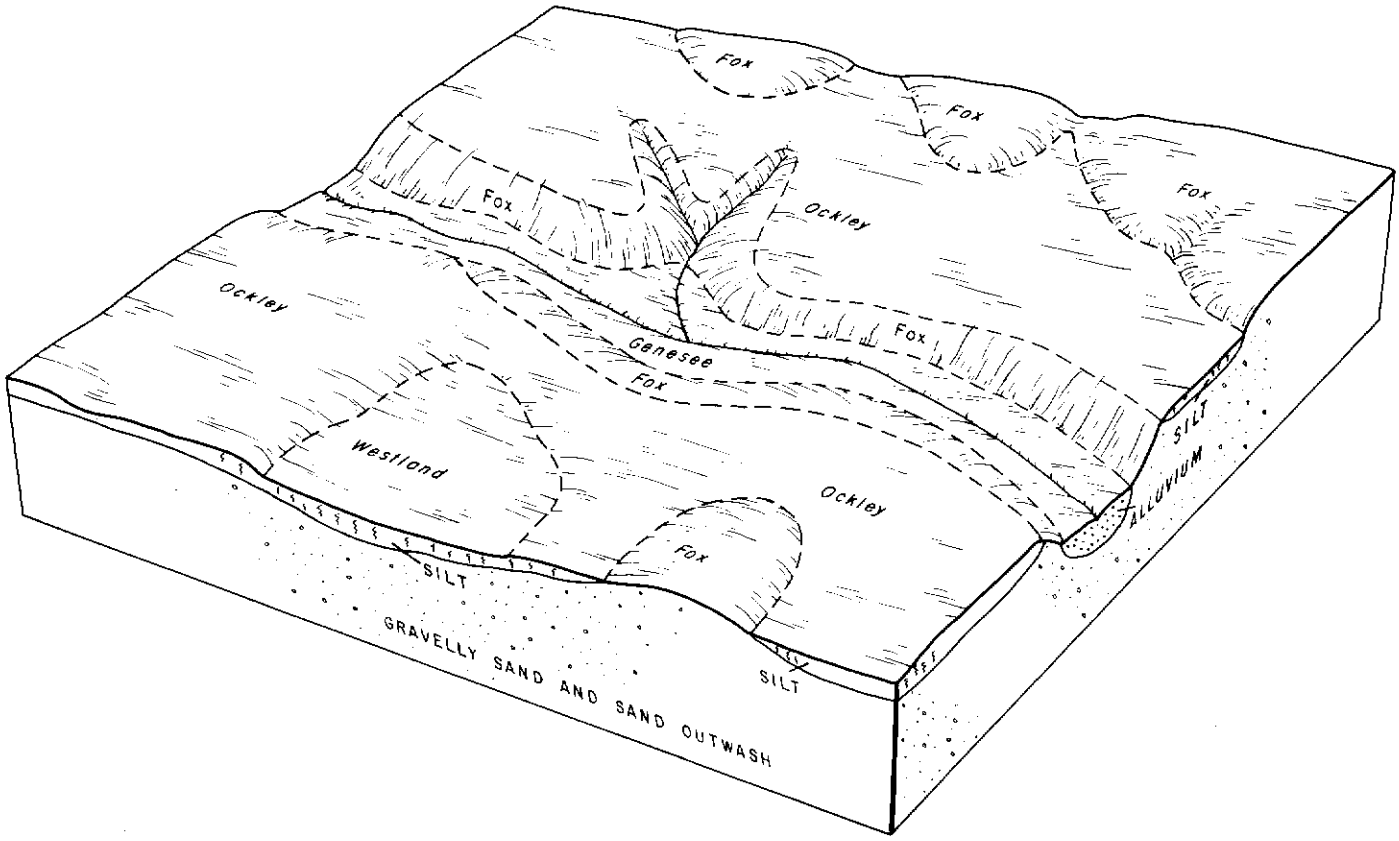


Figure 2.—Typical pattern of soils and underlying material in the Ockley-Fox association.

upper 12 inches it is dark brown, firm clay loam; in the next 5 inches it is dark brown, firm gravelly clay loam; and in the lower 4 inches it is dark reddish brown, firm gravelly loam. The underlying material, to a depth of 60 inches, is stratified very coarse sand and fine gravel.

The minor soils in this association are Westland soils. They are very poorly drained soils in narrow drainageways.

Nineveh and Ockley soils are well suited to farming. Fox soils are suited to all crops commonly grown in the county. Most gravel and sand pits are in areas of Fox soils; some gravel and sand pits are in areas of Ockley soils. Soils of this association have only slight limitations for most nonfarm uses.

This association is used mainly for farming. Corn, soybeans, and wheat are the principal crops. Cash-grain farming is the major farm enterprise.

4. *Ockley-Fox association*

Well drained, nearly level to moderately sloping soils that formed in loamy outwash; deep and moderately deep over stratified sand and gravel

This association is on broad outwash plains and terraces adjacent to larger bottom lands (fig. 2). It occupies about 5 percent of the county. This association is approximately 60 percent Ockley soils, 30 percent Fox soils, and 10 percent minor soils.

Ockley soils are nearly level and gently sloping, deep, and well drained. They are on broad irregularly shaped flats, short side slopes, and low knolls that characterize the association. The surface layer is dark grayish brown and dark brown loam about 11 inches thick. The subsoil is 39 inches thick. In the upper 6 inches it is dark brown, friable heavy loam; in the next 5 inches it is dark brown, firm clay loam; in the 14 inches below that it is brown, firm sandy clay loam; in the next 7 inches it is dark brown friable light sandy clay loam; and in the lower 7 inches it is dark brown firm gravelly loam. The underlying material, to a depth of 60 inches, is brown stratified gravelly sand and fine sand.

Fox soils are nearly level to moderately sloping, moderately deep over sand and gravelly sand, and well drained. They are on broad, irregularly shaped flats and on the side slopes of drainageways, on knolls, and on breaks onto bottom lands. The surface layer is dark grayish brown loam about 8 inches thick. The subsoil is 26 inches thick. In the upper 7 inches it is dark brown, firm loam; in the next 7 inches it is dark brown, firm sandy clay loam; in the 5 inches below that it is dark brown, firm gravelly sandy clay loam; and in the lower 7 inches it is reddish brown, firm gravelly sandy clay loam. The underlying material, to a depth of 60 inches, is pale brown or very pale brown stratified gravelly loamy sand, gravelly sand, or sand.

The minor soils in this association are Genesee, Sleeth, Whitaker, Rensselaer, and Westland soils. The well drained Genesee soils are in the major drainageways. The somewhat poorly drained Sleeth and Whitaker soils and the very poorly drained Rensselaer and Westland soils are in shallow drainageways scattered through the association.

Ockley soils and the nearly level Fox soils are well suited to farming. If erosion is adequately controlled, the gently sloping and moderately sloping Fox soils are also well suited to farming. Droughtiness is the major limitation to use of the moderately deep Fox soils, which are droughty during the latter part of the growing season. Ockley soils and the nearly level and gently sloping Fox soils have only slight limitations for most nonfarm uses, but the moderately sloping Fox soils have moderate limitations.

This association is used mainly for farming. Corn, wheat, and soybeans are the principal crops. Cash-grain farming is the major farm enterprise. Some areas along State Highway 37 are used for urban development.

Very poorly drained and somewhat poorly drained, nearly level and gently sloping soils on terraces and uplands

The three associations in this group are in scattered areas throughout the county. The soils formed mainly in loamy outwash over gravelly sand and sand or in a thin silty layer and the underlying glacial till. Slope is dominantly nearly level. Gently sloping soils are of minor extent.

5. *Rensselaer-Whitaker association*

Very poorly drained and somewhat poorly drained, deep, nearly level soils that formed in loamy outwash over stratified silty, loamy, and sandy sediments

This association is on outwash plains and terraces and in old glacial sluiceways (fig. 3). It occupies about 6 percent of the county. This association is approximately 65 percent Rensselaer soils, 25 percent Whitaker soils, and 10 percent minor soils.

Rensselaer soils are nearly level and very poorly drained. They are in broad and narrow depressions. The surface layer is silty clay loam about 14 inches thick. It is very dark grayish brown in the upper part and very dark gray in the lower part. The subsoil is 28 inches thick. In the upper 11 inches it is mottled, dark gray, firm silty clay loam; in the next 11 inches it is mottled, olive gray, firm silty clay loam; and in the lower 6 inches it is mottled gray and yellowish brown, firm loam. Between depths of 42 and 49 inches the underlying material is mottled gray and yellowish brown sandy loam. Below this, to a depth of 60 inches, the underlying material is gray, stratified sandy loam and sand.

Whitaker soils are nearly level and somewhat poorly drained. They are on slightly higher flats and ridges within the broad and narrow depressions occupied by Rensselaer soils. The surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is grayish brown silt loam 4 inches thick. The subsoil is 32 inches thick. In the upper 4 inches it is mottled, brown, friable loam; in the next 14 inches it is mottled, dark grayish brown, firm clay loam; in the lower 6 inches it is mottled, grayish brown, friable loam. Between depths of 44 and 46 inches the underlying material is mottled, grayish brown, fine sandy loam. Below this, to a depth of 60 inches, the under-

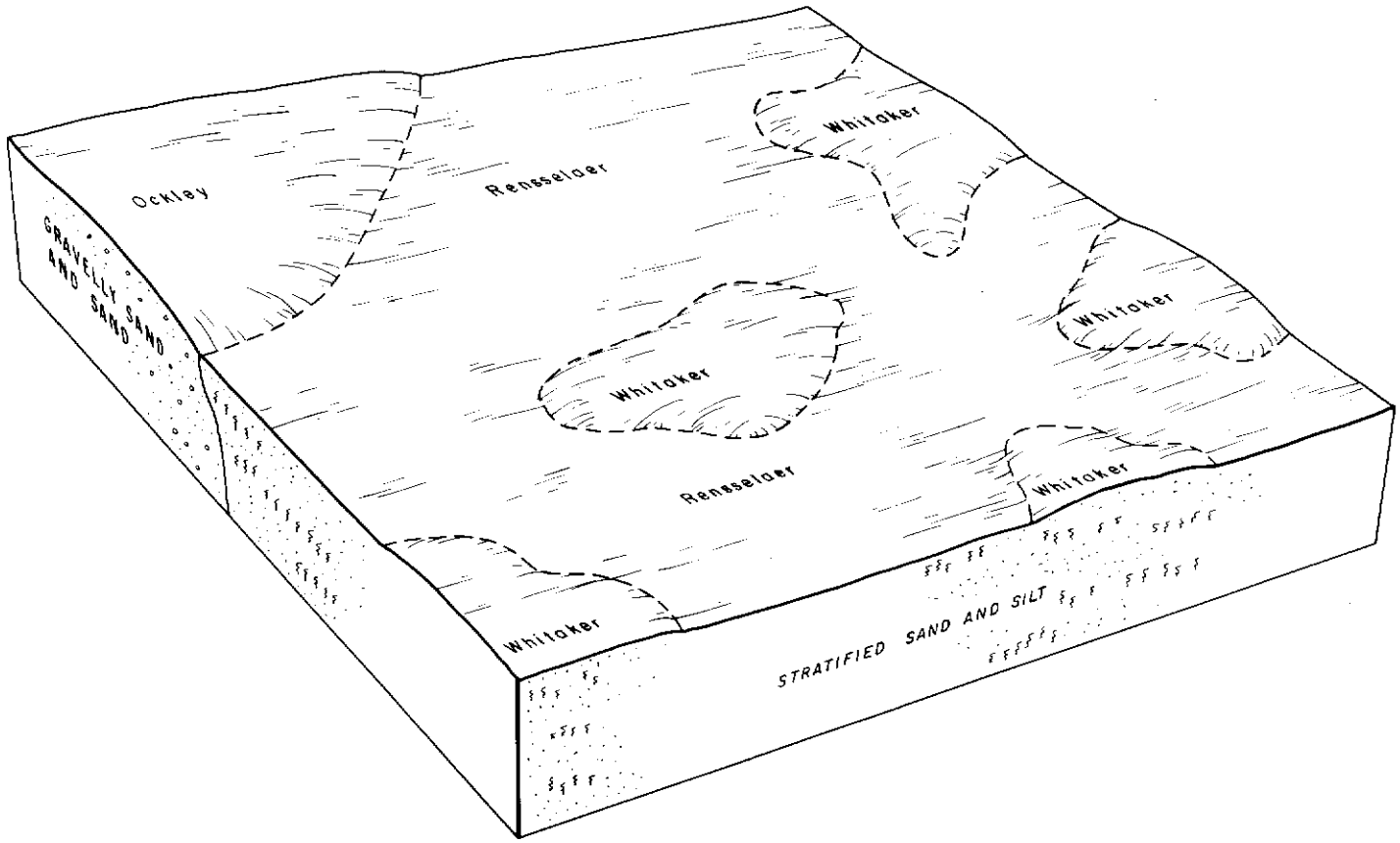


Figure 3.—**Typical pattern of soils and underlying material in the Rensselaer-Whitaker association.**

lying material is dark grayish brown, yellowish brown, light brownish gray, pale brown and light gray stratified silt loam, fine sand, and coarse sand.

The minor soils in this association are Fox, Ockley, Sleeth, and Westland soils. The well drained Fox and Ockley soils are on the high, broad outwash plains and terraces adjacent to the sluiceways. The somewhat poorly drained Sleeth soils and the very poorly drained Westland soils are intermingled with Rensselaer and Whitaker soils in some areas.

If adequately drained, Rensselaer and Whitaker soils are well suited to farming. Because of wetness, they have severe limitations for most nonfarm uses.

This association is used mainly for farming. Corn and soybeans are the principal crops. Small acreages are used for small grain and meadow. Cash-grain farming, hogs, and feeder cattle are the major farm enterprises.

6. *Westland-Sleeth association*

Very poorly drained and somewhat poorly drained, deep, nearly level soils that formed in loamy outwash over stratified sand and gravel

This association is on outwash plains and terraces and in old glacial sluiceways. It occupies about 6 percent of the county. This association is approximately 60 percent Westland soils, 30 percent Sleeth soils, and 10 percent minor soils.

Westland soils are nearly level and very poorly drained. They are in broad and narrow depressions. In some places the depressions are about one-half mile wide. The surface layer is black clay loam about 15 inches thick. The subsoil is 33 inches thick.. In the upper 6 inches the subsoil is mottled, dark gray, firm clay loam; in the next 11 inches it is mottled, dark grayish brown, firm clay loam; in the 6 inches below that it is mottled, gray, firm clay loam; and in the lower 10 inches it is mottled, dark gray, firm gravelly clay loam. The underlying material, to a depth of 60 inches, is stratified gray sandy loam, gravelly sand, and sand.

Sleeth soils are nearly level and are somewhat poorly drained. They are mostly on slightly higher flats and knolls within areas of the Westland soils. The surface layer is dark grayish brown loam about 9 inches thick. The subsurface layer is grayish brown, friable loam 4 inches thick. The subsoil is 35 inches thick. In the upper 4 inches the subsoil is mottled, yellowish brown, friable loam; in the next 10 inches it is yellowish brown and grayish brown, firm clay loam; in the 9 inches below that it is mottled, grayish brown, firm gravelly clay loam; in the next 8 inches it is mottled, dark gray, friable gravelly clay loam; and in the lower 4 inches it is dark gray, friable gravelly clay loam. The underlying material, to a depth of 60 inches, is light gray stratified coarse sand and fine gravel.

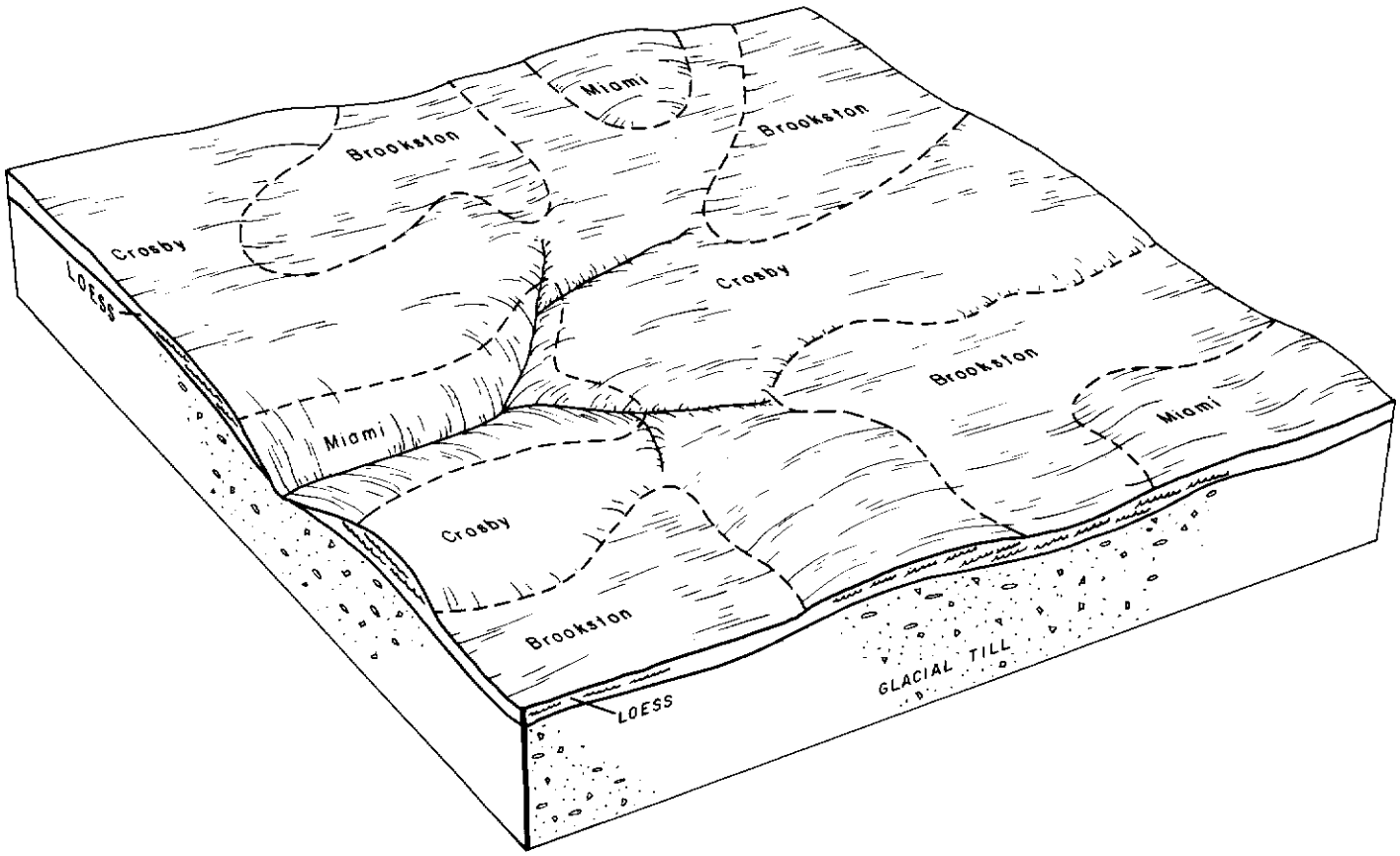


Figure 4.—**Typical pattern of soils and underlying material in the Crosby-Brookston association.**

The minor soils are Fox, Ockley, Rensselaer, and Whitaker soils. The well drained Fox and Ockley soils are on the high outwash plains and terraces adjacent to depressions or on isolated knolls. The very poorly drained Rensselaer soils and the somewhat poorly drained Whitaker soils are intermingled with Westland and Sleeth soils in some areas.

If adequately drained, Westland and Sleeth soils are well suited to farming. Because of wetness, they have severe limitations for most nonfarm uses.

This association is used mainly for farming. Corn and soybeans are the principal crops. Small acreages are used for small grains and meadow. Cash-grain farming, hogs, and feeder cattle are the major farm enterprises.

7. *Crosby-Brookston association*

Somewhat poorly drained and very poorly drained, deep, nearly level and gently sloping soils that formed in a thin silty layer and underlying glacial till

This association is on gently undulating till plains in the uplands (fig. 4). It occupies about 32 percent of the county. This association is approximately 54 percent Crosby soils, 34 percent Brookston soils, and 12 percent minor soils.

Crosby soils are nearly level and gently sloping and somewhat poorly drained. They are on higher, irregularly shaped flats and low knolls. The surface layer is grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam 5 inches thick. The subsoil is 23 inches thick. In the upper 6 inches the subsoil is mottled, grayish brown, firm clay loam; in the 11 inches below that it is mottled, brown, firm clay loam; and in the lower 6 inches it is mottled, yellowish brown, firm loam. The underlying material, to a depth of 60 inches, is mottled yellowish brown and pale brown loam.

Brookston soils are nearly level or depressional and very poorly drained. They are in depressions or narrow shallow drainageways. The surface layer is silty clay loam about 17 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is 29 inches thick. In the upper 5 inches it is mottled, dark gray, firm clay loam; in the next 8 inches it is mottled, gray, firm clay loam; and in the lower 16 inches it is mottled brownish yellow and light gray, firm clay loam. The underlying material, to a depth of 60 inches, is mottled light gray and brownish yellow loam.

The minor soils in this association are Miami, Eel, Genesee, and Shoals soils. The well drained Miami

Figure 5.—A soil pattern of light colored, somewhat poorly drained Crosby silt loam and dark colored, very poorly drained Brookston silty clay loam.

soils are on the side slopes of knolls and the larger drainageways; the moderately well drained Eel soils, the well drained Genesee soils, and the somewhat poorly drained Shoals soils are on the bottom lands of these drainageways.

If adequately drained, Crosby and Brookston soils are well suited to farming (fig. 5). Because of wetness, they have severe limitations for most nonfarm uses.

This association is used mainly for farming. Corn and soybeans are the principal crops. Small acreages are used for small grains and meadow. Cash-grain farming, hogs, and feeder cattle are the major farm enterprises. Some areas in the northern part of the county are used for urban development.

Well drained and somewhat poorly drained, nearly level to moderately steep soils on uplands

The two associations in this group are in scattered areas throughout the county. The soils formed in a thin silty layer and the underlying glacial till. Slope is dominantly nearly level and gently sloping, but ranges to moderately steep on the sides of drainageways.

8. Miami-Fincastle association

Well drained and somewhat poorly drained, deep, nearly level to moderately steep soils that formed in a thin to thick silty layer and underlying glacial till

This association is on moderately dissected, silt-mantled till plains between bottom lands and gently undulating till plains in the uplands. It occupies about 7 percent of the county. This association is approximately 60 percent Miami soils, 20 percent Fincastle soils, and 20 percent minor soils.

Miami soils are gently sloping to moderately steep and are well drained. They are on the sides of deep ravines and drainageways that characterize the association. The surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown, friable silt loam 3 inches thick. The subsoil is

24 inches thick. In the upper 4 inches it is a mixture of dark yellowish brown, firm light silty clay loam and brown, firm silt loam; in the next 16 inches it is dark yellowish brown, firm clay loam; and in the lower 4 inches it is a mixture of brown and dark yellowish brown, firm light clay loam. The underlying material, to a depth of 60 inches, is pale brown loam.

Fincastle soils are nearly level and gently sloping and somewhat poorly drained. They are on narrow flat ridgetops and on moderately broad flats that adjoin and lead to the flat ridgetops. The surface layer is dark grayish brown loam about 7 inches thick. The subsurface layer is grayish brown silt loam 5 inches thick. The subsoil is 33 inches thick. In the upper 11 inches it is mottled, brown, firm light silty clay loam; in the next 10 inches it is mottled, yellowish brown, firm silty clay loam; and in the lower 12 inches it is mottled, dark yellowish brown, firm clay loam. The underlying material, to a depth of 60 inches, is mottled light brownish gray and brownish yellow loam.

The minor soils in this association are Eel, Genesee, Hennepin, and Shoals soils. The moderately well drained Hennepin soils are on the steepest parts of side slopes adjacent to the bottom lands.

If erosion is adequately controlled, the gently sloping and moderately sloping Miami soils are well suited to farming. If adequately drained, the nearly level Fincastle soils are also well suited to farming. The strongly sloping and moderately steep Miami soils are best suited to pasture and woodland; they have severe limitations for most nonfarm uses. Because of wetness and slow permeability, the nearly level Fincastle soils also have severe limitations for most nonfarm uses, but the gently sloping and moderately sloping Miami soils have only moderate limitations.

This association is used mainly for farming. Corn and soybeans are the principal crops. Cash-grain farming is the major farm enterprise. If low areas are not adequately drained, winter grain is often damaged by ponded water. Some small areas are too wet for crops and are used for pasture. The steeper soils are used for permanent pasture or woodland.

9. *Crosby-Miami association*

Somewhat poorly drained and well drained, deep, nearly level to moderately steep soils that formed in a thin silty layer and underlying glacial till

This association is on slightly dissected till plains on uplands adjacent to broad, nearly level and gently sloping ground moraines (fig. 6). It occupies about 28 percent of the county. This association is approximately 60 percent Crosby soils, 30 percent Miami soils, and 20 percent minor soils.

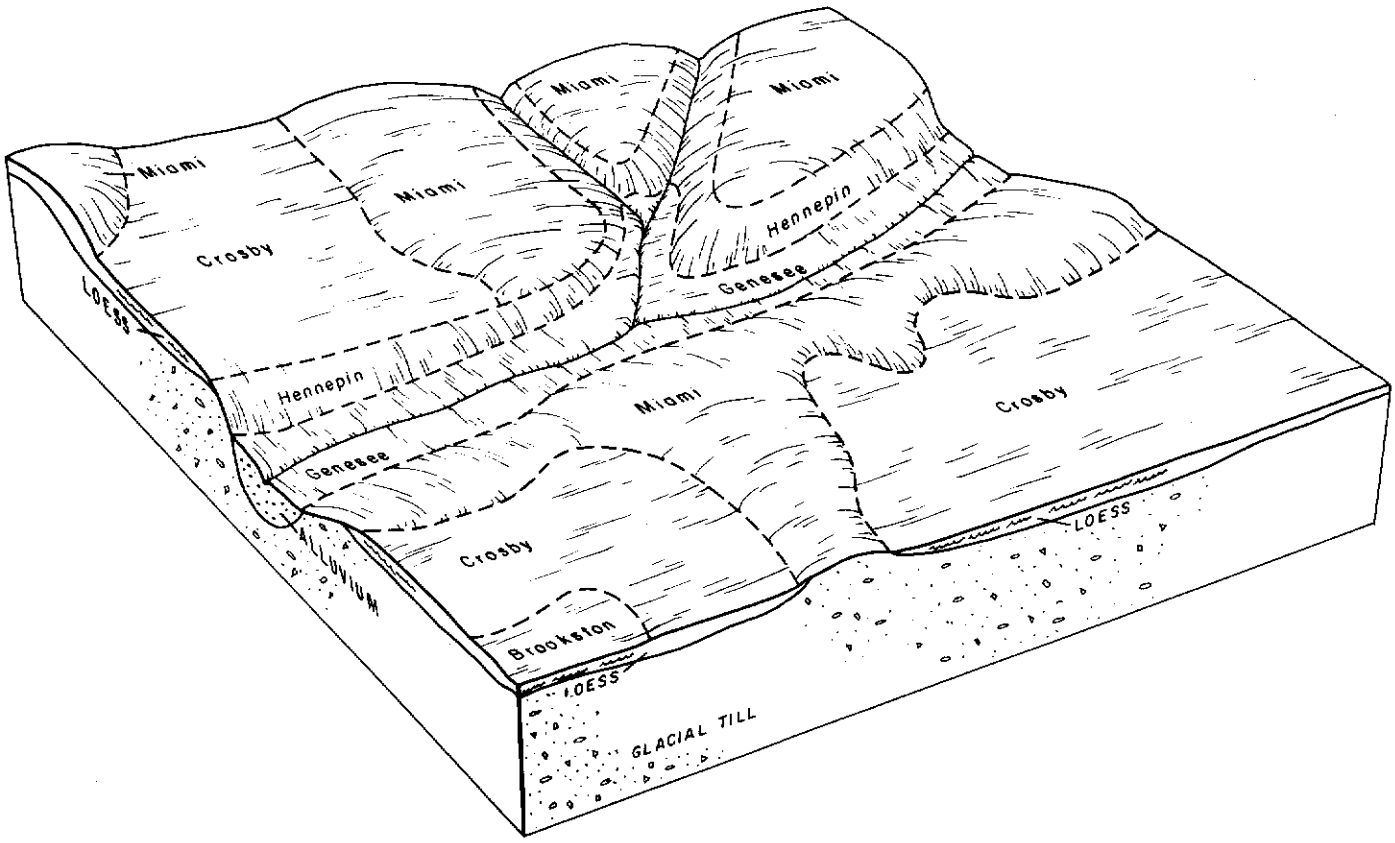


Figure 6.—Typical pattern of soils and underlying material in the Crosby-Miami association.

Crosby soils are nearly level and gently sloping and somewhat poorly drained. They are on irregularly shaped flats and ridgetops. The surface layer is grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam 5 inches thick. The subsoil is 23 inches thick. In the upper 6 inches it is mottled, grayish brown, firm clay loam; in the next 11 inches it is mottled, brown, firm clay loam; and in the lower 6 inches it is mottled, yellowish brown, firm loam. The underlying material, to a depth of 60 inches, is mottled yellowish brown and pale brown loam.

Miami soils are gently sloping to moderately steep and well drained. They are on side slopes and tops of hills and knolls that characterize the area. The surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown, friable silt loam 3 inches thick. The subsoil is 24 inches thick. In the upper 4 inches it is a mixture of dark yellowish brown, firm light silty clay loam and brown, firm silt loam; in the next 16 inches it is dark yellowish brown, firm clay loam; and in the lower 4 inches it is a mixture of brown and dark yellowish brown, firm light clay loam. The underlying material, to a depth of 60 inches, is pale brown loam.

The minor soils of this association are Brookston, Genesee, Hennepin, and Shoals soils. The very poorly drained Brookston soils are in narrow drainageways and the larger depressions on uplands. The well drained Hennepin soils are on steep breaks adjacent to narrow bottom lands. The well drained Genesee soils and the somewhat poorly drained Shoals soils are on narrow bottom lands.

If adequately drained, Crosby soils are well suited to farming. If erosion is adequately controlled, the gently sloping and moderately sloping Miami soils are also well suited to farming. Erosion and wetness are the main limitations to use of soils in this association. Water often ponds in low pockets for several days following a rain. The strongly sloping and moderately steep Miami soils are best suited to pasture or woodland. Because of wetness and slow permeability, the Crosby soils have severe limitations for most nonfarm uses. The strongly sloping and moderately steep Miami soils also have severe limitations for most nonfarm uses, but the gently sloping and moderately sloping Miami soils have only moderate limitations.

This association is used mainly for farming. Corn and soybeans are the principal crops. Cash-grain farming is the major farm enterprise. If low areas are not adequately drained, winter grain is often damaged by ponded water. Some small areas are too wet for crops and are used for pasture.

Well drained, gently sloping to very steep soils on uplands

The three associations in this group are mainly in the western and southern part of the county. The soils formed in loamy or silty material over outwash, glacial till, or bedrock. The soils are on strongly dissected landforms.

10. Miami-Hennepin association

Well drained, deep, gently sloping to very steep soils that formed in a thin silty layer and underlying glacial till

This association is on strongly dissected till plains in the uplands between bottom lands and more gently sloping till plains. It occupies about 3 percent of the county. This association is approximately 40 percent Miami soils, 40 percent Hennepin soils, and 20 percent minor soils.

Miami soils are gently sloping to moderately steep and well drained. They are on ridgetops and the sides of pronounced deep ravines and drainageways that characterize the association. The surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown friable silt loam 3 inches thick. The subsoil is 24 inches thick. In the upper 4 inches it is a mixture of dark yellowish brown, firm light silty clay loam and brown, firm silt loam; in the next 16 inches it is dark yellowish brown, firm clay loam; and in the lower 4 inches is a mixture of brown and dark yellowish brown, firm light clay loam. The underlying material, to a depth of 60 inches, is pale brown loam.

Hennepin soils are steep to very steep and well drained. They are on the steepest parts of the sides of ravines and on breaks between uplands and terraces or bottom lands. The surface layer is dark grayish brown loam about 6 inches thick. The subsoil is brown friable loam 8 inches thick. The underlying material, to a depth of 60 inches, is yellowish brown and dark yellowish brown loam.

The minor soils in this association are Crosby, Shoals, and Eel soils. The somewhat poorly drained Crosby soils are on wide ridgetops. The moderately well drained Eel soils and the somewhat poorly drained Shoals soils are on narrow bottom lands along meandering streams.

If erosion is adequately controlled, the gently sloping to strongly sloping Miami soils are suited to grasses, legumes, and an occasional row crop. The moderately steep Miami soils are best suited to permanent pasture or woodland. The steeply sloping and very steeply sloping Hennepin soils are best suited to woodland. Erosion is the major limitation to use of soils in this association. The strongly sloping and moderately steep Miami soils and the steeply sloping and very steeply sloping Hennepin soils have severe limitations for most nonfarm uses. The gently sloping and moderately sloping Miami soils have moderate limitations for most nonfarm uses.

This association is used mainly for pasture and woodland. Most of the gently sloping to strongly sloping soils have been cleared and are used for pasture and crops. The steeper soils are wooded.

11. Hickory-Parke association

Well drained, deep, gently sloping to very steep soils that formed in a thin to thick silty layer and underlying weathered glacial till and outwash

This association is on very strongly dissected till

plains adjacent to very strongly dissected bedrock and moderately dissected till plains in the uplands. It occupies about 2 percent of the county. This association is approximately 30 percent Hickory soils, 30 percent Parke soils, and 40 percent minor soils.

Hickory soils are strongly sloping to very steep. They are on the sides of the ravines that characterize the area. The surface layer is very dark grayish brown and dark grayish brown silt loam about 6 inches thick. The subsurface layer is brown, friable silt loam 7 inches thick. The subsoil is 50 inches thick. In the upper 7 inches it is yellowish brown, firm light clay loam; in the next 23 inches it is strong brown, firm clay loam; and in the lower 20 inches it is brownish yellow, firm light clay loam. The underlying material, to a depth of 73 inches, is olive brown loam.

Parke soils are gently sloping and moderately sloping. They are on ridgetops and upper side slopes between deep ravines. The surface layer is dark grayish brown silt loam about 4 inches thick. The subsurface is brown, friable silt loam 5 inches thick. The subsoil is 53 inches thick. In the upper 4 inches it is yellowish brown, friable silt loam; in the next 23 inches it is strong brown, firm silty clay loam; and in the lower 26 inches it is strong brown, friable loam. The underlying material, to a depth of 95 inches, is reddish brown, friable heavy loam.

The minor soils of this association are Eel, Muskingum, Muren, Shoals, and Wellston soils. The moderately well drained Eel soils and the somewhat poorly drained Shoals soils are on narrow bottom lands. The well drained Muskingum soils are on the lower, very steep side slopes. The moderately well drained Muren soils and the well drained Wellston soils are on ridgetops.

If erosion is adequately controlled, the gently sloping and moderately sloping Parke soils are suited to farming and the strongly sloping Hickory soils are suited to pasture and woodland. The moderately steep to very steep Hickory soils are suited to woodland. Because of slope, Hickory soils have severe limitations for most nonfarm uses, and Parke soils have moderate limitations.

This association is used mainly for recreation. Woodland, manmade lakes, and all-season homes are typical of this area.

12. *Muskingum-Wellston association*

Well drained, moderately deep and deep, steep and very steep and moderately sloping soils that formed in silty or loamy material over sandstone, siltstone, or shale

This association is on very strongly dissected bedrock adjacent to very strongly dissected and moderately dissected till plains in the uplands. It occupies about 1 percent of the county. This association is approximately 30 percent Muskingum soils, 15 percent Wellston soils, and 55 percent minor soils.

Muskingum soils are steep and very steep and moderately deep. They are on sides of deep ravines that characterize the area. The surface layer is dark grayish brown silt loam about 4 inches thick. The subsurface layer is light yellowish brown, very friable silt loam 6 inches thick. The subsoil is 15 inches thick. In the upper 9 inches it is yellowish brown, friable silt loam, and in the lower 6 inches it is yellowish brown or light yellowish brown, friable channery silt loam. The underlying material, to a depth of 34 inches, is dark yellowish brown channery silt loam. Below this is fractured sandstone and shale bedrock.

Wellston soils are moderately sloping and deep. They are on long narrow ridgetops between deep ravines. The surface layer is brown silt loam about 8 inches thick. The subsoil is 30 inches thick. In the upper 8 inches it is strong brown, friable or firm silt loam; in the next 11 inches it is strong brown and brown, firm silty clay loam; and in the lower 11 inches it is strong brown, firm silt loam. The underlying material, to a depth of 52 inches, is brownish yellow silt loam. Below this is fractured sandstone bedrock.

The minor soils in this association are Eel, Hickory, Hennepin, Parke, and Shoals soils. The well drained Hickory, Hennepin, and Parke soils are on ridgetops and side slopes. The somewhat poorly drained Shoals soils and the moderately well drained Eel soils are on narrow bottom lands.

Muskingum soils are best suited to woodland. If erosion is adequately controlled, the moderately sloping Wellston soils are well suited to farming. Because of slope, Wellston soils have moderate limitations for most nonfarm uses. Muskingum soils have severe limitations for most nonfarm uses.

This association is used mainly for recreation. Woodland, manmade lakes, and summer and all-season homes and buildings are typical of this area.

Descriptions of the soils

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

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface down to rock or other underlying material. The profile of each series is described twice. The first description is brief and in terms familiar to a layman. The second is more detailed and is for those who need to make thorough and precise studies of soils. The profile described is representative of mapping units in a series. If the profile of a given mapping unit is different from the one described for the series, the differences are apparent in the name of the mapping unit or are stated in describing the mapping unit. Color terms are for moist soil unless otherwise stated.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping

unit are the capability unit and woodland suitability subclass in which the mapping unit has been placed. The page where each capability unit is described is listed in the "Guide to Mapping Units" at the back of this survey.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with previously published soil maps of adjacent counties. Differences are the result of better knowledge of soils and modifications in series concepts as well as different intensity of mapping and extent of soils within the survey areas. In some places it is more feasible to combine small acreages of similar soils that respond in much the same way to use and management than it is to map them separately and under separate names.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*4*).[1]

Brookston series

The Brookston series consists of deep, nearly level or depressional, very poorly drained soils that formed in loess and the underlying calcareous glacial till. These soils are on broad till plains. The native vegetation was water-tolerant grasses and hardwood trees.

In a representative profile, the surface layer is silty clay loam about 17 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is 29 inches thick. In the upper 5 inches the subsoil is dark gray, mottled, firm clay loam; in the next 8 inches it is gray, mottled, firm clay loam; and in the lower 16 inches it is light gray, mottled, firm clay loam. The underlying material, to a depth of 60 inches, is mottled light gray and brownish yellow loam.

The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is high. These soils have a seasonal high water table that is within about a foot of the surface during some part of the year.

Brookston soils are extensive in the county. When adequately drained, they are well suited to farming.

Representative profile of Brookston silty clay loam, in a cultivated field 2,240 feet south and 360 feet west of the northeast corner of sec. 26, T. 14 N., R. 4 E.

Ap—0 to 8 inches; black (10YR 2/1) light silty clay loam; weak medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

A12—8 to 17 inches; very dark gray (10YR 3/1) silty clay loam; few fine faint light gray (10YR 7/1) mottles; moderate medium and coarse subangular blocky structure; friable; few fine roots; neutral; clear wavy boundary.

IIB2tg—17 to 22 inches; dark gray (10YR 4/1) clay loam; common fine faint yellowish brown (10YR 5/6) and olive brown (2.5Y 4/4) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; discontinuous faint thin dark gray (N 4/0) clay films on faces of peds; few fine pebbles; neutral; clear wavy boundary.

[1] Italic numbers in parentheses refer to References, p. 73.

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

Map symbol	Soil name	Area	Extent
		Acres	*Percent*
Br	Brookston silty clay loam	33,957	16.8
CrA	Crosby silt loam, 0 to 2 percent slopes	52,971	26.3
CsB2	Crosby-Miami silt loams, 2 to 4 percent slopes, eroded	10,675	5.3
Ee	Eel silt loam	3,906	1.9
FnA	Fincastle silt loam, 0 to 3 percent slopes	3,001	1.5
FoA	Fox loam, 0 to 2 percent slopes	3,402	1.7
FoB2	Fox loam, 2 to 6 percent slopes, eroded	2,003	1.0
FxC2	Fox complex, 6 to 12 percent slopes, eroded	2,205	1.1
Ge	Genesee loam	9,458	4.7
HeF	Hennepin loam, 25 to 50 percent slopes	4,702	2.3
HkD2	Hickory silt loam, 12 to 18 percent slopes, eroded	168	0.1
HkF	Hickory silt loam, 18 to 40 percent slopes	673	0.3
MnB2	Miami silt loam, 2 to 6 percent slopes, eroded	21,580	10.7
MnC2	Miami silt loam, 6 to 12 percent slopes, eroded	5,495	2.7
MnD2	Miami silt loam, 12 to 18 percent slopes, eroded	1,729	0.9
MnE	Miami silt loam, 18 to 25 percent slopes	1,528	0.8
MtB3	Miami clay loam, 2 to 6 percent slopes, severely eroded	821	0.4
MtC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	5,589	2.8
MtD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	2,669	1.3
MuA	Muren silt loam, 0 to 3 percent slopes	585	0.3
MxG	Muskingum silt loam, 25 to 50 percent slopes	620	0.3
NnA	Nineveh loam, 0 to 2 percent slopes	726	0.4
OcA	Ockley loam, 0 to 2 percent slopes	9,017	4.5
OcB2	Ockley loam, 2 to 6 percent slopes, eroded	1,398	0.7
Pa	Palms muck	151	0.1
PkB2	Parke silt loam, 2 to 6 percent slopes, eroded	385	0.2
PkC2	Parke silt loam, 6 to 12 percent slopes, eroded	595	0.3
Re	Rensselaer silty clay loam	8,164	4.0
Rs	Ross loam	475	0.2
Sh	Shoals silt loam	3,605	1.8
Sk	Sleeth loam	1,299	0.6
Sn	Sloan clay loam	913	0.5
WdC2	Wellston silt loam, 6 to 12 percent slopes, eroded	275	0.1
We	Westland clay loam	2,740	1.4
Wh	Whitaker silt loam	2,926	1.5
	Gravel pits	229	0.1
	Water	965	0.5
	Total	201,600	100.0

IIB22tg—22 to 30 inches; gray (10YR 5/1) clay loam; many medium distinct light olive brown (2.5Y 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; discontinuous distinct thick dark gray (10YR 4/1) clay films on faces of peds; few fine pebbles; neutral; clear wavy boundary.

IIB23tg—30 to 46 inches; light gray (10YR 6/1) clay loam; many medium distinct brownish yellow (10YR 6/8) mottles; moderate medium and coarse subangular blocky structure; firm; discontinuous distinct

thick dark gray (10YR 4/1) clay films on faces of peds; 3 percent fine gravel; neutral; clear wavy boundary.

IIC—46 to 60 inches; mottled light gray (10YR 6/1) and brownish yellow (10YR 6/6) loam; massive; firm; 5 percent fine and coarse gravel; strong effervescence; moderately alkaline.

The solum ranges from 35 to 60 inches in thickness. Thickness of the loess mantle ranges from 0 to 20 inches.

The Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2) silt loam, silty clay loam, or clay loam. It has weak or moderate, medium or coarse, granular structure. The A12 horizon is very dark gray (10YR 3/1) or dark gray (10YR 4/1) silty clay loam or clay loam. It has weak or moderate, medium or coarse, subangular blocky structure that parts to moderate, medium, or coarse granular.

The B21 horizon is dark gray (10YR 4/1), gray (10YR 5/1), or light brownish gray (10YR 6/2) clay loam or silty clay loam. The B22 horizon is gray (10YR 5/1) or dark gray (10YR 4/1) clay loam or silty clay loam. The B23 horizon is light gray (10YR 6/1) or gray (10YR 5/1). It has moderate, medium, prismatic structure that parts to moderate, medium or coarse, subangular or angular blocky. Some profiles have a B3 horizon, which is gray (10YR 5/1) or yellowish brown (10YR 5/4, 5/8) clay loam. It has coarse, subangular blocky structure. Mottles in the B horizon are common or many, fine or medium, and faint to prominent.

The C horizon is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence. The lower part of the B horizon and the C horizon have few or common cobbles and are 1 to 5 percent fine and coarse gravel.

Brookston soils have drainage similar to that of Rensselaer, Sloan, and Westland soils. Brookston soils have a loam C horizon, and Rensselaer soils have a stratified sandy loam and sand C horizon. Brookston soils have less gravel in the B horizon than Westland soils. They have a Bt horizon, and Sloan soils do not.

Br—Brookston silty clay loam. This nearly level soil is on broad flats and in depressions and narrow drainageways between better drained soils on broad plains. Most areas are irregularly shaped but some are elongated or rounded. Areas of this soil range from 2 to 200 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of somewhat poorly drained Crosby soils and Shoals soils, small areas of very poorly drained Sloan soils, small areas of Brookston soils that have a surface layer of grayish brown or brownish gray silt loam 10 to 20 inches thick, and small areas of very poorly drained soils that have thin discontinuous strata of loamy sand, sandy loam, and loam in the underlying soil material. Also included are small, isolated, undrained wet areas. These areas are shown on the map by a special symbol.

Runoff is very slow or ponded. Wetness is the main limitation to use of this soil and is a severe limitation for most nonfarm uses. If adequately drained, this soil is well suited to corn and soybeans. Most areas are cultivated. A few areas are wooded. Wooded areas have fair stands of hardwood trees, but some have been heavily pastured. Capability unit IIw-1; woodland suitability subclass 2w.

Crosby series

The Crosby series consists of deep, nearly level and gently sloping, somewhat poorly drained soils that formed in loess and the underlying calcareous glacial till. These soils are on broad till plains. The native vegetation was hardwood treees.

In a representative profile, the surface layer is grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is 23 inches thick. In the upper 6 inches the subsoil is grayish brown, mottled, firm clay loam; in the next 11 inches it is brown, mottled, firm clay loam; and in the lower 6 inches it is yellowish brown, mottled, firm loam. The underlying material, to a depth of 60 inches, is mottled yellowish brown and pale brown loam.

The available water capacity is high, and permeability is slow. The organic-matter content of the surface layer is low. These soils have a seasonal high water table within about 1 to 3 feet of the surface during some part of the year.

Crosby soils are extensive in the county. When adequately drained, they are well suited to farming.

Representative profile of Crosby silt loam, 0 to 2 percent slopes, in a cultivated field 1,330 feet west and 1,185 feet south of the northeast corner of sec. 21, T. 13 N., R. 4 E.

Ap—0 to 8 inches; grayish brown (10YR 5/2) silt loam; moderate medium and coarse granular structure; friable; few fine roots; medium acid; abrupt smooth boundary.

A2—8 to 13 inches; dark grayish brown (10YR 4/2) silt loam; weak thick platy structure parting to moderate medium granular; friable; few fine roots; medium acid; abrupt smooth boundary.

IIB21t—13 to 19 inches; grayish brown (10YR 5/2) clay loam; many medium prominent yellowish brown (10YR 5/8) mottles; moderate fine and medium subangular blocky structure; firm; few fine roots; few pebbles; continuous distinct thin gray (10YR 6/1) clay films on faces of peds; strongly acid; clear wavy boundary.

IIB22t—19 to 30 inches; brown (10YR 5/3) clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; few pebbles; continuous distinct thin grayish brown (10YR 5/2) clay films on faces of peds; common fine very dark grayish brown (10YR 3/2) concretions of iron and manganese oxides; slightly acid; clear wavy boundary.

IIB23t—30 to 36 inches; yellowish brown (10YR 5/6) loam; common medium distinct gray (10YR 5/1) mottles; weak coarse subangular blocky structure; firm; few pebbles; discontinuous faint thin grayish brown (10YR 5/2) clay films on faces of peds; neutral; clear wavy boundary.

IIC—36 to 60 inches; mottled yellowish brown (10YR 5/6) and pale brown (10YR 6/3) loam; massive; firm; 3 to 5 percent fine and coarse gravel; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness, but typically is 26 to 36 inches thick. Thickness of the loess mantle ranges from 0 to 18 inches.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 5/3) loam or silt loam. The A2 horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2) loam or silt loam.

The B2 horizon is brown (10YR 5/3), grayish brown (10YR 5/2), pale brown (10YR 6/3), or yellowish brown (10YR 5/6) clay loam or silty clay loam. Mottles are common or many, fine and medium, faint or distinct. Some profiles have a B3 horizon.

The C horizon is mildly alkaline or moderately alkaline

and has slight effervescence or strong effervescence. The lower part of the B horizon and the C horizon have few cobbles and are 1 to 5 percent fine and coarse gravel.

Crosby soils have drainage similar to that of Fincastle, Sleeth, and Whitaker soils. Crosby soils have a thinner silt mantle than Fincastle soils. Crosby soils do not have stratification in the solum as do Sleeth and Whitaker soils.

CrA—Crosby silt loam, 0 to 2 percent slopes. This nearly level soil is on broad plains, on ridgetops in rolling areas, and in low drainageways. Most areas are irregularly shaped, but some on ridgetops are long and narrow. Areas of this soil range from 2 to 150 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of very poorly drained Brookston soils in depressions and narrow water courses, small and intricately associated areas of somewhat poorly drained soils that contain less clay in the subsoil than this Crosby soil, and small areas of soils that have calcareous underlying material at a depth of less than 24 inches.

Runoff is slow. Wetness is the main limitation to use of this soil. If adequately drained, this soil is well suited to corn, soybeans, and most small grain and meadow crops. Because of wetness and slow permeability, this soil has severe limitations for most nonfarm uses. Most areas are farmed. The few wooded areas have fair stands of hardwood trees, but some have been heavily pastured. Capability unit IIw-2; woodland suitability subclass 3w.

CsB2—Crosby-Miami silt loams, 2 to 4 percent slopes, eroded. This gently sloping complex is on broad plains; on low knolls within broad, nearly level plains; and at the heads of drainageways. Most areas are irregularly shaped or rounded, but some are elongated or fan-shaped. They range from 2 to 30 acres.

This mapping unit is about 60 percent somewhat poorly drained Crosby soils, 30 percent well drained Miami soils, and 10 percent other soils. In areas where slopes are uniform, Crosby soils are on the lower and upper parts of the slopes and the Miami soils are on the middle parts. In hummocky areas, Crosby soils are on the lower knolls and ridges and on the lower parts of the higher knolls and ridges, and the Miami soils are on the upper parts of the higher knolls and ridges.

Crosby soils have a profile similar to the one described as representative of the series, but the surface layer is thinner and incorporates some clay loam. A profile of this Miami soil, in an uneroded part of the mapping unit, was described as representative of the Miami series.

Included in mapping are small areas of nearly level Crosby soils and small areas of very poorly drained Brookston soils in slight depressions. Also included are small areas of Crosby-Miami silt loams that have been wooded or are in permanent pasture for many years and that are not eroded and small areas of moderately well drained soils that are somewhat similar to Miami soils.

Runoff is medium. If drainage is adequate and erosion is controlled, these soils are well suited to corn, soybeans, small grain, grasses, and legumes. Because of wetness and slow permeability, Crosby soils have severe limitations for most nonfarm uses and Miami soils have moderate limitations for most nonfarm uses. Most areas are cultivated. The few wooded areas have fair stands of hardwood trees. A moderate hazard of erosion is the main limitation to use of this complex. Wetness is also a limitation for Crosby soils. Capability unit IIe-12; Crosby soils in woodland suitability subclass 3w, Miami soils in woodland suitability subclass 1o.

Eel series

The Eel series consists of deep, nearly level, moderately well drained soils that formed in loamy alluvium. These soils are on flood plains of rivers and creeks. The native vegetation was hardwood trees.

In a representative profile, the surface layer is dark grayish brown silt loam about 8 inches thick. The underlying material is brown, friable silt loam in the upper 9 inches; in the next 9 inches it is brown, mottled, friable loam; and in the next 14 inches it is brown, mottled, friable silt loam. Below this, to a depth of 60 inches, the underlying material is dark grayish brown, mottled, stratified loam and sandy loam.

The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is moderate. These soils have a seasonal high water table about 3 to 6 feet below the surface during some part of the year.

Eel soils are of moderate extent. They are well suited to farming, but crops are subject to damage from flooding.

Representative profile of Eel silt loam, in a cultivated field 660 feet east and 430 feet north of the southwest corner of sec. 32, T. 13 N., R. 3 E.

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

C1—8 to 17 inches; brown (10YR 4/3) silt loam; weak fine and medium granular structure; friable; few fine roots; neutral; clear smooth boundary.

C2—17 to 26 inches; brown (10YR 5/3) loam; common fine and medium distinct dark grayish brown (10YR 4/2) and light brownish gray (10YR 6/2) mottles; weak medium granular structure; friable; few pebbles; mildly alkaline; clear smooth boundary.

C3—26 to 40 inches; brown (10YR 5/3) silt loam; many fine and medium distinct dark grayish brown (10YR 4/2) and light brownish gray (10YR 6/2) mottles; weak fine and medium granular structure; friable; mildly alkaline; clear smooth boundary.

C4—40 to 60 inches; dark grayish brown (10YR 4/2) stratified sandy loam and loam; many medium light brownish gray (10YR 6/2) mottles; friable; mildly alkaline; slight effervescence.

Reaction throughout the profile is neutral to moderately alkaline.

The Ap horizon is dark grayish brown (10YR 4/2), dark brown (10YR 4/3), very dark grayish brown (10YR 3/2), or brown (10YR 5/3) silt loam or loam.

The C horizon is brown (10YR 4/3, 5/3), dark grayish brown (10YR 4/2), or yellowish brown (10YR 5/4) silt loam, loam, sandy loam, or thin strata of loamy sand or sand.

Eel soils are in the same landscape as well drained Genesee soils, somewhat poorly drained Shoals soils, and very poorly drained Sloan soils. Eel soils are moderately well drained.

Ee—Eel silt loam. This nearly level soil is on broad flood plains of rivers and on narrow flood plains of meandering creeks. Most areas are long and narrow, but some are irregularly shaped. Areas of this soil range from 5 to 40 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of somewhat poorly drained Shoals soils and very poorly drained Sloan soils.

Runoff is slow and flooding is a hazard. This soil is well suited to corn and soybeans, and most areas are cultivated. Wooded areas have poor to fair stands of hardwood trees. The soil is subject to flooding in winter and early in spring, and it is occasionally flooded during some growing seasons. Because of flooding, this soil has severe limitations for most nonfarm uses. Capability unit I-2; woodland suitability subclass 1o.

Fincastle series

The Fincastle series consists of deep, nearly level and gently sloping, somewhat poorly drained soils that formed in loess and the underlying calcareous glacial till. These soils are on broad till plains. The native vegetation was hardwood trees.

In a representative profile, the surface layer is dark grayish brown loam about 7 inches thick. The subsurface layer is grayish brown silt loam 5 inches thick. The subsoil is 33 inches thick. In the upper 11 inches the subsoil is brown, mottled, firm light silty clay loam; in the next 10 inches it is yellowish brown, mottled, firm silty clay loam; and in the lower 12 inches it is dark yellowish brown, mottled, firm clay loam. The underlying material, to a depth of 60 inches, is mottled light brownish gray and brownish yellow loam.

The available water capacity is high. Permeability is moderately slow in the subsoil and slow to moderate in the underlying till. The organic-matter content of the surface layer is low. These soils have a seasonal high water table about 1 to 3 feet below the surface during some part of the year.

Fincastle soils are of minor extent in the county. When adequately drained, they are well suited to farming.

Representative profile of Fincastle silt loam, 0 to 3 percent slopes, in a cultivated field 50 feet east and 25 feet north of the southwest corner of sec. 22, T. 11 N., R. 3 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; weak medium granular structure; friable; neutral; many fine roots; abrupt smooth boundary.

A2—7 to 12 inches; grayish brown (10YR 5/2) silt loam; weak medium platy structure parting to weak medium granular; friable; few fine roots; neutral; clear smooth boundary.

B1t—12 to 23 inches; brown (10YR 4/3) light silty clay loam; many medium distinct light gray (10YR 6/1) mottles; moderate fine and medium subangular and angular blocky structure; firm; few fine roots; continuous distinct thin to thick light brownish gray (10YR 6/2) clay films and silt coatings on faces of peds; slightly acid; clear smoooth boundary.

B21t—23 to 33 inches; yellowish brown (10YR 5/4) silty clay loam; many medium distinct light brownish gray (10YR 6/2) mottles; moderate medium and coarse subangular blocky structure; firm, continuous distinct thin light brownish gray (10YR 6/2) silt coatings and clay films on faces of peds; few medium black (10YR 2/1) iron and manganese oxide concretions; strongly acid; clear smooth boundary.

IIB22t—33 to 38 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; patchy faint thin light brownish gray (10YR 6/2) clay films on faces of peds; few medium very dark grayish brown (10YR 3/2) iron and manganese oxide concretions; few pebbles; medium acid; clear smooth boundary.

IIB3t—38 to 45 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few pebbles; neutral; clear smooth boundary.

IIC—45 to 60 inches; mottled light brownish gray (10YR 6/2) and brownish yellow (10YR 6/6) loam; firm; massive; 3 to 5 percent fine and coarse gravel; strong effervescence; moderately alkaline.

The solum ranges from 36 to 60 inches in thickness, but typically is 40 to 50 inches thick. Thickness of the loess mantle ranges from 20 to 36 inches.

The Ap horizon is dark grayish brown (10 YR 4/2) or grayish brown (10YR 5/2), and the A2 horizon is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2).

The B2 horizon is grayish brown (10YR 5/2) or brown (10YR 4/3, 5/3). Some profiles have a B1 horizon, which is brown (10YR 4/3, 5/3) or pale brown (10YR 6/3) heavy silt loam or light silty clay loam.

The C horizon is yellowish brown, light brownish gray, or brownish yellow. The lower part of the B horizon and the C horizon have a few cobbles and are 1 to 5 percent fine and coarse gravel.

Fincastle soils have drainage similar to that of Crosby, Sleeth, and Whitaker soils. Fincastle soils have a thicker silt mantle than Crosby soils. They lack the stratification that is in the solum of Sleeth and Whitaker soils.

FnA—Fincastle silt loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is on silt-mantled till plains and on ridgetops in rolling areas. Most areas are irregularly shaped, but some on ridgetops are elongated. Areas of this soil range from 2 to 100 acres. In a few areas where slopes are 2 or 3 percent, the brown silty clay loam subsoil is mixed with the original surface layer.

Included with this soil in mapping are small areas of somewhat poorly drained Crosby soils and small areas of very poorly drained Brookston soils in depressions and narrow watercourses. Also included are small areas of soils that have a grayer profile than Fincastle soils and small areas of moderately well drained soils that are somewhat similar to Fincastle soils.

Runoff is slow or medium. Wetness is the main limitation to use of this soil, but erosion is also a hazard where slopes are 3 percent. If adequately drained, this soil is well suited to corn, soybeans, and most small grain and meadow crops. Because of wetness and slow permeability, this soil has severe limitations for most nonfarm uses. Most areas are farmed.

The small wooded areas have fair stands of hardwood trees, but some have been heavily pastured. Capability unit IIw-2; woodland suitability subclass 3w.

Fox series

The Fox series consists of nearly level to moderately sloping, well drained soils that are moderately deep over sand and gravelly loamy sand. These soils are on outwash plains and terraces, kames, and eskers. The native vegetation was hardwood trees.

In a representative profile, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is 26 inches thick. In the upper 7 inches the subsoil is dark brown, firm loam; in the next 7 inches it is dark brown, firm sandy clay loam; in the next 5 inches it is dark brown, firm gravelly sandy clay loam; and in the lower 7 inches it is reddish brown, firm gravelly sandy clay loam. The underlying material, to a depth of 60 inches, is pale brown and very pale brown, stratified gravelly loamy sand and sand.

The available water capacity is moderate, and permeability is moderate. The organic-matter content of the surface layer is moderate.

Fox soils are of moderate extent. They are suited to all crops commonly grown in the county. Most gravel and sand pits are in areas of Fox soils.

Representative profile of Fox loam, 0 to 2 percent slopes, in a field 1,980 feet west and 530 feet south of the northeast corner of sec. 29, T. 11 N., R. 5 E.

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

B21t—8 to 15 inches; dark brown (7.5YR 4/4) loam; moderate fine and medium subangular blocky structure; firm; few fine roots; few pebbles; neutral; clear wavy boundary.

B22t—15 to 22 inches; dark brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; few fine roots; discontinuous distinct thin dark brown (7.5YR 3/2) clay films on faces of peds; 3 to 5 percent coarse gravel; neutral; clear wavy boundary.

B23t—22 to 27 inches; dark brown (7.5YR 4/4) gravelly sandy clay loam; moderate medium subangular blocky structure; firm; discontinuous distinct thin dark brown (7.5YR 3/2) clay films on faces of peds; neutral; clear wavy boundary.

B3t—27 to 34 inches; reddish brown (5YR 4/4) gravelly sandy clay loam; weak medium subangular blocky structure; firm; patchy distinct thin dark reddish brown (5YR 3/3) clay films on faces of peds and on some pebbles; neutral; abrupt irregular boundary.

IIC1—34 to 39 inches; pale brown (10YR 6/3) gravelly loamy sand; weak fine granular structure; very friable; violent effervescence; moderately alkaline; abrupt wavy boundary.

IIC2—39 to 60 inches; very pale brown (10YR 7/3) sand; single grained; loose; 2 percent fine and coarse gravel; violent effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness, but typically is 30 to 40 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3). It is dominantly loam, but it ranges to sandy loam and silt loam. Some profiles have an A2 horizon, which is grayish brown (10YR 5/2), brown (10YR 5/3), or dark brown (7.5YR 4/4) sandy loam or loam.

The B2 horizon is dark brown (7.5YR 4/4) or dark yellowish brown (10YR 4/4) loam, clay loam, gravelly clay loam, or sandy clay loam. The B3 horizon is dark reddish brown (5YR 3/2) or reddish brown (5YR 4/4) light clay loam, loam, gravelly loam, or gravelly sandy clay loam. In places, tongues of the B3 horizon extend 1 foot to 4 feet into the C horizon (fig. 7).

The C horizon is yellowish brown, pale brown, or very pale brown.

Fox soils have drainage similar to that of Nineveh and Ockley soils. Fox soils have a thinner solum than Ockley soils and have a lighter colored A horizon than Nineveh soils.

FoA—Fox loam, 0 to 2 percent slopes. This nearly level soil is on broad outwash plains and terraces adjacent to the bottom lands of the rivers and creeks and on the tops of kames and eskers. Most areas are irregularly shaped, but some are rounded or elongated. Areas of this soil range from 2 to 100 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of very poorly drained Westland soils in long, narrow, faintly defined drainageways, small areas of darker

Figure 7.—**Profile of Fox loam, 2 to 6 percent slopes, eroded, showing tongues that are characteristic of this soil.**

colored Nineveh soils, and small areas of gently sloping Fox soils.

Runoff is slow. Droughtiness is the main limitation to use of this soil. This soil is suited to corn, soybeans, small grain, grasses, and legumes. It has slight limitations for most nonfarm uses. Most areas are farmed. Wooded areas have fair stands of hardwood trees, but some have been heavily pastured. Capability unit IIs-1; woodland suitability subclass 1o.

FoB2—Fox loam, 2 to 6 percent slopes, eroded. This gently sloping soil is on side slopes of drainageways within broad outwash plains and terraces and on side slopes of kames and eskers. Most areas are long and narrow, but some are rounded or irregularly shaped. The areas range from 2 to 30 acres. Slopes are short and dominantly 4 percent. This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and includes some dark brown material from the subsoil. Small areas of this soil that have been in woods or pasture for many years have not been eroded.

Included with this soil in mapping are small areas of severely eroded soils, which are shown on the map by a special symbol, small areas of nearly level or moderately sloping Fox soils, small areas of soils that have a darker colored surface layer, and small areas of very poorly drained Westland and Rensselaer soils in weakly defined drainageways.

Runoff is medium. This soil is well suited to small grain, grasses, and legumes, and is moderately well suited to corn and soybeans. Most areas of this soil are cultivated or in pasture. The few small wooded areas have poor to fair stands of hardwood trees. The main concern of management is controlling erosion. Droughtiness is also a limitation. This soil has only slight limitations for most nonfarm uses. Capability unit IIe-9; woodland suitability subclass 1o.

FxC2—Fox complex, 6 to 12 percent slopes, eroded. This mapping unit is moderately sloping. It is on side slopes of drainageways, on steep breaks, and on side slopes of hummocky areas of kames and eskers. Most areas are long and narrow, but some are rounded or irregularly shaped. The areas range from 2 to 30 acres. Slopes are short and irregular; most range from 10 to 12 percent.

Fox soils that have a surface layer of sandy loam, loam, gravelly clay loam, sandy clay loam, and clay loam make up this complex. Most areas are eroded or severely eroded, but small areas that have been in woods or permanent pasture for many years are not eroded. These soils are adjacent to each other and are too intricately associated to be mapped separately.

Fox loam, 6 to 12 percent slopes, eroded, makes up about 45 percent of this complex. It has a profile similar to the one described as representative of the Fox series, but the surface layer is thinner and includes some dark brown material from the subsoil.

Severely eroded soils make up about 45 percent of this complex. The surface layer of these soils is dark brown to brown and consists of material from the original surface layer mixed with material from the upper part of the subsoil. Cobbles, stones, and pebbles are scattered on the surface and are in the surface layer. Depth to the underlying gravelly sand and sand varies considerably within short distances.

Included in mapping are small areas of gently sloping and steep to very steep soils, soils underlain by gravelly sand and sand at a depth of less than 24 inches, where calcareous gravelly sand and sand are exposed, well drained soils that have a higher sand content throughout their profile, and soils that have less than 6 inches of gravel between the subsoil and the underlying loam till. Also included are small areas of severely eroded soils and very steeply sloping soils that are shallow to gravelly sand and sand; these are shown on the map by a special symbol.

Runoff is medium. The soils are suited to small grains, grasses, and legumes. Because of slope, they have moderate limitations for most nonfarm uses. Most areas are cultivated or are in pasture. The few small wooded areas have poor to fair stands of hardwood trees. The hazard of erosion is moderate. Droughtiness is a limitation. Capability unit IIIe-9; woodland suitability subclass 1o.

Genesee series

The Genesee series consists of deep, nearly level, well drained soils that formed in loamy alluvium. These soils are on the flood plains of rivers and creeks. The native vegetation was hardwood trees.

In a representative profile, the surface layer is dark grayish brown loam about 8 inches thick. The underlying material is dark brown, friable silt loam in the upper 9 inches; in the next 13 inches it is dark yellowish brown, friable heavy silt loam; and in the 10 inches below that it is brown, friable heavy silt loam. Below this, to a depth of 60 inches, it is yellowish brown stratified loam, loamy sand, and sandy loam.

The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is moderate.

Genesee soils are of moderate extent. They are well suited to farming, but crops are subject to damage from flooding.

Representative profile of Genesee loam, in a hayfield 1,720 feet east and 2,370 feet south of the northwest corner of sec. 20, T. 11 N., R. 5 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate fine and medium granular structure; friable; many fine roots; mildly alkaline; clear smooth boundary.

C1—8 to 17 inches; dark brown (10YR 4/3) silt loam; moderate fine and medium granular structure; friable; many fine roots; mildly alkaline; clear smooth boundary.

C2—17 to 30 inches; dark yellowish brown (10YR 3/4) heavy silt loam; weak fine subangular blocky structure; friable; common fine roots; mildly alkaline; clear smooth boundary.

C3—30 to 40 inches; brown (10YR 4/3) heavy silt loam; weak medium subangular blocky structure; friable; few fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

C4—40 to 48 inches; yellowish brown (10YR 5/4) loam;

massive; friable; slight effervescence; moderately alkaline; clear smooth boundary.

C5—48 to 60 inches; yellowish brown (10YR 5/8) thinly stratified loamy sand and sandy loam; massive; very friable; slight effervescence; moderately alkaline.

Reaction throughout the profile is neutral to moderately alkaline.

The Ap horizon is dark grayish brown (10YR 4/2), dark brown (10YR 4/3, 3/3), or brown (10YR 5/3). It is dominantly loam, but it ranges to fine sandy loam and silt loam.

The C horizon is dark yellowish brown, brown, dark brown, or yellowish brown silt loam, loam, or sandy loam. Thin strata of fine sandy loam, loamy sand, and loam are also in places.

Genesee soils are in the same landscape as moderately well drained Eel soils, somewhat poorly drained Shoals soils, very poorly drained Sloan soils, and well drained Ross soils. Genesee soils have a lighter colored A horizon than Ross soils. They differ from the other soils in being well drained.

Ge—Genesee loam. This nearly level soil is on broad flood plains of rivers and the larger creeks and on narrow flood plains of meandering creeks. Most areas are long and broad, but some are long and narrow. Areas of this soil range from 2 to 200 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Eel, Ross, and Shoals soils. Also included are small areas of well drained alluvial soils that have thick strata of fine sand and loamy sand at a depth of less than 24 inches or that are sandier throughout their profile than this Genesee soil. Small sand bars and sand spots are shown on the soil map by special symbols.

Runoff is slow. Flooding is the main hazard in the use and management of this soil. This soil is subject to flooding in winter and early in spring, and it is subject to occasional flooding of short duration during some growing seasons. It is well suited to corn and soybeans. Because of flooding, it has severe limitations for most nonfarm uses. Most areas of this soil are cultivated. Wooded areas have poor to fair stands of hardwood trees. Capability unit I-2; woodland suitability subclass 1o.

Hennepin series

The Hennepin series consists of deep, steep and very steep, well drained soils that formed in calcareous glacial till. These soils are on side slopes and escarpments along streams and drainageways of till plains. The native vegetation was hardwood trees.

In a representative profile, the surface layer is dark grayish brown loam about 6 inches thick. The subsoil is brown, friable loam 8 inches thick. The underlying material, to a depth of 60 inches, is yellowish brown and dark yellowish brown loam.

The available water capacity is high, and permeability is moderate or moderately slow. The organic-matter content of the surface layer is moderate.

Hennepin soils are of minor extent in the county. They are best suited to trees.

Representative profile of Hennepin loam, 25 to 50 percent slopes, in a wooded area 720 feet north and 25 feet east of southwest corner of sec. 24, T. 11 N., R. 3 E.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) loam; moderate fine and medium granular structure; friable; many fine roots; neutral; clear smooth boundary.

B2—6 to 14 inches; brown (10YR 4/3) loam; moderate fine and medium granular structure; friable; neutral; common fine roots; clear wavy boundary.

C—14 to 60 inches; yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) loam; massive; friable; strong effervescence; moderately alkaline.

The solum ranges from 8 to 20 inches in thickness, but typically is 12 to 15 inches thick. Thickness of the solum coincides with depth to effervescent soil material. Reaction in the solum is neutral.

The A horizon is dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2). It is dominantly loam, but it ranges to fine sandy loam and silt loam.

The B horizon is brown (10YR 4/3) or yellowish brown (10YR 5/4) loam and is 6 to 12 inches thick.

The C horizon is yellowish brown (10YR 5/4), dark yellowish brown (10YR 4/4), or light yellowish brown (10YR 6/4) loam. It has slight effervescence or strong effervescence and is mildly alkaline or moderately alkaline. The lower part of the B horizon and the C horizon have few cobbles and are 1 to 5 percent fine and coarse gravel.

Hennepin soils have the same drainage as Hickory and Muskingum soils. Hennepin soils are less acid and contain less clay than Hickory soils. They are less acid than Muskingum soils.

HeF—Hennepin loam, 25 to 50 percent slopes. This steep and very steep soil is on side slopes between broad areas of nearly level Crosby and Fincastle soils and nearly level soils on bottom lands or terraces. Most areas are long and narrow, but some are irregularly shaped. Areas of this soil range from 2 to 100 acres. Slopes average 120 feet in length, but range from 30 to 300 feet.

Included with this soil in mapping are small areas of moderately steep Miami soils, small areas of steep and very steep Hickory soils, small areas of soils that have a surface layer of gravelly loam or that have large glacial stones party or fully exposed on the surface, small areas that have 1 to 3 inches of partly decomposed leaf litter on the surface, and small pastured areas where rills and gullies have developed. Areas of Hennepin soils that are too narrow and steep to map separately are shown on the soil map by a special symbol.

Runoff is very rapid, and the main concern of management is controlling erosion on the steep and very steep slopes. This soil is best suited to woodland or wildlife. Wooded areas have fair stands of hardwood trees. Because of steep slopes, this soil has severe limitations for most nonfarm uses. Capability unit VIIe-2; woodland suitability subclass 1r.

Hickory series

The Hickory series consists of deep, strongly sloping to very steep, well drained soils that formed in a thin layer of silt and the underlying weathered glacial till. These soils are on strongly dissected uplands. The native vegetation was hardwood trees.

In a representative profile, the surface layer is very dark grayish brown and dark grayish brown silt loam about 6 inches thick. The subsurface layer is brown, friable silt loam 7 inches thick. The subsoil is 50 inches thick. In the upper 7 inches it is yellowish brown, firm light clay loam; in the next 23 inches it is strong brown, firm clay loam; and in the lower 20 inches it is brownish yellow, firm light clay loam. The underlying material, to a depth of 73 inches, is olive brown loam.

The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is moderate.

Hickory soils are of minor extent in the county. They are suited to pasture or woodland.

Representative profile of Hickory silt loam, 18 to 40 percent slopes, in a wooded area 10 feet east and 1,200 feet north of the southwest corner of sec. 32, T. 11 N., R. 3 E.

A11—0 to 2 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

A12—2 to 6 inches; dark grayish brown (10YR 4/2) silt loam; weak medium granular structure; friable; many fine roots; strongly acid; abrupt smooth boundary.

A2—6 to 13 inches; brown (10YR 5/3) silt loam; moderate fine and medium granular structure; friable; many fine roots; strongly acid; clear wavy boundary.

IIB1t—13 to 20 inches; yellowish brown (10YR 5/6) light clay loam; moderate fine and medium subangular blocky structure; firm; common fine and coarse roots; discontinuous faint thin brown (10YR 5/3) clay films on faces of peds; few stones; strongly acid; clear wavy boundary.

IIB21t—20 to 30 inches; strong brown (7.5YR 5/6) clay loam; moderate medium subangular blocky structure; firm; few fine medium and coarse roots; discontinuous distinct thin very pale brown (10YR 7/3) clay and silt films on faces of peds; few stones; strongly acid; clear wavy boundary.

IIB22t—30 to 43 inches; strong brown (7.5YR 5/6) clay loam; moderate medium angular and subangular blocky structure; firm; few coarse roots; discontinuous distinct thin brownish yellow (10YR 6/6) clay films on faces of peds; few very dark brown (10YR 2/2) concretions of iron and manganese oxides; few stones; strongly acid; clear wavy boundary.

IIB3t—43 to 63 inches; brownish yellow (10YR 6/6) light clay loam; common medium distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; firm; few fine roots; few stones and pebbles; neutral; clear wavy boundary.

IIC—63 to 73 inches; olive brown (2.5Y 4/4) loam; massive; firm; slight effervescence; moderately alkaline.

The solum ranges from 42 to 75 inches in thickness, but typically is 42 to 65 inches thick.

The A1 or Ap horizon is dark grayish brown (10YR 4/2), very dark grayish brown (10YR 3/2), or very dark brown (10YR 2/2). It is dominantly silt loam, but it ranges to loam.

The B2t horizon is brown (10YR 5/3), dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4, 5/6), or strong brown (7.5YR 5/6) clay loam or light silty clay loam. It contains a few pebbles and an occasional cobblestone.

The C horizon is loam or light clay loam. It contains a few pebbles and cobbles.

Hickory soils have the same drainage as Hennepin and Muskingum soils. Hickory soils are more acid and have more clay in the solum than Hennepin soils. They have a thicker solum than Muskingum soils.

HkD2—Hickory silt loam, 12 to 18 percent slopes, eroded. This strongly sloping soil is on thin silt-mantled dissected glacial uplands and on side slopes and point slopes of deep ravines. Areas of this soil range from 2 to 30 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and contains some yellowish brown material from the subsoil. Small areas of this soil that have been in woods or permanent pasture for many years have not been eroded.

Included with this soil in mapping are small areas of well drained Wellston soils and Parke soils on gently sloping and moderately sloping ridges, and small areas of well drained soils that have more than 18 inches of silt overlying the glacial till. Small areas of severely eroded and gullied soils are shown on the soil map by a special symbol.

Runoff is rapid, and the main concern in management is controlling erosion. This soil is best suited to grasses and legumes or to trees. Most areas are idle or have regrowth timber. Because of slope, this soil has severe limitations for most nonfarm uses. Capability unit IVe-1; woodland suitability subclass 1o.

HkF—Hickory silt loam, 18 to 40 percent slopes. This moderately steep to very steep soil is on thin, silt-mantled, dissected glacial uplands and on side slopes and point slopes of deep ravines. Areas of this soil range from 20 to 200 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of well drained Hennepin soils and Muskingum soils and small areas of strongly sloping Hickory soils.

Runoff is rapid to very rapid on this soil, and the hazard of erosion is severe. This soil is suited to woodland or wildlife. Most areas have been in woodland for many years. Because of slope, this soil has severe limitations for most nonfarm uses. Capability unit VIe-1; woodland suitability subclass 1r.

Miami series

The Miami series consists of deep, gently sloping to moderately steep, well drained soils that formed in loess and the underlying calcareous glacial till. These soils are on till plains. The native vegetation was hardwood trees.

In a representative profile, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown, friable silt loam 3 inches thick. The subsoil is 24 inches thick. In the upper 4 inches it is a mixture of dark yellowish brown, firm light silty clay loam and brown, firm silt loam; in the next 16 inches it is dark yellowish brown, firm clay loam; and in the lower 4 inches it is a mixture of brown and dark yellowish brown, firm light clay loam. The underlying material, to a depth of 60 inches, is pale brown loam.

The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is moderate.

Miami soils are extensive. They are suited to all crops commonly grown in the county.

Representative profile of Miami silt loam, in an uneroded area of Crosby-Miami silt loams, 2 to 4 percent slopes, eroded, 1,720 feet west and 450 feet north of the southeast corner of sec. 26, T. 14 N., R. 4 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and medium granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.

A2—7 to 10 inches; brown (10YR 4/3) silt loam; weak thick platy structure parting to moderate medium granular; friable; few fine roots; silghtly acid; clear wavy boundary.

A&B—10 to 14 inches; brown (10YR 4/3) silt loam (A2) and dark yellowish brown (10YR 4/4) light silty clay loam (B2t); moderate fine subangular blocky structure; firm; few fine roots; discontinuous distinct thin dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; clear wavy boundary.

IIB21t—14 to 23 inches; dark yellowish brown (10YR 4/4) clay loam; few fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular and angular blocky structure; firm; few fine roots; discontinuous distinct thin dark grayish brown (10YR 4/2) and dark yellowish brown (10YR 4/4) clay films on faces of peds; 2 percent fine and coarse gravel; medium acid; clear wavy boundary.

IIB22t—23 to 30 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium and coarse subangular blocky structure; firm; discontinuous distinct thin dark brown (10YR 3/3) clay films on faces of peds; 2 percent fine and coarse gravel; medium acid; clear wavy boundary.

IIB3—30 to 34 inches; mottled brown (10YR 5/3) and dark yellowish brown (10YR 3/4) light clay loam; massive; firm; 2 percent fine and coarse gravel; neutral; clear wavy boundary.

IIC—34 to 60 inches; pale brown (10YR 6/3) loam; massive; firm; 3 to 5 percent fine and coarse gravel; few cobbles and stones; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness, but typically is 28 to 36 inches thick. Thickness of the loess mantle ranges from 0 to 20 inches.

The Ap horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or brown (10YR 4/3). It is dominantly silt loam, but in some areas it is loam. The A2 horizon is brown (10YR 4/3, 5/3) or yellowish brown (10YR 5/4, 5/6) silt loam or loam.

The B2t horizon is dark brown (10YR 4/3, 7.5YR 4/4) or dark yellowish brown (10YR 4/4) silty clay loam or clay loam. Clay films are thin to thick and patchy to continuous.

The C horizon is mildly alkaline or moderately alkaline. The lower part of the B horizon and the C horizon have few cobbles and are 1 to 5 percent fine and coarse gravel.

Miami soils have drainage similar to that of Fox, Hickory, Ockley, and Parke soils. Miami soils do not have as much gravel in the lower part of the solum as Fox and Ockley soils. They are not so acid and have a thinner solum than Hickory and Parke soils.

MnB2—Miami silt loam, 2 to 6 percent slopes, eroded. This gently sloping soil is on sides of drainageways through areas of somewhat poorly drained Crosby soils; on isoated small knolls on broad, nearly level till plains; and on ridgetops. Most areas are irregularly shaped. Areas of this soil range from 2 to 60 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner in most areas. Small areas of this soil that have been in woods or permanent pasture for many years are not eroded.

Included with this soil in mapping are small areas of somewhat poorly drained Crosby soils and very poorly drained Brookston soils in weakly defined drainageways, small areas of moderately sloping and strongly sloping Miami soils along larger drainageways, and small areas of moderately well drained soils that are somewhat similar to Miami soils. Also included, in the southwestern part of the county where the loess is thicker, are small areas of well drained soils, similar to this Miami soil, that have a silt mantle more than 20 inches thick. Small areas of severely eroded soils are shown on the soil map by a special symbol.

Runoff is medium. The hazard of erosion is moderate, and erosion control practices are needed. This soil is well suited to corn, soybeans, and deep rooted legumes. Because of slope, this soil has moderate limitations for most nonfarm uses. Most areas are farmed. The wooded areas have poor to fair stands of hardwood trees, but many have been heavily pastured. Capability unit IIe-1; woodland suitability subclass 1o.

MnC2—Miami silt loam, 6 to 12 percent slopes, eroded. This moderately sloping soil is on irregularly shaped knolls surrounded by gently sloping and nearly level soils, in long narrow bands around ridgetops, on sides of drainageways leading to terraces or bottom land, or on undulating moraines. Areas of this soil range from 2 to 30 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner. Areas of this soil have many shallow crossable drainageways. Small areas that have been wooded or in permanent pasture for many years are not eroded.

Included with this soil in mapping are small areas of gently sloping Miami soils, small areas where rills have formed and cobbles and stones are on the surface and in the surface layer, severely eroded areas shown on the soil map by a special symbol, very small areas of somewhat poorly drained Crosby soils and very poorly drained Brookston soils in depressions and narrow drainageways, and small areas of well drained Fox soils near terrace breaks. Also included, in the southwestern part of the county where the loess is thicker, are small areas of well drained soils similar to this Miami soil that have a silt mantle more than 20 inches thick.

Runoff is medium. The hazard of erosion is moderate, and erosion control practices are needed. This soil is suited to small grain, grasses and legumes, and an occasional row crop. Because of slope, this soil has moderate limitations for most nonfarm uses. Most areas are farmed. Wooded areas have poor to fair stands of hardwoods, and some have been heavily pastured. Capability unit IIIe-1; woodland suitability subclass 1o.

MnD2—Miami silt loam, 12 to 18 percent slopes, eroded. This strongly sloping soil is on side slopes between gently sloping Miami soils and steeply sloping Miami and Hennepin soils, on sides of drainageways, and on breaks between nearly level uplands and bottom lands or terraces. Most areas are irregularly shaped, but some are long and narrow. Areas of this soil range from 2 to 20 acres. This soil has a profile similar to the

one described as representative of the series, but the surface layer and subsoil are thinner and the depth to the underlying calcareous soil material is 24 to 28 inches. Small areas of this soil that have been in woods or permanent pasture for many years are not eroded.

Included with this soil in mapping are small areas of severely eroded soils, which are shown on the soil map by a special symbol; small areas of moderately sloping or moderately steep Miami soils; and small areas of soil that is less than 24 inches to calcareous underlying material.

Runoff is rapid. The main concern in management is controlling erosion. This soil is poorly suited to row crops. It is best suited to small grain, grasses, and legumes. Because of slope, this soil has severe limitations for most nonfarm uses, and most areas are now in pasture or woodland. Wooded areas are small to moderate in size and have fair stands of hardwood trees. Capability unit IVe-1; woodland suitability subclass 1o.

MnE—Miami silt loam, 18 to 25 percent slopes. This moderately steep soil is on short side slopes and breaks between broad areas of nearly level, somewhat poorly drained Crosby soils and very poorly drained Brookston soils and areas of nearly level, very poorly drained soils on bottom lands or terraces. It is also on side slopes of strongly dissected uplands. Most areas are irregularly shaped, but some are long and narrow. Areas of this soil range from 10 to 40 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner and the depth to calcareous soil material is 24 to 26 inches. Cobbles are scattered on the surface and occasional small boulders are half-buried in the surface layer. Most areas of this soil have remained in woodland, and as a result, the organic-matter content of the upper part of the surface layer is higher than in other Miami soils.

Included with this soil in mapping are small areas of strongly sloping Miami soils, steep to very steep Hennepin soils, and soils that are not so deep to the underlying calcareous material. Also included are small areas of soils on bottom lands that are too narrow to map separately.

Runoff is rapid, and the main concern in management is controlling erosion. Steepness of slope is the main limitation of this soil. This soil is best suited to woodland and wildlife. Because of slope, it has severe limitations for most nonfarm uses. Most areas are in woodland and have fair stands of hardwood trees. Capability unit VIe-1; woodland suitability subclass 1r.

MtB3—Miami clay loam, 2 to 6 percent slopes, severely eroded. This gently sloping soil is on sides of knolls, on isolated knobs within areas of less eroded Miami soils, or in narrow bands around heads of drainageways. Most areas are irregularly shaped but some are long and narrow. Areas of this soil range from 2 to 10 acres. This soil has a profile similar to the one described as representative of the series, but the original surface layer has been eroded and the remaining surface layer has been mixed with some material from the upper part of the subsoil to form a plow layer of yellowish brown or dark yellowish brown clay loam about 7 inches thick. Pebbles, stones, and cobbles are scattered on the surface and are in the plow layer.

Included with this soil in mapping are small areas of Miami soils that are less severely eroded or are moderately sloping and small areas of nearly level, somewhat poorly drained Crosby soils that are intricately mixed with areas of the Miami soils.

Surface runoff is rapid. The main concern in management is controlling erosion. Poor workability, in comparison with surrounding or adjacent soils that have a surface layer of silt loam, is also a limitation. Most areas of this soil are farmed and are managed in the same manner as surrounding less eroded and gently sloping soils. Because of slope, this soil has moderate limitations for most nonfarm uses. Capability unit IIIe-1; woodland suitability subclass 1c.

MtC3—Miami clay loam, 6 to 12 percent slopes, severely eroded. This moderately sloping soil is on sides of irregularly shaped knolls surrounded by gently sloping and nearly level soils, in long narrow bands around more level soils on ridgetops, on sides of drainageways of terraces and bottom lands, and on side slopes of undulating moraines. Areas of this soil average about 4 acres, but range from 2 to 15 acres. This soil has a profile similar to the one described as representative of the series, but the original surface layer has been eroded. The remaining surface layer has been mixed with some material from the upper part of the subsoil to form a dark brown to dark yellowish brown plow layer of clay loam about 7 inches thick. Pebbles, stones, and cobbles are scattered on the surface and are in the plow layer.

Included with this soil in mapping are small areas of Miami soils that are less eroded or are strongly sloping, small areas that have calcareous soil material exposed on the surface or at a depth of less than 24 inches, and very small areas of well drained Fox soils.

Runoff is rapid. The hazard of erosion is severe. This soil is poorly suited to cultivated crops; it is best suited to small grain, grasses, and legumes. Because of slope, this soil has moderate limitations for most nonfarm uses. Most areas are farmed, but some areas are in pasture or are idle. Capability unit IVe-1; woodland suitability subclass 1c.

MtD3—Miami clay loam, 12 to 18 percent slopes, severely eroded. This strongly sloping soil is on side slopes between moderately sloping Miami soils and moderately steep Miami and Hennepin soils, on isolated knolls and side slopes within areas of moderately sloping Miami soils and nearly level Crosby and Brookston soils, and on breaks between more nearly level soils on uplands and bottom lands or terraces. Areas of this soil range from 2 to 10 acres. This soil has a profile similar to the one described as representative of the series, but the original surface layer has been eroded. The remaining surface layer has been mixed with some material from the upper part of the subsoil to form a dark brown to dark yellowish brown surface layer of clay loam about 7 inches thick. Many cobbles,

stones, and pebbles are on the surface and in the plow layer. Depth to the underlying calcareous soil material is 24 to 26 inches.

Included with this soil in mapping are small areas of less eroded Miami soils, small areas of more sloping or less sloping Miami soils, very small areas of Fox soils, and small areas that have calcareous soil material exposed on the surface or at a depth of less than 24 inches.

Runoff is very rapid, and the hazard of erosion is severe. Slope is the main limitation to use of this soil. This soil is poorly suited to cultivated crops; it is best suited to permanent pasture or to woodland. Because of slope, this soil has severe limitations for most nonfarm uses. Most areas are now in permanent pasture or young regrowth woodland. Capability unit VIe-1; woodland suitability subclass 1c.

Muren series

The Muren series consists of deep, nearly level to gently sloping, moderately well drained soils that formed in silty deposits 5 to 8 feet thick over glacial till. These soils are on narrow to broad ridgetops of strongly dissected till plains. The native vegetation was hardwood trees.

In a representative profile, the surface layer is brown silt loam about 8 inches thick. The subsurface layer is brown silt loam 6 inches thick. The subsoil is 32 inches thick. In the upper 12 inches the subsoil is yellowish brown, mottled, firm silty clay loam and in the lower 20 inches it is dark yellowish brown, mottled, firm silty clay loam. The underlying material, to a depth of 60 inches, is mottled dark yellowish brown and grayish brown silt loam.

The available water capacity is high, and permeability is moderately slow. The organic-matter content of the surface layer is moderate.

Muren soils are of minor extent. They are well suited to farming.

Representative profile of Muren silt loam, 0 to 3 percent slopes, in a cultivated field 1,320 feet west and 1,450 feet north of the southeast corner of sec. 36, T. 11 N., R. 3 E.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam; weak medium granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

A2—8 to 14 inches; brown (10YR 5/3) silt loam; moderate medium granular structure; friable; few fine roots; slightly acid; clear smooth boundary.

B21t—14 to 19 inches; yellowish brown (10YR 5/6) silty clay loam; few fine faint light gray (10YR 7/2) mottles; moderate fine and medium subangular blocky structure; firm; medium acid; clear smooth boundary.

B22t—19 to 26 inches; yellowish brown (10YR 5/6) silty clay loam; common medium distinct light brownish gray (10YR 6/2) mottles; firm patchy distinct thin pale brown (10YR 6/3) clay films on faces of peds; strongly acid; clear smooth boundary.

B23t—26 to 37 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium angular blocky structure; firm; continuous distinct thin grayish brown (10YR 5/2) clay films on surfaces of peds; strongly acid; clear smooth boundary.

B24t—37 to 46 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine and medium subangular blocky structure; firm; discontinuous distinct thin grayish brown (10YR 5/2) clay films on faces of peds; strongly acid; clear smooth boundary.

C—46 to 60 inches; mottled dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) silt loam; massive; friable; medium acid.

The solum ranges from 40 to 60 inches in thickness, but typically is 45 to 55 inches thick.

The Ap and A12 horizons are dark yellowish brown (10YR 4/4), brown (10YR 4/3), or dark grayish brown (10YR 4/2). Some profiles have an A2 horizon, which is brown (10YR 5/3), yellowish brown (10YR 5/4), or light yellowish brown (10YR 6/4) silt loam.

The B2t horizon is yellowish brown (10YR 5/4,5/6), dark yellowish brown (10YR 4/4), brown (10YR 5/3), or light yellowish brown (10YR 6/4) heavy silt loam or silty clay loam. The Bt horizon has few or common, fine or medium, faint or distinct mottles;

The C horizon is medium acid to neutral.

Muren soils in most landscapes are near Hickory, Parke, and Wellston soils. Muren soils are moderately well drained, and the Hickory, Parke, and Wellston soils are well drained. The entire solum of Muren soils formed in silts, whereas the lower part of the solum of Hickory soils formed in weathered Illinoian-age till; the lower part of the solum of Parke soils formed in weathered Illinoian-age till or outwash; and the lower part of the solum of Wellston soils formed in material weathered from sandstone, siltstone, or shale.

MuA—Muren silt loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is on ridgetops. Most areas are irregularly shaped, but some are long and narrow. Areas of this soil range from 2 to 40 acres. Slope is dominantly 2 percent.

Included with this soil in mapping are small areas of somewhat poorly drained soils that are on the more nearly level flats and small areas of well drained Parke soils and Hickory soils.

Runoff is slow to medium. This soil is well suited to corn, soybeans, small grain, and other adapted crops. Because of moderately slow permeability, it has moderate limitations for most nonfarm uses. Most areas are in pasture or woodland. Wooded areas have fair stands of hardwood trees. Capability unit I-1; woodland suitability subclass 1o.

Muskingum series

The Muskingum series consists of moderately deep, steep and very steep, well drained soils that formed in residuum weathered from interbedded sandstone, siltstone, and shale. These soils are on side slopes of strongly dissected uplands.

In a representative profile, the surface layer is dark grayish brown silt loam about 4 inches thick. The subsurface layer is light yellowish brown silt loam 6 inches thick. The subsoil is 15 inches thick. In the upper 9 inches the subsoil is yellowish brown, friable silt loam, and in the lower 6 inches it is yellowish brown and light yellowish brown, friable channery silt loam. The underlying material, which extends to a depth of 34 inches, is dark yellowish brown channery silt loam. Below this is fractured sandstone and shale bedrock.

The available water capacity is moderate, and permeability is moderate. The organic-matter content of the surface layer is moderate.

Muskingum soils are of minor extent in the county. They are suited to woodland and wildlife.

Representative profile of Muskingum silt loam, 25 to 50 percent slopes, in a wooded area 1,025 feet east and 1,585 feet north of the southwest corner of sec. 34, T. 11 N., R. 3 E.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; very friable; many fine and medium roots; 5 percent coarse fragments; medium acid; clear wavy boundary.

A2—4 to 10 inches; light yellowish brown (10YR 6/4) silt loam; weak fine subangular blocky structure; very friable; many fine and medium roots; 5 percent coarse fragments; medium acid; clear wavy boundary.

B21—10 to 19 inches; yellowish brown (10YR 5/4) silt loam; moderate fine and medium subangular blocky structure; friable; many fine roots and few medium roots; 10 percent coarse fragments; strongly acid; gradual wavy boundary.

B22—19 to 25 inches; yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4) channery silt loam; moderate fine and medium subangular blocky structure; friable; few fine roots; 15 percent coarse fragments; strongly acid; gradual wavy boundary.

C—25 to 34 inches; dark yellowish brown (10YR 4/4) channery silt loam; few fine distinct pale brown (10YR 6/3) mottles; weak fine and medium subangular blocky structure; friable; 40 percent coarse fragments; strongly acid; abrupt wavy boundary.

R—34 inches; fractured sandstone and shale.

The solum is 16 to 30 inches thick and depth to fractured bedrock is 20 to 40 inches.

The A1 horizon is dark grayish brown (10YR 4/2), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3). The A2 horizon is light yellowish brown (10YR 6/4), yellowish brown (10YR 5/4), or brown (10YR 5/3).

The B2 horizon is yellowish brown (10YR 5/4, 5/6) or dark yellowish brown (10YR 4/4) silt loam or channery silt loam.

The C horizon is dark yellowish brown (10YR 4/4, 3/4) channery or very channery silt loam or loam.

The underlying bedrock is fractured sandstone, siltstone, and shale.

Muskingum soils in most landscapes are near Wellston, Hickory, and Hennepin soils. They have less clay and more coarse fragments throughout the profile than Wellston soils. Muskingum soils are underlain by bedrock, but Hickory and Hennepin soils are underlain by glacial till.

MxG—Muskingum silt loam, 25 to 50 percent slopes. This steep and very steep soil is on middle and lower side slopes and point slopes of strongly dissected sandstone, siltstone, and shale uplands. Most areas are irregularly shaped. Areas of this soil range from 10 to 80 acres.

Included with this soil in mapping are small areas of Wellston, Hickory, and Hennepin soils; small areas of soils on bottom lands that are too narrow to map separately; and some outcrops of bedrock, which are shown on the soil map by special symbols.

Runoff is very rapid, and the hazard of erosion is severe. Slope is the main limitation to use of this soil. This soil is poorly suited to cultivated crops or to pasture; it is best suited to woodland. Because of erosion and slope, this soil has severe limitations for most nonfarm uses. Most areas are wooded and have fair stands of hardwood trees. Capability unit VIIe-2; woodland suitability subclass 3f.

Nineveh series

The Nineveh series consists of nearly level, well drained soils that are moderately deep over stratified sands and gravel. These soils are on broad outwash plains and terraces. The native vegetation was tall prairie grasses and scattered hardwood trees.

In a representative profile, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is dark brown clay loam 7 inches thick. The subsoil is 21 inches thick. In the upper 12 inches the subsoil is dark brown, firm clay loam; in the next 5 inches it is dark brown, firm gravelly clay loam; and in the lower 4 inches it is dark reddish brown, firm gravelly loam. The underlying material, to a depth of 60 inches, is stratified very coarse sand and fine gravel.

The available water capacity is moderate. Permeability is moderate in the surface layer and subsoil and very rapid in the underlying material. The organic-matter content of the surface layer is high.

Nineveh soils are of minor extent in the county. They are well suited to farming.

Representative profile of Nineveh loam, 0 to 2 percent slopes, in a cultivated field 40 feet west and 20 feet north of the southeast corner of sec. 34, T. 11 N., R. 5 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam; dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; common fine roots; few pebbles; neutral; abrupt smooth boundary.

A3—8 to 15 inches; dark brown (10YR 3/3) clay loam; weak medium subangular blocky structure; friable; few fine roots; discontinuous faint thin very dark grayish brown (10YR 3/2) clay and organic films on faces of peds; few pebbles; neutral; clear wavy boundary.

B21t—15 to 27 inches; dark brown (10YR 3/3) clay loam; moderate medium subangular blocky structure; firm; continuous faint thin very dark grayish brown (10YR 3/2) clay and organic films on faces of peds; 10 percent fine gravel; neutral; abrupt wavy boundary.

B22t—27 to 32 inches; dark brown (10YR 3/3) gravelly clay loam; moderate medium subangular blocky structure; firm; common continuous faint thin very dark grayish brown (10YR 3/2) clay and organic films on faces of peds; neutral; clear wavy boundary.

B3t—32 to 36 inches; dark reddish brown (5YR 3/3) gravelly loam; weak coarse subangular blocky structure; firm, sticky when wet; mildly alkaline; abrupt irregular boundary.

IIC—36 to 60 inches; brown (10YR 5/3) stratified very coarse sand and fine gravel; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 24 to 42 inches in thickness, but typically is 30 to 40 inches thick. Reaction throughout the solum is slightly acid to mildly alkaline.

The Ap horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3, 7.5YR 3/2) loam. It is dominantly loam, but ranges to silt loam. The A3 horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3) loam or clay loam.

The B2 horizon is dark brown (7.5YR 4/4, 10YR 3/3) or very dark grayish brown (10YR 3/2) loam, clay loam, or gravelly loam. The clay films are continuous or discontinuous.

The B3t horizon is dark reddish brown (5YR 3/2, 3/3) gravelly clay loam or gravelly loam. Tongues of this horizon extend 5 to 15 inches into the underlying C horizon.

The IIC horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4) very coarse sand and fine gravel or gravelly sand and sand.

Nineveh soils have drainage similar to that of Fox, Ockley, and Ross soils. Nineveh soils have a darker colored A horizon than Fox soils. They have a darker colored A horizon and a thinner solum than Ockley soils. Nineveh soils have stronger structure than Ross soils.

NnA—Nineveh loam, 0 to 2 percent slopes. This nearly level soil is on broad outwash plains and terraces. Most areas are irregularly shaped. Areas of this soil range from 2 to about 100 acres.

Included with this soil in mapping are small areas of well drained Fox and Ockley soils, small areas of soils that do not have as dark and thick a surface layer, and small areas of soils that are not as deep to stratified gravelly sand and sand.

Runoff is slow. This soil is well suited to corn and soybeans. It has slight limitations for most nonfarm uses. Most areas are farmed. Capability unit IIs-1; woodland suitability subclass 1o.

Ockley series

The Ockley series consists of deep, nearly level and gently sloping, well drained soils that formed in loamy outwash over stratified gravelly sand and sand. These soils are on broad outwash plains and terraces. The native vegetation was hardwood trees.

In a representative profile, the surface layer is dark grayish brown and dark brown loam about 11 inches thick. The subsoil is 39 inches thick. In the upper 6 inches the subsoil is dark brown, friable loam; in the next 5 inches it is dark brown, firm clay loam; in the 14 inches below that it is dark brown, firm sandy clay loam; in the next 7 inches it is brown, friable sandy clay loam; and in the lower 7 inches it is dark brown, firm gravelly loam. The underlying material, to a depth of 60 inches, is brown stratified gravelly sand and fine sand.

Runoff is slow. The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is moderate.

Ockley soils are extensive. They are well suited to farming. Some gravel and sand pits are in areas of Ockley soils.

Representative profile of Ockley loam, 0 to 2 percent slopes, in a cultivated field 2,640 feet east and 330 feet south of the northwest corner of sec. 33, T. 14 N., R. 3 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam; weak medium granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

A12—7 to 11 inches; dark brown (10YR 4/3) loam; moderate medium granular structure; friable; common fine roots; slightly acid; clear wavy boundary.

B1t—11 to 17 inches; dark brown (7.5YR 4/4) loam; weak medium platy structure parting to moderate, medium granular; friable; few fine roots; slightly acid; clear wavy boundary.

B21t—17 to 22 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; patchy distinct thin dark brown (10YR 4/3) clay films on faces of peds; medium acid; clear wavy boundary.

B22t—22 to 36 inches; dark brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; few pebbles; continuous distinct dark brown (10YR 4/3) clay films as bridging of sand grains; medium acid; clear wavy boundary.

B23t—36 to 43 inches; brown (7.5YR 4/4) sandy clay loam; weak medium subangular blocky structure; friable; few pebbles; continuous distinct reddish brown (5YR 4/4) clay films as bridging and coatings of sand grains; medium acid; clear wavy boundary.

B24t—43 to 50 inches; dark brown (7.5YR 3/2) gravelly loam; weak coarse granular structure to massive; firm; continuous distinct dark brown (7.5YR 3/2) thin clay films as bridging and coatings of sand grains; wedge-shaped tongues extend 4 to 20 inches into the underlying calcareous gravelly sand and fine sand; slightly acid; abrupt irregular boundary.

IIC—50 to 60 inches; brown (10YR 5/3) stratified gravelly sand and fine sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness, but typically is 45 to 55 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2) or dark yellowish brown (10YR 4/4). It is dominantly loam, but ranges to silt loam. The A12 horizon is dark brown or brown (10YR 4/3) loam. Some profiles have an A2 horizon, which is grayish brown (10YR 5/2) or brown (10YR 5/3) loam.

The B1 horizon is dark yellowish brown (10YR 3/4) or brown to dark brown (7.5YR 4/4) loam, light clay loam, silt loam, or light silty clay loam. The B2t horizon is dark yellowish brown (10YR 3/4, 4/4) or dark brown (10YR 4/3, 7.5YR 4/4) sandy clay loam, clay loam, silty clay loam, or gravelly clay loam. Sand and gravel content increases as depth increases.

The IIC horizon is brown (10YR 5/3), pale brown (10YR 6/3), or light yellowish brown (10YR 6/4) gravelly sand and fine sand.

Ockley soils have drainage similar to that of Fox and Nineveh soils. Ockley soils have a thicker solum than Fox soils or Nineveh soils. They do not have as dark an A horizon as Nineveh soils.

OcA—Ockley loam, 0 to 2 percent slopes. This nearly level soil is on broad outwash plains and terraces adjacent to bottom lands of rivers and creeks. Most areas are irregularly shaped, but some are long and narrow. Areas of this soil range from 2 to 300 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of well drained Fox soils; small areas of somewhat poorly drained Sleeth soils and very poorly drained Westland soils in discontinuous, narrow, slightly depressional drainageways; and small areas of deep, well drained soils that have less gravel in the subsoil than this Ockley soil.

Runoff is slow. This soil is well suited to corn, soybeans, and small grain. It has slight limitations for most nonfarm uses. Most areas are cultivated. Wooded areas have fair stands of hardwood trees, but some have been heavily pastured. Capability unit I-1; woodland suitability subclass 1o.

OcB2—Ockley loam, 2 to 6 percent slopes, eroded. This gently sloping soil is on side slopes of weakly defined drainageways, on slightly higher knolls on the broad outwash plains, and on toe slopes of kames and

eskers. Most areas are long and narrow, but some are rounded or irregularly shaped. Areas of this soil range from 2 to 10 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is 7 or 8 inches thick and includes some clay loam or heavy loam material from the subsoil.

Included with this soil in mapping are small areas of well drained Fox soils; small areas of well drained soils that have a higher sand content throughout their profile than this Ockley soil; and small areas of somewhat poorly drained Sleeth and Whitaker soils and very poorly drained Rensselaer and Westland soils in discontinuous, narrow, slightly depressional drainageways.

Runoff is medium, and erosion control practices are needed. This soil is well suited to corn, soybeans, and small grain. It has slight limitations for most nonfarm uses. Most areas of this soil are cultivated. Some are in pasture. Capability unit IIe-3; woodland suitability subclass 1o.

Palms series

The Palms series consists of deep, nearly level, very poorly drained soils that formed in organic deposits over mineral material. These soils are in old oxbows of rivers and creeks. The native vegetation was water-tolerant grasses and sedges.

In a representative profile, black friable muck extends to a depth of 28 inches. The underlying material, to a depth of 48 inches, is very dark gray, friable, calcareous silt loam. Below this, to a depth of 60 inches, it is gray calcareous fine sandy loam.

The available water capacity is high. Permeability is moderately rapid in the organic material and moderate in the underlying loamy material. The organic-matter content of the surface layer is very high. These soils have a seasonal high water table within about a foot of the surface during part of the year.

Palms soils are of minor extent in the county. When adequately drained, they are well suited to farming.

Representative profile of Palms muck, in a pasture 1,940 feet east and 440 feet south of the northwest corner of sec. 16, E. 11 N., R. 5 E.

Oa1—0 to 9 inches; black (5YR 2/1) sapric material, black (N 2/0) rubbed and pressed; about 10 percent fiber, 2 percent rubbed; weak fine and medium granular structure; friable; many fine roots; clean sand grains along cleavage planes; neutral; clear wavy boundary.

Ot2—9 to 22 inches; black (2.5Y 2/0) sapric material, black (5Y 2/1) rubbed and pressed; about 5 percent fiber, a trace rubbed; weak medium prismatic structure parting to weak medium and coarse granular; friable; many fine roots; clean sand grains along cleavage planes; neutral; gradual wavy boundary.

Oa3—22 to 28 inches; black (2.5Y 2/0) sapric material, rubbed and pressed; about 5 percent fiber, a trace rubbed; massive; friable; many fine roots; neutral; clear wavy boundary.

IIC1g—28 to 48 inches; very dark gray (10YR 3/1) silt loam; massive; friable; many small snail shells; few pebbles; slight effervescence; moderately alkaline; clear wavy boundary.

IIC2—48 to 60 inches; gray (10YR 5/1, 6/1) fine sandy loam; strong effervescence; moderately alkaline.

The organic layer ranges from 16 to 50 inches in thickness, but typically is 20 to 35 inches thick.

The Oa horizon is black (10YR 2/1, 5YR 2/1, or N 2/0) and very dark brown (10YR 2/2).

The C horizon is gray (10YR 5/1, or 6/1), very dark gray (10YR 3/1, or 5Y 3/1), and dark gray (10YR 4/1, or 5Y 4/1) fine sandy loam, loam, mucky silt loam, silt loam, and clay loam.

Palms soils have drainage similar to that of Brookston, Rensselaer, Sloan, and Westland soils. Palms soils have an organic surface horizon, and the others have a mineral surface horizon.

Pa—Palms muck. This ponded soil occupies filled-in oxbows of old river and creek channels on bottom lands and terraces. The areas range from 10 to 20 acres in size, and most are half-moon shaped.

Included with this soil in mapping are small areas of very poorly drained Sloan soils and somewhat poorly drained Shoals soils, and small areas of very poorly drained muck soils that have less than 16 inches or more than 50 inches of organic matter overlying the mineral soil material.

Runoff is very slow, or the soil is ponded. If adequately drained, this soil is well suited to soybeans, corn, and other suitable crops. Most areas are in pasture or are idle. Wetness is the main limitation of this soil. Because of wetness, this soil has severe limitations for most nonfarm uses. Capability unit IIw-10; woodland suitability subclass 4w.

Parke series

The Parke series consists of deep, gently sloping and moderately sloping, well drained soils that formed in loess and the underlying weathered till or outwash. These soils are on ridgetops and knolls. The native vegetation was hardwood trees.

In a representative profile, the surface layer is dark grayish brown silt loam about 4 inches thick. The subsurface layer is brown silt loam 5 inches thick. The subsoil is 53 inches thick. In the upper 4 inches the subsoil is yellowish brown, friable silt loam; in the next 23 inches it is strong brown, firm silty clay loam; and in the lower 26 inches it is strong brown, friable loam. The underlying material, to a depth of 95 inches, is reddish brown, friable heavy loam.

The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is moderate.

Parke soils are of minor extent in the county. When erosion is controlled, they are well suited to farming.

Representative profile of Parke silt loam, 6 to 12 percent slopes, eroded, in an uneroded part of the unit, 2,000 feet east and 2,800 feet north of the southwest corner of sec. 34, T. 11 N., R. 3 E.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; many fine roots; slightly acid; abrupt wavy boundary.

A2—4 to 9 inches; brown (10YR 5/3) silt loam; moderate medium granular structure; friable; many fine roots; medium acid; clear wavy boundary.

B1—9 to 13 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure;

friable; few fine roots; patchy faint thin grayish brown (10YR 5/2) clay films on faces of peds; strongly acid; clear wavy boundary.

B2t—13 to 36 inches; strong brown (7.5YR 5/6) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; continuous distinct thin dark brown (7.5YR 4/4) clay films on faces of peds; very strongly acid; clear wavy boundary.

IIB3t—36 to 62 inches; strong brown (7.5YR 5/6) loam; weak medium subangular blocky structure; friable; few fine roots; strongly acid; gradual wavy boundary.

C—62 to 95 inches; reddish brown (5YR 4/4) heavy loam; weak medium subangular blocky structure; friable; few fine roots; discontinuous faint thin yellowish red (5YR 5/6) clay films on faces of peds; strongly acid.

The solum ranges from 48 to 84 inches in thickness, but typically is 50 to 70 inches thick. Thickness of the silt mantle is 20 to 40 inches.

The A1 or Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3). The A2 horizon is grayish brown (10YR 5/2) or brown (10YR 5/3) silt loam.

The B1 horizon is yellowish brown (10YR 5/4) or dark yellowish brown (10YR 4/4) silt loam, heavy silt loam, or loam. It has weak or moderate, fine or medium, subangular blocky structure.

The B2 horizon is strong brown (7.5YR 5/6) or dark brown (7.5YR 4/4) loam, silt loam, or silty clay loam. It has fine, medium, or coarse angular or subangular blocky structure.

The B3 horizon is yellowish brown (10YR 5/6), strong brown (7.5YR 5/6), reddish brown (5YR 4/4), or yellowish red (5YR 5/6) heavy loam or loam. It has weak, medium, or coarse subangular blocky structure or is massive.

The C horizon is reddish brown (5YR 4/4) or yellowish red (5YR 4/6) heavy loam, loam, or sandy loam.

Parke soils are associated with Fox, Ockley, and Hickory soils and have similar drainage. Parke soils have a deeper solum than Fox and Ockley soils. Parke soils have a thicker mantle of loess than Hickory soils, which formed mainly in glacial till.

PkB2—Parke silt loam, 2 to 6 percent slopes, eroded. This gently sloping soil is on ridgetops and upper side slopes of loess-mantled, strongly dissected, glacial uplands and on low-lying knolls within areas of nearly level and gently sloping, moderately well drained Muren soils. Most areas are irregularly shaped. Areas of this soil range from 2 to 30 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer and some material from the upper part of the subsoil are mixed and form a brown surface layer. Small areas of this soil that have been in woods or pasture many years are not eroded.

Included with this soil in mapping are small areas of moderately well drained Muren soils and well drained Wellston soils and small areas of severely eroded soils, which are shown on the soil map by a special symbol.

Runoff is medium. The main concern in management is controlling erosion. This soil is well suited to corn and soybeans. Because of slope, it has moderate limitations for most nonfarm uses. Most areas are in pasture or woodland. Wooded areas have fair stands of hardwood trees. Capability unit IIe-1; woodland suitability subclass 1o.

PkC2—Parke silt loam, 6 to 12 percent slopes, eroded. This soil is on the side slopes, point slopes, and heads of drainageways on loess-mantled, strongly dissected, glacial uplands. Most areas are irregularly shaped. Areas of this soil range from 2 to 25 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is dark brown and is not as thick. Areas of this soil that have been in pasture or woods many years are not eroded.

Included with this soil in mapping are small areas of well drained Welston soils and well drained Hickory soils. Small areas of severely eroded soils are shown on the soil map by a special symbol.

Runoff is medium. Erosion is the main hazard. Erosion control practices are needed. This soil is well suited to small grain, legumes, and an occasional row crop. Because of slope, this soil has moderate limitations for most nonfarm uses. Most areas of this soil are in pasture or woodland. Wooded areas have fair stands of hardwood trees. Capability unit IIIe-1; woodland suitability subclass 1o.

Rensselaer series

The Rensselaer series consists of deep, nearly level, very poorly drained soils that formed in loamy outwash sediments. These soils are on broad outwash plains and in old glacial drainageways and lake basins. The native vegetation was water-tolerant grasses and hardwood trees.

In a representative profile, the surface layer is silty clay loam about 14 inches thick. It is very dark grayish brown in the upper part and very dark gray in the lower part. The subsoil is 28 inches thick. In the upper 11 inches the subsoil is dark gray, mottled, firm silty clay loam; in the next 11 inches it is olive gray, mottled, firm silty clay loam; and in the lower 6 inches it is mottled gray and yellowish brown, firm loam. Between depths of 42 and 47 inches, the underlying material is mottled gray and yellowish brown sandy loam. Below this, to a depth of 60 inches, the underlying material is gray, stratified sandy loam and sand.

The available water capacity is high, and permeability is slow. The organic-matter content of the surface layer is high. These soils have a seasonal high water table within about a foot of the surface, during some part of the year.

Rensselaer soils are of moderate extent. When adequately drained, they are well suited to farming.

Representative profile of Rensselaer silty clay loam, in a cultivated field 2,375 feet east and 40 feet south of northwest corner of sec. 30, T. 13 N., R. 5 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate fine and medium granular structure; friable; common fine roots; mildly alkaline; abrupt smooth boundary.

A12—8 to 14 inches; very dark gray (10YR 3/1) silty clay loam; few medium faint brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; common fine roots; neutral; clear wavy boundary.

B21tg—14 to 25 inches; dark gray (10YR 4/1) silty clay loam; few fine faint dark brown (10YR 3/3) mottles;

moderate medium prismatic structure that parts to moderate medium subangular blocky; firm; few fine roots; patchy distinct thin very dark gray (10YR 3/1) clay films on faces of peds; neutral; clear wavy boundary.

B22tg—25 to 36 inches; olive gray (5Y 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/8) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; patchy distinct thin gray (10YR 5/1) clay films on faces of peds; few very dark grayish brown (10YR 3/2) iron and manganese oxide concretions; mildly alkaline; clear wavy boundary.

IIB23tg—36 to 42 inches; mottled gray (10YR 5/1) and yellowish brown (10YR 5/6) loam; weak medium to coarse subangular blocky structure; firm; discontinuous distinct thin very dark gray (10YR 3/1) clay films on faces of peds; 3 percent fine and coarse gravel; slightly alkaline; abrupt wavy boundary.

IIC1—42 to 47 inches; mottled gray (10YR 5/1) and yellowish brown (10YR 5/6) sandy loam; weak coarse subangular block structure to massive; slightly sticky when wet; strong effervescence; moderately alkaline; abrupt wavy boundary.

IIC2—47 to 60 inches; gray (10YR 5/1) stratified sandy loam and sand; loose; strong effervescence; moderately alkaline.

The solum ranges from 30 to 55 inches in thickness, but typically is 35 to 45 inches thick.

The Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1). It is dominantly silty clay loam, but loam and clay loam are also within the range.

The B2t horizon is very dark gray (N 3/0), dark gray (10YR 4/1), gray (10YR 5/1), light gray (10YR 6/1), olive gray (5Y 5/2), or grayish brown (2.5Y 5/2) silty clay loam or clay loam; some subhorizons are silt loam or loam. Mottles are few to many, fine to coarse, distinct or prominent. Clay films are patchy to continuous, faint to prominent, and thin to thick.

The C horizon is stratified sand, loamy sand, sandy loam, silt loam, silt, or very thin strata of silty clay loam.

Rensselaer soils have drainage similar to that of Brookston, Sloan, and Westland soils. Rensselaer soils have less gravel in the lower part of the profile than Westland soils. They have a Bt horizon, and the Sloan soils do not. Rensselaer soils have a C horizon of stratified sandy loam and sand, and Brookston soils have a C horizon of loam.

Re—Rensselaer silty clay loam. This nearly level soil is in slightly depressional areas of broad outwash plains and in old glacial drainageways and lake basins. Most areas are irregularly shaped, but some are long and narrow. Areas of this soil range from 2 to more than 300 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of very poorly drained Brookston, Sloan, and Westland soils and somewhat poorly drained Sleeth and Whitaker soils. Wet spots are shown on the soil map by a special symbol.

Runoff is very slow or ponded. Wetness is the main limitation to use of this soil. If adequately drained, this soil is well suited to corn and soybeans. Because of wetness and slow permeability, this soil has severe limitations for most nonfarm uses. Most areas are cultivated. Wooded areas have fair stands of hardwood trees, but some have been heavily pastured. Capability unit IIw-1; woodland suitability subclass 2w.

Ross series

The Ross series consists of deep, nearly level, well drained soils that formed in loamy alluvium. These soils are on bottom lands. The native vegetation was prairie grasses and scattered hardwood trees.

In a representative profile, the surface layer is about 36 inches thick. In the upper 22 inches the surface layer is very dark grayish brown, friable loam, and in the lower 14 inches it is very dark brown, friable sandy clay loam. The underlying material, to a depth of 49 inches, is dark yellowish brown, mottled, sandy clay loam. Below this, to a depth of 60 inches, it is stratified mottled brown sandy loam.

The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is high.

Ross soils are of minor extent in the county. They are well suited to farming, but crops are subject to damage from flooding.

Representative profile of Ross loam, in a cultivated area 2,510 feet east and 930 feet south of northwest corner of sec. 34, T. 12 N., R. 5 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam; weak fine and medium granular structure; friable; few fine roots; few pebbles; neutral; abrupt smooth boundary.

A12—8 to 15 inches; very dark grayish brown (10YR 3/2) loam; moderate medium granular structure; friable; few fine roots; few small pebbles; mildly alkaline; clear smooth boundary.

A13—15 to 22 inches; very dark grayish brown (10YR 3/2) loam; weak fine and medium subangular blocky structure; friable; few fine roots; few pebbles; mildly alkaline; clear smooth boundary.

A14—22 to 36 inches; very dark brown (10YR 2/2) sandy clay loam; weak medium subangular blocky structure; friable; few pebbles; mildly alkaline; clear smooth boundary.

C1—36 to 49 inches; dark yellowish brown (10YR 4/4) sandy clay loam; common medium distinct dark grayish brown (10YR 4/2) mottles; massive; few pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C2—49 to 60 inches; brown (10YR 5/3) sandy loam; common medium distinct light brownish gray (10YR 6/2) mottles; massive; few pebbles; strong effervescence; moderately alkaline.

Reaction is neutral to moderately alkaline throughout the profile.

The A horizon ranges from 25 to 40 inches in thickness. It is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3). It is dominantly loam, but ranges to fine sandy loam or silt loam. The lower part of the A horizon is clay loam or sandy loam in places.

The upper part of the C horizon is silty clay loam, sandy clay loam, silt loam, loam, or fine sandy loam. The lower part of the C horizon is stratified sand, loamy sand, sandy loam, loam, and thin strata of fine gravel.

Ross soils have drainage the same as that of Genesee soils. Ross soils have a darker colored A horizon than Genesee soils.

Rs—Ross loam. This nearly level soil is on slightly raised natural levees on flood plains. Most areas are irregularly shaped. Areas of this soil range from 5 to 50 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of well drained Genesee soils, moderately well drained Eel soils, and somewhat poorly drained Shoals soils; and small areas of moderately well drained soils that have a thick, dark colored surface layer like that of Ross soils.

Runoff is slow. Flooding is the main hazard in use

and management of this soil. This soil is subject to flooding in winter and early in spring, and is subject to occasional flooding of short duration during some parts of the growing season. This soil is well suited to corn and soybeans. Because of flooding, it has severe limitations for most nonfarm uses. Most areas of this soil are cultivated. Wooded areas have poor stands of hardwood trees. Capability unit I-2; woodland suitability subclass 1o.

Shoals series

The Shoals series consists of deep, nearly level, somewhat poorly drained soils that formed in loamy alluvium. These soils are on flood plains of rivers and creeks. The native vegetation was hardwood trees.

In a representative profile, the surface layer is dark grayish brown silt loam about 8 inches thick. The underlying material is grayish brown, mottled, friable silt loam in the upper 5 inches; in the next 12 inches it is pale brown, mottled, friable silt loam; and to a depth of 35 inches it is grayish brown, mottled, friable loam. Below this, to a depth of about 60 inches, it is yellowish brown, mottled, stratified silt loam, loam, and sandy loam.

The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is moderate. These soils have a seasonal high water table about 1 to 3 feet below the surface during some part of the year.

Shoals soils are of minor extent in the county. When adequately drained, they are well suited to farming, but crops are subject to damage from flooding.

Representative profile of Shoals silt loam in a cultivated field 2,370 feet west and 2,100 feet north of the southeast corner of sec. 23, T. 12 N., R. 5 E.

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

C1—8 to 13 inches; grayish brown (10YR 5/2) silt loam; common medium distinct pale brown (10YR 6/3) and light yellowish brown (10YR 6/4) mottles; moderate medium granular structure; friable; few fine roots; neutral; clear smooth boundary.

C2—13 to 25 inches; pale brown (10YR 6/3) silt loam; many medium distinct grayish brown (10YR 5/2) and light yellowish brown (10YR 6/4) mottles; weak medium granular structure; friable; neutral; clear wavy boundary.

C3—25 to 35 inches; grayish brown (10YR 5/2) loam; many prominent light yellowish brown (10YR6/4) and yellowish brown (10YR 5/6) mottles; weak fine and medium granular structure; friable; few very dark grayish brown (10YR 3/2) iron and manganese oxide concretions; neutral; clear smooth boundary.

C4—35 to 60 inches; yellowish brown (10YR 5/4) stratified silt loam, sandy loam, and loam; many medium distinct grayish brown (10YR 5/2) and few medium faint yellowish brown (10YR 5/6) mottles; friable; neutral.

Reaction throughout the profile is neutral or mildly alkaline.

The Ap horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2).

The C horizon is grayish brown (10YR 5/2), pale brown (10YR 6/3), or yellowish brown (10YR 5/4) silt loam, loam, fine sandy loam, or heavy silt loam to light clay loam.

Shoals soils have drainage similar to that of Crosby, Sleeth, and Whitaker soils. Shoals soils contain less clay, are less acid, and have weaker structure than Crosby, Sleeth, or Whitaker soils.

Sh—Shoals silt loam. This nearly level soil is on narrow flood plains of meandering creeks and in low lying, weakly defined drainageways on bottom lands of large rivers. Most areas are long and narrow, but some are irregularly shaped. Areas of this soil range from 2 to 60 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of moderately well drained Eel soils and very poorly drained Sloan soils.

Runoff is slow. Wetness is the main limitation to use of this soil. This soil is subject to flooding in winter and early in spring and is subject to occasional flooding during some parts of the growing season. If adequately drained, it is well suited to corn and soybeans. Because of flooding and wetness, it has severe limitations for most nonfarm uses. Most areas are cultivated or in permanent pasture. Wooded areas have poor to fair stands of hardwood trees. Capability unit IIw-7; woodland suitability subclass 2w.

Sleeth series

The Sleeth series consists of deep, nearly level, somewhat poorly drained soils that formed in loamy outwash over stratified sand and gravel. These soils are on broad outwash plains and terraces and in old glacial drainageways. The native vegetation was hardwood trees.

In a representative profile, the surface layer is dark grayish brown loam about 9 inches thick. The subsurface layer is grayish brown, friable loam 4 inches thick. The subsoil is about 35 inches thick. In sequence from the top, it is 4 inches of yellowish brown, mottled, friable loam; 10 inches of yellowish brown and grayish brown, firm clay loam; 9 inches of grayish brown, mottled, firm gravelly clay loam; 8 inches of dark gray, mottled, friable gravelly clay loam; and 4 inches of dark gray, friable gravelly clay loam. The underlying material, to a depth of 60 inches, is light gray stratified coarse sand and fine gravel.

The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is moderate. These soils have a seasonal high water table about 1 to 3 feet below the surface during some part of the year.

Sleeth soils are of minor extent in the county. When adequately drained, they are well suited to farming.

Representative profile of Sleeth loam, in a cultivated field 2,330 feet east and 925 feet south of northwest corner of sec. 13, T. 12 N., R. 4 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam; moderate medium granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.

A2—9 to 13 inches; grayish brown (2.5Y 5/2) loam; moderate thick platy structure; friable; few fine roots; slightly acid; clear smooth boundary.

B1—13 to 17 inches; yellowish brown (10YR 5/4) loam; common medium faint grayish brown (10YR 5/2) mottles; friable; weak medium granular structure; slightly acid; clear smooth boundary.

B21t—17 to 27 inches; yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; continuous distinct thin light brownish gray (2.5Y 6/2) clay and silt films on faces of peds; few pebbles; common tubular pores; thin dark grayish brown (10YR 4/2) organic coatings in some pores and on worm casts; medium acid; slightly wavy boundary.

B22t—27 to 36 inches; grayish brown (10YR 5/2) gravelly clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; discontinuous faint thin grayish brown (2.5Y 5/2) clay films on faces of peds and in voids; few fine black (10YR 2/1) iron and manganese oxide concretions; medium acid; gradual wavy boundary.

B23t—36 to 44 inches; dark gray (10YR 4/1) gravelly clay loam; common medium distinct strong brown (7.5YR 5/8) mottles; weak coarse subangular blocky structure; friable; neutral; clear irregular boundary.

B24t—44 to 48 inches; dark gray (10YR 4/1) gravelly clay loam; weak coarse subangular blocky structure; friable; calcareous in peds and dolomitic rock; abrupt irregular boundary.

IIC—48 to 60 inches; light gray (10YR 6/1) stratified coarse sand and fine gravel; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 40 to 55 inches in thickness, but typically is 40 to 50 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 5/3). It is dominantly loam, but ranges to fine sandy loam and silt loam. The A2 horizon is grayish brown (2.5Y 5/2 or 10YR 5/2) or light brownish gray (10YR 6/2) loam or silt loam.

The B2 horizon is grayish brown (10YR 5/2), yellowish brown (10YR 5/4, 5/6), brown (10YR 5/3), or dark gray (10YR 4/1) sandy loam, clay loam, silty clay loam, sandy clay loam, or gravelly clay loam. Mottles throughout the B2 horizon are few to many, fine to coarse, and faint to prominent.

The C horizon is light gray (10YR 6/1), gray (10YR 5/1), or dark gray (10YR 4/1) stratified gravelly sand, loamy sand, sand, and coarse sand or fine gravel.

Sleeth soils have drainage similar to that of Crosby, Fincastle, and Whitaker soils. Sleeth soils have stratification in the solum, but the Crosby and Fincastle soils do not. They have more gravel in the solum than Whitaker soils.

Sk—Sleeth loam. This nearly level, somewhat poorly drained soil is surrounded by very poorly drained Rensselaer or Westland soils or by well drained Ockley or Fox soils on outwash plains and terraces and in old glacial drainageways. Most areas are irregularly shaped, but some are island-like. Areas of this soil range from 5 to 80 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of very poorly drained Westland and Rensselaer soils and somewhat poorly drained Crosby and Whitaker soils.

Runoff is slow. Wetness is the main limitation to use of this soil. If adequately drained, this soil is well suited to corn and soybeans. Because of wetness and slow permeability, it has severe limitations for most nonfarm uses. Most areas of this soil are farmed. The wooded areas have fair stands of hardwood trees, but some have been heavily pastured. Capability unit IIw-2; woodland suitablity subclass 3w.

Sloan series

The Sloan series consists of deep, nearly level, very poorly drained soils that formed in loamy alluvium. These soils are on bottom lands of rivers and creeks. The native vegetation was water-tolerant hardwood trees and grasses.

In a representative profile, the surface layer is about 14 inches thick. In the upper 7 inches it is very dark brown clay loam, and in the lower 7 inches it is very dark brown silty clay loam. The subsoil is 24 inches thick. In the upper 10 inches the subsoil is dark gray, mottled, firm clay loam, and in the lower 14 inches it is gray, mottled, firm clay loam. Between depths of 38 and 44 inches the underlying material is gray, mottled, light silty clay loam. Below this, to a depth of 60 inches, the underlying material is light gray, stratified coarse silts and very fine sand.

The available water capacity is high, and permeability is moderate or moderately slow. The organic-matter content of the surface layer is high. These soils have a seasonal high water table within about 6 inches of the surface during some part of the year.

Sloan soils are of minor extent in the county. When adequately drained they are well suited to farming, but crops are subject to damage from flooding.

Representative profile of Sloan clay loam in a cultivated field, 2,380 feet east and 1,585 feet north of the southwest corner of sec. 17, T. 11 N., R. 5 E.

Ap—0 to 7 inches; very dark brown (10YR 2/2) clay loam, very dark gray (10YR 3/1) rubbed; moderate fine and medium subangular blocky structure; friable; few fine roots; neutral; abrupt smooth boundary.

A12—7 to 14 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) rubbed; few medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; neutral; clear smooth boundary.

B21g—14 to 24 inches; dark gray (10YR 4/1) clay loam; few medium distinct dark yellowish brown (10YR 3/4) mottles; moderate medium subangular blocky structure; firm; mildly alkaline; clear smooth boundary.

B22g—24 to 38 inches; gray (10YR 5/1) clay loam; many medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; mildly alkaline; abrupt smooth boundary.

C1g—38 to 44 inches; gray (10YR 5/1) light silty clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; few medium distinct light gray (10YR 7/2) mottles; weak medium prismatic structure; friable; slight effervescence; mildly alkaline; abrupt irregular boundary.

C2g—44 to 60 inches; light gray (10YR 7/1) stratified coarse silts and very fine sand; common coarse distinct yellowish brown (10YR 5/6) mottles; massive; friable; strong effervescence; moderately alkaline.

The solum ranges from 20 to 50 inches in thickness, but typically is 25 to 45 inches thick. Reaction is neutral to moderately alkaline throughout the profile.

The Ap or A1 horizon is very dark brown (10YR 2/2), very dark gray (10YR 3/1), or black (10YR 2/1). It is dominantly light clay loam, but ranges to loam, silt loam, and light clay loam.

The B horizon is dark gray (10YR 4/1) or gray (10YR 5/1) clay loam, silty clay loam, or loam. Mottles are few to many, fine to coarse, and faint to prominent.

The C horizon is stratified loam, silt loam, silty clay loam, silt, and very fine sand.

Sloan soils are in the same landscape as well drained Genesee soils, moderately well drained Eel soils, and somewhat poorly drained Shoals soils. Sloan soils are very poorly drained.

Sn—Sloan clay loam. This nearly level soil is in low swales or oxbows of old channels of rivers or creeks. Most areas are long and narrow or half-moon shaped. Areas of this soil range from 2 to 10 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of somewhat poorly drained Shoals soils and very poorly drained Rensselaer soils. Also included are small areas of mucky soils in the lowest areas of Sloan soils. These wet mucky soils, which dry out more slowly than Sloan soils, are shown on the soil map by a special symbol.

Runoff is very slow. Wetness is the main limitation to use of this soil. This soil is subject to flooding in winter and early in spring and is subject to occasional flooding during parts of the growing season. If adequately drained, it is well suited to corn and soybeans. Because of flooding and wetness, it has severe limitations for most nonfarm uses. About half of the acreage is farmed. Wooded areas have poor stands of hardwood trees. Capability unit IIIw-9; woodland suitability subclass 2w.

Wellston series

The Wellston series consists of deep, moderately sloping, well drained soils that formed in loess and the underlying residuum of acid sandstone, shale, and siltstone. These soils are on ridgetops and on upper side slopes and point slopes of strongly dissected bedrock areas in the uplands. The native vegetation was hardwood trees.

In a representative profile, the surface layer is brown silt loam about 8 inches thick. The subsoil is 30 inches thick. In the upper 8 inches the subsoil is strong brown, friable and firm silt loam; in the next 11 inches it is strong brown and brown, firm silty clay loam; and in the lower 11 inches it is strong brown, firm silt loam. The underlying material, to a depth of 52 inches, is brownish yellow silt loam. Below this is fractured sandstone bedrock.

The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is moderate.

Wellston soils are of minor extent in the county. When erosion is adequately controlled, they are well suited to farming.

Representative profile of Wellston silt loam, 6 to 12 percent slopes, eroded, in an idle and regrowth timber area, 1,500 feet north and 1,125 feet east of the southwest corner of sec. 31, T. 11 N., R. 4 E.

Ap—0 to 8 inches; brown (10YR 5/3) silt loam; weak fine and medium granular structure; friable; many fine roots; strongly acid; abrupt smooth boundary.

B1t—8 to 11 inches; strong brown (7.5YR 5/6) silt loam; moderate fine and medium subangular blocky structure; friable; many fine roots; strongly acid; clear smooth boundary.

B21t—11 to 16 inches; strong brown (7.5YR 5/6) heavy silt loam; moderate fine and medium subangular blocky structure; firm; common fine roots; discontinuous faint thin very pale brown (10YR 7/3) silt coatings on faces of peds; strongly acid; clear smooth boundary.

B22t—16 to 20 inches; strong brown (7.5YR 5/6) light silty clay loam; moderate fine and medium angular and subangular blocky structure; firm; common fine roots; continuous faint thin very pale brown (10YR 7/3) silt coatings on faces of peds; strongly acid; clear smooth boundary.

B23t—20 to 27 inches; brown (7.5YR 4/4) silty clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; patchy faint thin light gray (10YR 7/2) silt coatings on faces of peds; very strongly acid; clear smooth boundary.

IIB24t—27 to 38 inches; strong brown (7.5YR 5/6) silt loam; weak medium subangular blocky structure; firm; patchy faint thin pale brown (10YR 6/3) silt coatings on faces of peds; 2 percent sandstone fragments; very strongly acid; clear wavy boundary.

IIC—38 to 52 inches; brownish yellow (10YR 6/6) silt loam; common medium distinct gray (10YR 6/1) and yellowish brown (10YR 5/8) mottles; massive; 10 percent sandstone fragments; very strongly acid; abrupt wavy boundary.

R—52 inches; fractured sandstone.

The solum is 32 to 50 inches thick. Thickness of the loess mantle ranges from 25 to 45 inches.

The Ap horizon is brown (10YR 5/3, 4/3) or dark grayish brown (10YR 4/2). Some profiles have an A2 horizon, which is pale brown (10YR 6/3) silt loam.

The B21t horizon is strong brown (7.5YR 5/6) silt loam or heavy silt loam. The upper part of the B2t horizon is strong brown (7.5YR 5/6) or brown (7.5YR 5/4) silt loam or silty clay loam. The lower part of the Bt horizon is loam, silt loam, or silty clay loam that is 1 to 20 percent coarse fragments.

The C horizon is brownish yellow (10YR 6/6, 6/8) or light yellowish brown (10YR 6/4) silt loam or loam.

The underlying bedrock is fractured sandstone, shale, or siltstone.

Wellston soils in most landscapes are near Muren and Muskingum soils. Wellston soils are well drained, and Muren soils are moderately well drained. Wellston soils have more clay between depths of 10 and 30 inches than Muskingum soils; they do not have channery fragments in the solum.

WdC2—Wellston silt loam, 6 to 12 percent slopes, eroded. This moderately sloping soil is on the upper side slopes, point slopes, and head slopes of drainageways and on ridgetops of silt-mantled, dissected sandstone, siltstone, and shale uplands. Most areas are irregularly shaped, but some are long and narrow. Areas of this soil range from 2 to 40 acres.

Included with this soil in mapping are small areas of well drained Muskingum soils and Parke soils and moderately well drained Muren soils. Some severely eroded areas are shown on the soil map by a special symbol.

Runoff is medium. The hazard of erosion is moderate, and erosion control practices are needed. This soil is suited to corn and soybeans. It has moderate limitations for most nonfarm uses; it has moderate limitations for residential development where septic tank absorption fields are needed. Most areas of this soil are idle or wooded. Wooded areas have fair stands of hardwoods. Capability unit IIIe-3; woodland suitability subclass 3o.

Westland series

The Westland series consists of deep, nearly level, very poorly drained soils that formed in loamy outwash over stratified gravelly sand and sand. These

soils are on broad outwash plains and in old glacial drainageways. The native vegetation was water-tolerant grasses and hardwood trees.

In a representative profile, the surface layer is black clay loam about 15 inches thick. The subsoil is 33 inches thick. In the upper 6 inches the subsoil is dark gray, mottled, firm clay loam; in the next 11 inches it is dark grayish brown, mottled, firm clay loam; in the 6 inches below that it is gray, mottled, firm clay loam; and in the lower 10 inches it is dark gray, mottled, firm gravelly clay loam. The underlying material, to a depth of 60 inches, is stratified dark gray sandy loam, gravelly sand, and sand.

The available water capacity is high, and permeability is slow. The organic-matter content of the surface layer is high. These soils have a seasonal high water table within about a foot of the surface during some part of the year.

Westland soils are of moderate extent. When adequately drained, they are well suited to farming.

Representative profile of Westland clay loam, in a pasture field 1,320 feet west and 2 feet south of northeast corner of sec. 22, T. 11 N., R. 5 E.

Ap—0 to 7 inches; black (10YR 2/1) clay loam; moderate medium granular structure; friable; common fine roots; slightly acid; clear wavy boundary.

A12—7 to 15 inches; black (10YR 2/1) clay loam; moderate medium and coarse granular structure; friable; few fine roots; neutral; clear wavy boundary.

B21tg—15 to 21 inches; dark gray (10YR 4/1) clay loam; few medium faint dark brown (10YR 4/3) mottles; moderate fine and medium subangular blocky structure; firm; discontinuous faint thin dark grayish brown (10YR 4/2) clay films on faces of peds; 10 percent fine gravel; neutral; clear wavy boundary.

B22tg—21 to 32 inches; dark grayish brown (2.5Y 4/2) clay loam; many medium distinct grayish brown (2.5Y 5/2) and gray (10YR 5/1) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; 15 percent fine gravel; neutral; clear wavy boundary.

B23tg—32 to 38 inches; gray (10YR 5/1) clay loam; many medium distinct yellowish brown (10YR 5/6) and few medium distinct dark gray (10YR 4/1) mottles; weak medium and coarse subangular blocky structure; firm; few pebbles; neutral; clear wavy boundary.

B3tg—38 to 48 inches; dark gray (10YR 4/1) gravelly clay loam; few medium distinct light olive brown (2.5Y 5/6) mottles; weak coarse subangular blocky structure to massive; firm; mildly alkaline; abrupt irregular boundary.

IIC1—48 to 52 inches; dark gray (N 4/0) stratified sandy loam, sand, and gravelly sand; massive and single grained; very friable; loose; strong effervescence; moderately alkaline; abrupt wavy boundary.

IIC12—52 to 60 inches; dark gray (N 4/0) stratified gravelly sand and sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness, but typically is 40 to 55 inches thick.

The A11 or Ap horizon is black (10 YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). It is dominantly clay loam, but ranges to silty clay loam, heavy loam, or heavy silt loam. The A2 horizon is very dark gray (10YR 3/1), dark gray (10YR 4/1), black (10YR 2/1), or very dark brown (10YR 2/2) clay loam or silty clay loam.

The B2t horizon is dark gray (10YR 4/1), gray (10YR 5/1), grayish brown (10YR 5/2), or dark grayish brown (2.5Y 4/2) clay loam, sandy clay loam, gravelly loam, or gravelly clay loam. Mottles are few to many, fine to coarse, and faint to prominent.

The C horizon is dark gray (N 4/0) or gray (N 5/0 or 6/0) stratified gravelly sand, sand, loamy sand, and sandy loam.

Westland soils have drainage similar to that of Brookston, Rensselaer, and Sloan soils. Westland soils have more gravel in the solum than Brookston or Rensselaer soils. Westland soils have a Bt horizon, and Sloan soils do not.

We—Westland clay loam. This nearly level soil is on broad outwash plains and in old glacial drainageways. Most areas are irregularly shaped, but some are long and narrow. Areas of this soil range from 2 to more than 400 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of very poorly drained Rensselaer soils and Sloan soils and somewhat poorly drained Sleeth soils. Areas that stay wet for long periods are shown on the soil map by a special symbol.

Runoff is very slow or ponded. Wetness is the main limitation to use of this soil. If adequately drained, this soil is well suited to corn and soybeans. Because of wetness and slow permeability, it has severe limitations for most nonfarm uses. Wooded areas have fair stands of hardwood trees, but some have been heavily pastured. Capability unit IIw-1; woodland suitability subclass 2w.

Whitaker series

The Whitaker series consists of deep, nearly level, somewhat poorly drained soils that formed in stratified loamy and sandy glacial outwash. These soils are on broad terraces and outwash plains. The native vegetation was hardwood trees.

In a representative profile, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is grayish brown silt loam 4 inches thick. The subsoil is 32 inches thick. In the upper 4 inches the subsoil is brown, mottled, friable loam; in the next 14 inches it is dark grayish brown, mottled, firm clay loam; in the 8 inches below that it is yellowish brown, mottled, friable loam; and in the lower 6 inches it is grayish brown, mottled, friable loam. Between depths of 44 and 46 inches the underlying material is grayish brown, mottled, fine sandy loam. Below this, to a depth of 60 inches, the underlying material is mottled dark grayish brown, yellowish brown, light brownish gray, pale brown, and light gray stratified silt loam, fine sand, and coarse sand.

The available water capacity is high, and permeability is moderate. The organic-matter content of the surface layer is moderate. These soils have a seasonal high water table about 1 to 3 feet below the surface during some part of the year.

Whitaker soils are of minor extent in the county. When adequately drained, they are well suited to farming.

Representative profile of Whitaker silt loam, in a cultivated field 50 feet south and 300 feet west of northeast corner of sec. 8, T. 12 N., R. 5 E.

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

A2—8 to 12 inches; grayish brown (10YR 5/2) silt loam; common medium distinct pale brown (10YR 6/3) and yellowish brown (10YR 5/6) mottles; weak medium platy structure; friable; few fine roots; few black (10YR 2/1) iron and manganese oxide concretions; medium acid; clear smooth boundary.

B1—12 to 16 inches; brown (10YR 4/3) loam; many medium distinct grayish brown (10YR 5/2) and few yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few fine roots; patchy distinct thin grayish brown (10YR 5/2) films on faces of peds; few black (10YR 2/1) iron and manganese oxide concretions; strongly acid; clear smooth boundary.

B21t—16 to 30 inches; dark grayish brown (10YR 4/2) clay loam; many medium distinct dark yellowish brown (10YR 4/4) and common medium distinct yellowish brown (10YR 5/6, 5/8) mottles; moderate medium subangular blocky structure; firm; discontinuous distinct thin dark grayish brown (10YR 4/2) clay films on faces of peds and in some small pores within peds; few black (10YR 2/1) iron and manganese oxide concretions; strongly acid; clear smooth boundary.

B22t—30 to 38 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct dark brown (10YR 4/3, 3/3) and common medium distinct yellowish brown (10YR 5/6, 5/8) mottles; moderate medium subangular blocky structure; firm; discontinuous distinct thin dark grayish brown (10YR 4/2) clay films on faces of peds; few fine roots; few black blotches; strongly acid, gradually becoming medium acid in lower part; clear smooth boundary.

B3t—38 to 44 inches; grayish brown (10YR 5/2) loam; many medium distinct yellowish brown (10YR 5/6, 5/8) mottles and few medium distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; friable; patchy distinct dark grayish brown (10YR 4/2) clay films on vertical faces of some peds; some black blotches 2 to 5 millimeters wide; neutral; clear wavy boundary.

C1—44 to 46 inches; grayish brown (10YR 5/2) fine sandy loam; many coarse distinct yellowish brown (10YR 5/6, 5/8), pale brown (10YR 6/3), and light gray (10YR 7/1) mottles; massive; friable; few lime nodules; few black (10YR 2/1) iron and manganese oxide concretions; strong effervescence; moderately alkaline; abrupt wavy boundary.

C2—46 to 60 inches; mottled dark grayish brown (10YR 4/2), yellowish brown (10YR 5/6), 5/8), light brownish gray (10YR 6/2), pale brown (10YR 6/3), and light gray (10YR 7/1) stratified fine sand, silt, loam, and coarse sand, and at a depth of 52 inches a 1-inch layer of clay; massive or single grained; friable; strong effervescence; moderately alkaline.

The solum ranges from 34 to 55 inches in thickness, but typically is 40 to 50 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2), and the A2 horizon is grayish brown (10YR 5/2) or pale brown (10YR 6/3).

The B2t horizon is dark grayish brown (10YR 4/2), yellowish brown (10YR 5/4), grayish brown (10YR 5/2), or brown (10YR 5/3) clay loam or silty clay loam. There are few to many, fine or medium, faint to prominent mottles.

The C horizon is mottled grayish brown (10YR 5/2), yellowish brown (10YR 5/6), and pale brown (10YR 6/3), or all light gray (10YR 7/1) stratified sand, coarse sand, and silt loam. Thin strata of silty clay loam occur in places. Reaction is moderately alkaline. In a few scattered areas, glacial loam till is beneath the stratified C horizon.

Whitaker soils have drainage similar to that of Crosby, Fincastle, and Sleeth soils. Whitaker soils have stratification in the solum and in the underlying material, and Crosby and Fincastle soils do not. Whitaker soils have less gravel in the lower part of the solum than Sleeth soils.

Wh—Whitaker silt loam. This nearly level soil is on outwash plains and terraces. Most areas are irregularly shaped, but some areas surrounded by the slightly lower-lying Rensselaer soils are rounded and island-like. Areas of this soil range from 2 to 80 acres. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of somewhat poorly drained Sleeth and Crosby soils, small areas of very poorly drained Rensselaer soils, and small areas that have calcareous loam till below the subsoil.

Runoff is slow. Wetness is the main limitation to use of this soil. If adequately drained, this soil is well suited to corn and soybeans. Because of wetness, it has severe limitations for most nonfarm uses. Most areas are farmed. The wooded areas have fair stands of hardwood trees, but some have been heavily pastured. Capability unit IIw-2; woodland suitability subclass 3w.

Use and management of the soils

This section gives information on the use and management of the soils in Johnson County for cultivated crops and forage, wildlife, trees, engineering structures and practices, town and country planning, and recreation. Predicted yields of important crops are also given.

Specific management of individual soils is not suggested in this section. Detailed information on use and management can be obtained from the local district conservationist of the Soil Conservation Service or from the Johnson County Cooperative Extension Service.

Use of the soils for crops

About 75 percent of Johnson County is used for crops and pasture. The main crops are corn, soybeans, small grain, and grasses and legumes grown for forage. A small acreage is used for special crops, which include apples, sweet corn, popcorn, tomatoes, and nursery stock for landscaping.

Some major management concerns in the county are wetness, controlling soil blowing and water erosion, maintaining soil fertility and organic-matter content, and maintaining or improving tilth. About 45 percent of the intensively cultivated acreage is subject to wetness, and 10 percent is subject to the hazard of erosion. Only 3 percent of the acreage has few limitations for crops.

The major management practices are installing suitable tile drainage systems; grassing waterways; contour farming; using diversion terraces; stabilizing grades; minimum tillage; using crop residue, green manure crops, and winter cover crops; and, for most of these soils, applying lime and fertilizer in amounts indicated by tests and field trials.

On the pages that follow, the system of capability grouping used by the Soil Conservation Service is discussed, the soils in each capability unit are described, and management suited to the soils in each unit is suggested. In addition, predicted yields of the principal crops are given for all the soils in the county.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; it does not take into consideration possible but unlikely major reclamation project; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for forest trees, for wildlife, or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use.

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

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

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat. (None in Johnson County.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes. (None in Johnson County.)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w, s,* and *c,* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages, the capability units in Johnson County are described and suggestions for the use and management of the soils are given. The units are not numbered consecutively because not all of the units in the statewide system are represented in this county. The capability classification of each soil in the county is given in the "Guide to Mapping Units" at the back of this survey.

Capability unit I-1

The soils of this unit are well drained and moderately well drained, deep, and nearly level. The well drained soils are on outwash plains and terraces and the moderately well drained soils are on uplands. These soils have a medium textured surface layer and a moderately fine textured and medium textured subsoil.

The available water capacity is high. The organic-matter content of the surface layer is moderate. Runoff is slow to medium. The hazard of erosion is none to slight. These soils have moderate natural fertility. They have few limitations for cropping.

These soils are well suited to corn, soybeans, and small grain. The major management needs are to maintain organic-matter content and fertility and im-

prove and maintain soil tilth. Minimum tillage, winter cover crops, and use of crop residue help maintain organic-matter content and fertility and improve and maintain tilth. Periodic applications of lime help maintain favorable soil reaction for commonly grown crops.

Capability unit I-2

This unit consists of well drained and moderately well drained, deep, nearly level soils on bottom lands. These soils have a medium textured surface layer and medium textured or moderately fine textured lower layers.

The available water capacity is high. Permeability is moderate. The organic-matter content is moderate to high in the surface layer. Runoff is slow, and flooding is likely. These soils are generally neutral or mildly alkaline and have high natural fertility.

These soils are well suited to corn and soybeans. They are also suited to grasses such as tall fescue, which can tolerate periods of flooding. Small grain and most legumes are subject to damage from flooding. The major management needs are to maintain organic-matter content and fertility and improve and maintain tilth. Crops on these soils respond to fertilizer, but fertilization should be on a year-to-year basis because of flooding.

Capability unit IIe-1

This unit consists of well drained, deep, gently sloping, eroded soils on uplands. These soils have a medium textured surface layer and a moderately fine textured and medium textured subsoil.

The available water capacity is high. Permeability is moderate. The organic-matter content of the surface layer is moderate. Runoff is medium. These soils are generally medium acid to strongly acid and have moderate natural fertility. They are easy to cultivate. Erosion and runoff are the major hazards.

These soils are well suited to corn, soybeans, small grain, grasses, and legumes. The major management needs are to control erosion, maintain organic-matter content and fertility, and improve and maintain soil tilth. Minimum tillage, contour farming, winter cover crops, grassed waterways, and rotations that include grasses and legumes help control erosion and runoff. Use of crop residue and green manure crops helps maintain organic-matter content and fertility and improve and maintain tilth. Crops on these soils respond well to fertilizer. Periodic applications of lime help maintain favorable soil reaction for commonly grown crops.

Capability unit IIe-3

Ockley loam, 2 to 6 percent slopes, eroded, is the only soil in this unit. It is a well drained, deep soil on outwash plains and terraces. This soil has a medium textured surface layer and a moderately fine textured and medium textured subsoil.

The available water capacity is high. Permeability is moderate. The organic-matter content of the surface layer is moderate. Runoff is medium. This soil is medium to strongly acid and has moderate natural fertility. Runoff is medium, and the hazard of erosion is moderate. Erosion resulting from runoff is a major hazard.

This soil is well suited to small grain and meadow crops and moderately well suited to corn and soybeans. The major management needs are to control erosion, maintain organic-matter content and fertility, and improve and maintain soil tilth. Minimum tillage, contour farming, winter cover crops, grassed waterways, and rotations that include grasses and legumes help control erosion and runoff. Use of crop residue and green manure crops help maintain organic-matter content and fertility and improve and maintain tilth. Crops on this soil respond well to fertilizer. Periodic applications of lime help maintain favorable soil reaction for commonly grown crops.

Capability unit IIe-9

Fox loam, 2 to 6 percent slopes, eroded, is the only soil in this unit. It is well drained and moderately deep over sand and gravel and is on outwash plains and terraces. This soil has a medium textured surface layer, a moderately fine textured and medium textured subsoil, and has coarse textured underlying material at a depth of 24 to 40 inches.

The available water capacity is moderate. Permeability is moderate in the subsoil and very rapid in the underlying material. The organic-matter content is moderate in the surface layer. Runoff is medium. This soil is strongly acid and has moderate natural fertility. It is easy to cultivate. Erosion and runoff are the major hazards, but droughtiness during long dry seasons is also a problem.

This soil is well suited to small grain, grasses, and legumes and moderately well suited to corn and soybeans. The major management needs are to control erosion and runoff, maintain organic-matter content and fertility, and improve and maintain soil tilth. Minimum tillage, contour farming, winter cover crops, grassed waterways, and rotations that include grasses and legumes help control erosion and runoff. Use of crop residue and green manure crops helps maintain tilth. Crops on this soil respond well to fertilizer, but fertilization should be on a year-to-year basis because the soil is readily leached. Periodic applications of lime help maintain favorable soil reaction for commonly grown crops.

Capability unit IIe-12

Crosby-Miami silt loams, 2 to 4 percent slopes, eroded, are the only soils in this unit. These are somewhat poorly drained and well drained, deep, gently sloping soils intricately associated on uplands. These soils have a medium textured surface layer and a moderately fine textured subsoil.

The available water capacity is high. The somewhat poorly drained soils of this unit have slow permeability, and the organic-matter content of the surface layer is low. The well drained soils have moderate permeability, and the organic-matter content of the surface layer is moderate. Runoff is medium. These soils have moderate

natural fertility. Erosion is the major hazard, but wetness in the somewhat poorly drained soil is also a limitation for farming.

These soils are well suited to corn, soybeans, small grain, grasses, and legumes. The major management needs are to control erosion, maintain organic-matter content and fertility, and improve and maintain soil tilth. Other needs are to remove excess surface and subsurface water. Minimum tillage, contour farming, winter cover crops, grassed waterways, and rotations that include grasses and legumes help control erosion. The use of crop residue and green manure crops helps to maintain organic-matter content and fertility and improve and maintain tilth. Drainage and water management help remove excess surface and subsurface water. Periodic applications of lime are needed to maintain favorable soil reaction for crops commonly grown.

Capability unit IIs-1

This unit consists of well drained, nearly level soils that are moderately deep over sand and gravel on outwash plains and terraces. These soils have a medium textured surface layer, a moderately fine textured and medium textured subsoil, and, at a depth of 24 to 40 inches, coarse textured underlying material.

The available water capacity is moderate. Permeability is moderate in the subsoil and very rapid in the underlying material. The organic-matter content of the surface layer is moderate to high. Runoff is slow. These soils are easy to cultivate. Droughtiness during long dry seasons is the major hazard.

These soils are suited to all crops commonly grown in the county. Corn, soybeans, small grain, grasses, and legumes are the main crops. The major management needs are to maintain organic-matter content and fertility and to improve and maintain soil tilth. Minimum tillage, winter cover crops, and use of crop residue and green manure crops help maintain organic-matter content and fertility and improve and maintain tilth. Crops on these soils respond well to fertilizer, but fertilization should be on a year-to-year basis because the soils are readily leached. Periodic applications of lime help maintain favorable soil reaction for commonly grown crops.

Capability unit IIw-1

This unit consists of very poorly drained, deep, nearly level soils on uplands, outwash plains, and terraces. These soils have a moderately fine textured surface layer and a moderately fine textured and medium textured subsoil.

The available water capacity is high. Permeability is slow or moderate. The organic-matter content of the surface layer is high. Runoff is very slow or is ponded. These soils have high natural fertility. Wetness is the main hazard, but the high clay content of the surface layer restricts workability and is also a problem. If these soils are cultivated when wet, they become hard and cloddy when they dry.

If adequately drained, these soils are well suited to corn and soybeans (fig. 8). The major management

Figure 8.—Corn and soybeans on nearly level Brookston silty clay loam and Crosby silt loam, 0 to 2 percent slopes, in the foreground. Farm buildings and pasture on Miami silt loam, 2 to 6 percent and 6 to 12 percent slopes, eroded, in the background.

needs are to remove excess surface and subsurface water, maintain organic-matter content and fertility, and improve and maintain soil tilth. Surface and subsurface drains and outlets help remove excess surface and subsurface water. Minimum tillage, use of crop residue, and winter cover crops help maintain organic-matter content and fertility and improve and maintain soil tilth. Application of lime is seldom necessary because these soils have a reaction that is naturally favorable for crops.

Capability unit IIw-2

This unit consists of somewhat poorly drained, deep, nearly level soils on uplands, outwash plains, and terraces. These soils have a medium textured surface layer and a moderately fine textured and medium textured subsoil.

The available water capacity is high. Permeability is slow or moderate. The organic-matter content of the surface layer is low to moderate. Runoff is slow or medium. These soils have moderate natural fertility. Wetness is the major hazard.

If adequately drained, these soils are well suited to corn, soybeans, and most small grain and meadow crops. The major management needs are to remove excess surface and subsurface water, maintain organic-matter content and fertility, and improve and maintain soil tilth. Surface and subsurface drains and outlets help remove excess water. Minimum tillage, use of crop residue, and winter cover crops help maintain organic-matter content and fertility and maintain and improve soil tilth. Periodic applications of lime help maintain favorable sol reaction for commonly grown crops.

Capability unit IIw-7

Shoals silt loam is the only soil in this unit. It is a somewhat poorly drained, deep, nearly level soil on bottom lands. This soil has a medium textured surface layer and medium textured underlying material.

The available water capacity is high. Permeability is moderate. The organic-matter content of the surface layer is moderate. Runoff is slow. This soil has moderate natural fertility. It is easy to cultivate, but row crops are not practical in some narrow, long areas on flood plains dissected by meandering streams. Flooding and wetness are the major hazards.

If adequately drained, this soil is well suited to corn and soybeans. It is also suited to pasture and hay, which can be grown in the narrow, dissected areas where row crops are not practical. The major management needs are to remove excess impounded and subsurface water, maintain organic-matter content and fertility, and improve and maintain soil tilth. Subsurface drains help remove excess subsurface water, and random shallow surface drains help remove impounded water and supplement the subsurface drains to control wetness. Minimum tillage and use of crop residue help maintain organic-matter content and fertility and improve and maintain soil tilth. Application of lime is seldom necessary because this soil has a reaction naturally favorable for crops.

Capability unit IIw-10

Palms muck is the only soil in this unit. It is a very poorly drained, deep organic soil on bottom lands and terraces in old oxbows of rivers and creeks. This soil is 16 to 50 inches of muck over medium textured underlying material.

The available water capacity is high. Permeability is moderately rapid in the organic layers and moderate in the underlying loamy material. The organic-matter content of the surface layer is very high. Runoff is very slow or the soil is ponded. This soil is neutral or mildly alkaline and has moderate natural fertility. It is easy to cultivate. Wetness is the major hazard.

If adequately drained, this soil is well suited to corn and soybeans. The major management needs are to remove excess impounded and subsurface water and maintain organic-matter content and fertility. Subsurface drains help remove excess surface water, and random shallow surface drains help remove impounded water and supplement the subsurface drains to control wetness. Minimum tillage and use of crop residue help maintain organic-matter content and fertility and prevent soil blowing. Application of lime is seldom necessary because this soil has a reaction naturally favorable for crops.

Capability unit IIIe-1

This unit consists of well drained, deep, gently sloping and moderately sloping, eroded and severely eroded soils on uplands. These soils have a medium textured or moderately fine textured surface layer and a moderately fine textured and medium textured subsoil.

The available water capacity is high. Permeability is moderate. In the severely eroded soils of this unit the organic-matter content of the surface layer is low and natural fertility is low; in the eroded soils the organic-matter content of the surface layer is moderate and natural fertility is moderate. Runoff is rapid on the severely eroded soils and medium on the eroded soils. Erosion and runoff are the major concerns. The severely eroded soils have poor tilth. If they are cultivated when wet, they puddle and become cloddy when they dry. Cobbles and stones on the surface and in the plow layer may also hinder workability and harvesting operations. The eroded soils have good tilth.

These soils are suited to corn, soybeans, small grain, and legume-grass hay. The major management needs are to control erosion and runoff, maintain organic-matter content and fertility, and improve and maintain soil tilth. Minimum tillage, winter cover crops, spring plowing, crop rotations, and grassed waterways help control erosion and runoff. The use of crop residue and green manure crops helps maintain organic-matter content and fertility and maintain and improve soil tilth. Periodic applications of lime help maintain favorable soil reaction for commonly grown crops.

Capability unit IIIe-3

Wellston silt loam, 6 to 12 percent slopes, eroded,

is the only soil in this unit. It is a well drained, deep soil on silt-mantled residual bedrock uplands. This soil has a medium textured surface layer and a moderatedly fine textured and medium textured subsoil.

The available water capacity is high. Permeability is moderate. The organic-matter content of the surface layer is moderate. Runoff is medium. This soil has moderate natural fertility. Erosion is the major hazard.

This soil is suited to corn and soybeans. It is best suited to small grain and meadow crops. The major management needs are to control erosion, maintain organic-matter content and fertility, and improve and maintain soil tilth. Maintaining a cover crop wherever possible helps prevent erosion. Minimum tillage, spring plowing, contour farming, winter cover crops, grassed waterways, and crop rotations help control erosion and runoff. The use of crop residue and green manure crops helps to maintain organic-matter content and fertility and maintain and improve soil tilth. Periodic applications of lime help maintain favorable soil reaction for commonly grown crops.

Capability unit IIIe-9

Fox complex, 6 to 12 percent slopes, eroded, is the only soil in this unit. It is a well drained soil that is moderately deep over sand and gravelly sand on outwash plains. This soil has a medium textured surface layer, a moderately fine textured subsoil, and, at a depth of 24 to 40 inches, coarse textured underlying material.

The available water capacity is moderate. Permeability is moderate in the subsoil and very rapid in the underlying material. The organic-matter content of the surface layer is moderate. Runoff is medium. This soil has moderate natural fertility. Erosion, runoff, and droughtiness are the major hazards.

This soil is suited to all crops commonly grown in the area. It is best suited to small grain, grasses, and legumes. The major management needs are to control erosion and runoff, maintain organic-matter content and fertility, and improve and maintain soil tilth. Minimum tillage, spring plowing, contour farming, winter cover crops, crop rotations, and grassed waterways help control erosion and runoff. The use of crop residue and green manure crops helps to maintain organic-matter content and fertility and maintain and improve soil tilth. Fertilization should be on a year-to-year basis because this soil is readily leached. Periodic applications of lime help maintain favorable soil reaction for commonly grown crops.

Capability unit IIIw-9

Sloan clay loam is the only soil in this unit. It is a very poorly drained, deep, nearly level soil on bottom lands. This soil has a moderately fine textured surface layer and subsoil.

The available water capacity is high. Permeability is moderate. The organic-matter content of the surface layer is high. Runoff is very slow or ponded. This soil has high natural fertility. Flooding and wetness are the major hazards.

If adequately drained, this soil is well suited to corn and soybeans. It is also suited to water-tolerant grasses and legumes planted for pasture or hay. Fall-seeded small grain is subject to damage from flooding. The major management needs are to remove excess impounded and subsurface water, maintain organic-matter content and fertility, and maintain and improve soil tilth. Subsurface drains help remove excess subsurface water, and random shallow surface drains help remove impounded water and supplement the subsurface drains to control wetness. Diversion ditches help divert or dispose of excess water received as runoff from adjacent slopes. In places, suitable outlets for drainage systems are difficult to establish. Minimum tillage, use of crop residue, and spring plowing help maintain good tilth and allow a better air-water relationship. Application of lime is seldom necessary because this soil has a reaction that is naturally favorable for crops.

Capability unit IVe-1

This unit consists of well drained, deep, moderately sloping and strongly sloping, eroded and severely eroded soils on uplands. These soils have a medium textured or a moderately fine textured surface layer and a moderately fine textured subsoil.

The available water capacity is high. Permeability is moderate. In the eroded soils of this unit, the organic-matter content of the surface layer is moderate and natural fertility is moderate; in the severely eroded soils the organic-matter content of the surface layer is low and natural fertility is low. Runoff is rapid. Erosion and runoff are the major hazards. The eroded soils have good tilth. The severely eroded soils have poor tilth; if these soils are cultivated when wet, they puddle and become cloddy when they dry. In some places cobbles and stones on the surface and in the plow layer also interfere with planting and harvesting operations.

These soils are suited to small grain, grasses, legumes, and trees. They are also suited to an occasional row crop grown to get back to small grain and reestablish grasses and legumes. The major management needs are to control erosion and runoff, maintain organic-matter content and fertility, and maintain and improve soil tilth. Minimum tillage, contour farming, winter cover crops, crop rotations, and grassed waterways help control erosion and runoff. Use of crop residue during years when small grain and row crops are grown helps maintain organic-matter content and fertility and maintain and improve tilth. Periodic applications of lime help maintain favorable soil reaction for commonly grown crops.

Capability unit VIe-1

This unit consists of well drained, deep, strongly sloping to very steep soils on uplands. These soils have a medium textured or moderately fine textured surface layer and a moderately fine textured subsoil.

The available water capacity is high. Permeability is moderate. In the strongly sloping soils of this unit the organic-matter content of the surface layer is low

and natural fertility is low; in the other soils the organic-matter content of the surface layer is moderate and natural fertility is moderate. Runoff is rapid or very rapid. Erosion and runoff are the major hazards. All soils of this unit are subject to severe erosion if plant cover is not maintained at all times. The severely eroded soils have poor tilth, and in some places cobbles and stones on the surface and in the plow layer interfere with planting and harvesting operations. If these soils are cultivated when wet, the plow layer puddles and becomes cloddy when it dries. Steep slopes also interfere with planting and harvesting operations in places.

Because of steep slopes and the hazard of erosion, these soils are generally not suited to cultivation. They are best suited to woodland or wildlife. Cleared areas are best suited to permanent pasture or to the hay crops commonly grown in the county. The major management needs are to control erosion and runoff and maintain good plant cover. Mulch seeding, and, when renovating pastures, performing all land preparation and seeding operations on the contour help protect these soils from erosion.

Capability unit VIIe-2

This unit consists of well drained, moderately deep and deep, steep and very steep soils on uplands (fig. 9). These soils have a medium textured surface layer and a medium textured subsoil.

The available water capacity is moderate to high. Permeability is moderate. The organic-matter content of the surface layer is moderate. Runoff is very rapid. These soils have low natural fertility. Erosion and runoff are the major concerns.

These soils are best suited to woodland, wildlife habitat, or recreation. If protected from erosion, they are also suited to limited pasture. The major management needs are to control erosion and runoff and maintain good plant cover. Performing all land preparation and seeding operations on the contour during pasture renovation, mulch seeding, and limited grazing help protect these soils from erosion.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 2. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and

Figure 9.—A meandering creek through nearly level Genesee loam and adjacent Hennepin loam, 25 to 50 percent slopes, on the breaks in center left of the landscape.

extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 2.

The management needed to achieve the indicated yields of the various crops depends on 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-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The estimated yields reflect the productive capacity of the soils for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 2 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Woodland management and productivity[2]

Table 3 contains information useful to woodland owners or forest managers planning use of soils for wood crops. Mapping unit symbols for soils suitable for wood crops are listed, and the ordination (woodland suitability) symbol for each soil is given. All soils bearing the same ordination symbol require the same general kinds of woodland management and have about the same potential productivity.

The first part of the *ordination symbol,* a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w,* excessive water in or on the soil; *t,* toxic substances in the soil; *d,* restricted root depth; *c,* clay in the upper part of the soil; *s,* sandy texture; *f,* high content of coarse fragments in the soil profile; and *r,* steep slopes. The letter *o* indicates insignificant limitations or restrictions. If a soil has more than one limitation, priority in placing the soil into a limitation class is in the following order: x, w, t, d, c, s, f, and x.

In table 3 the soils are also rated for a number of factors to be considered in management. *Slight, moderate,* and *severe* are used to indicate the degree of major soil limitations.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well-managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if some measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or equipment; *severe* indicates a 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. Seedlings from good planting stock that are properly planted during a period of sufficient rainfall are rated. 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.

Considered in the ratings of *windthrow hazard* are characteristics of the soil that affect the development of tree roots and the ability of soil to hold trees firmly. A rating of *slight* indicates that trees in wooded areas are not expected to be blown down by commonly occurring winds; *moderate,* that some trees are blown down during periods of excessive soil wetness and strong winds; and *severe,* that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *important trees* on a soil is expressed as a *site index.* This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Important trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suitable for commercial wood production and that are suited to the soils.

Windbreaks and environmental plantings

Windbreaks are established to protect livestock, buildings, and yards from winds and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low-

[2] MITCHELL G. HASSLER, forester, Soil Conservation Service, helped prepare this section.

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

[The estimated yields are for crops under a high level of management in 1975. Dashes indicate that the crop is seldom grown or is not suited to the soil]

Soil series and map symbols	Corn	Soybeans	Wheat, winter	Grass-legume hay	Tall fescue
	Bu	*Bu*	*Bu*	*Ton*	*AUM*[1]
Brookston: Br	145	51	65	4.8	9.6
Crosby:					
CrA	105	37	47	3.4	6.8
CsB2[2]	102	35	45	3.3	6.6
Eel: Ee	85	32	33	3.0	8.0
Fincastle: FnA	130	46	52	4.3	8.6
Fox:					
FoA	90	32	45	3.0	6.0
FoB2	85	30	42	3.0	6.0
FxC2[2]	80	26	38	2.5	5.0
Genesee: Ge	85	32	32	3.0	8.0
Hennepin: HeF				1.3	2.6
Hickory: HkD2, HkF				2.2	3.4
Miami:					
MnB2	105	37	47	3.4	6.8
MnC2	95	33	43	3.1	6.2
MnD2	80	28	36	2.6	5.2
MnE				2.1	4.6
MtB3	100	35	45	3.3	6.6
MtC3	90	32	40	3.0	6.0
MtD3			32	2.5	5.0
Muren: MuA	125	44	50	4.1	8.2
Muskingum: MxG					
Nineveh: NnA	100	35	45	3.3	6.6
Ockley:					
OcA	110	38	44	3.6	7.2
OcB2	105	37	47	3.4	6.8
Palms: Pa					
Parke:					
PkB2	115	40	48	3.8	7.6
PkC2	105	37	42	3.4	6.8
Rensselaer: Re	150	53	60	5.0	10.0
Ross: Rs	130	50	54	5.5	11.0
Shoals: Sh	85	32	33	4.3	8.6
Sleeth: Sk	120	42	48	4.0	8.0
Sloan: Sn	85	32	33	5.0	10.0
Wellston: WdC2	100	33	38	3.1	6.2
Westland: We	140	49	56	4.6	9.2
Whitaker: Wh	130	46	52	4.3	8.6

[1]AUM means animal-unit-month. One AUM is 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.

[2]This mapping unit is made up of two or more dominant soils. See the description of the mapping unit for the composition and behavior characteristics of the mapping unit.

TABLE 3.—*Woodland management and productivity*

Soil series and map symbols	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Important trees	Potential productivity: Site index	Trees to plant
Brookston: Br	2w	Slight	Severe	Severe	Moderate	Pin oak White oak Sweetgum Northern red oak	85 75 90 75	Eastern white pine, baldcypress, Norway spruce, red maple, white ash, sweetgum.
Crosby:								
CrA	3w	Slight	Moderate	Slight	Slight	White oak Pin oak Yellow-poplar Sweetgum Northern red oak	75 85 85 80 75	Eastern white pine, baldcypress, white ash, red maple, yellow-poplar, American sycamore.
CsB2[1]:								
Crosby part	3w	Slight	Moderate	Slight	Slight	White oak Pin oak Yellow-poplar Sweetgum Northern red oak	75 85 85 80 75	Eastern white pine, baldcypress, white ash, red maple, yellow-poplar, American sycamore.
Miami part	1o	Slight	Slight	Slight	Slight	White oak Yellow-poplar Sweetgum	90 98 76	Eastern white pine, red pine, white ash, yellow-poplar, black walnut, black locust.
Eel: Ee	1o	Slight	Slight	Slight	Slight	Yellow-poplar	100	Eastern white pine, black walnut, yellow-poplar, black locust.
Fincastle: FnA	3w	Slight	Moderate	Slight	Slight	Northern red oak White oak Pin oak Yellow-poplar Sweetgum	75 75 85 85 80	Eastern white pine, baldcypress, white ash, red maple, yellow-poplar, Amercian sycamore.
Fox: FoA, FoB2, FxC2[1]	1o	Slight	Slight	Slight	Slight	Northern red oak White oak Sugar maple	80 --- ---	Eastern white pine, red pine, black locust, yellow-poplar, white ash, black walnut.
Genesee: Ge	1o	Slight	Slight	Slight	Slight	Yellow-poplar	100	Eastern white pine, black walnut, yellow-poplar, black locust.
Hennepin: HeF	1r	Severe	Severe	Slight	Slight	Northern red oak White oak	85 ---	Northern red oak, white oak, green ash, black walnut, eastern white pine, red pine, eastern redcedar.
Hickory:								
HkD2	1o	Moderate	Moderate	Slight	Slight	White oak Northern red oak Black oak Green ash Bitternut hickory Yellow-poplar	85 85 --- --- --- 95	Eastern white pine, red pine, yellow-poplar, sugar maple, white oak, black walnut.
HkF	1r	Severe	Severe	Slight	Slight	White oak Northern red oak Black oak Green ash Bitternut hickory Yellow-poplar	85 85 --- --- --- 95	Eastern white pine, red pine, yellow-poplar, sugar maple, white oak, black walnut.

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

Soil series and map symbols	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Important trees	Potential productivity: Site index	Trees to plant
Miami: MnB2, MnC2, MnD2	1o	Slight	Slight	Slight	Slight	White oak Yellow-poplar Sweetgum	90 98 76	Eastern white pine, red pine, white ash, yellow-poplar, black walnut, black locust.
MnE	1r	Moderate	Moderate	Slight	Slight	White oak Yellow-poplar Sweetgum	90 98 76	Eastern white pine, red pine, white ash, yellow-poplar, black walnut, black locust.
MtB3, MtC3, MtD3	1c	Slight	Moderate	Moderate	Slight	White oak Yellow-poplar Sweetgum	90 98 76	Eastern white pine, red pine, white ash, yellow-poplar, black walnut, black locust.
Muren: MuA	1o	Slight	Slight	Slight	Slight	White oak Yellow-poplar Sweetgum	90 98 76	Eastern white pine, red pine, black walnut, black locust, yellow-poplar, white ash.
Muskingum: MxG	3f	Moderate	Moderate	Moderate	Slight	White oak Yellow-poplar Red oak Virginia pine	70 78 75 55	Eastern white pine, red pine, Virginia pine, yellow-poplar.
Nineveh: NnA	1o	Slight	Slight	Slight	Slight	White oak Yellow-poplar Sweetgum	90 98 76	Eastern white pine, red pine, black walnut, yellow-poplar, white ash
Ockley: OcA, OcB2	1o	Slight	Slight	Slight	Slight	White oak Northern red oak Yellow-poplar Sweetgum	90 90 98 76	Eastern white pine, red pine, white ash, yellow-poplar, black walnut, black locust.
Palms: Pa	4w	Slight	Severe	Severe	Severe	Red maple Silver maple White ash Quaking aspen	46 --- --- ---	Red maple, silver maple.
Parke: PkB2, PkC2	1o	Slight	Slight	Slight	Slight	White oak Yellow-poplar Sweetgum	90 98 76	Eastern white pine, red pine, black walnut, yellow-poplar, white ash, black locust.
Rensselaer: Re	2w	Slight	Severe	Severe	Severe	Pin oak White oak Sweetgum Northern red oak	85 75 90 75	Eastern white pine, baldcypress, Norway spruce, red maple, white ash, sweetgum.
Ross: Rs	1o	Slight	Slight	Slight	Slight	Northern red oak Yellow-poplar Sugar maple	85 95 85	Eastern white pine, black walnut, white ash, Norway spruce, yellow-poplar.
Shoals: Sh	2w	Slight	Moderate	Slight	Slight	Pin oak Sweetgum Yellow-poplar Virginia pine	90 85 90 90	Sweetgum, red maple, swamp chestnut oak, pin oak, yellow-poplar.
Sleeth: Sk	3w	Slight	Moderate	Slight	Slight	Pin oak Yellow-poplar Sweetgum White oak	85 85 80 75	Eastern white pine, baldcypress, white ash, red maple, yellow-poplar, American sycamore.

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

Sloan: Sn	2w	Slight	Severe	Severe	Severe	Sweetgum Yellow-poplar Virginia pine Pin oak	85 90 90 85	Sweetgum, red maple, swamp chestnut oak, pin oak, yellow-poplar.
Wellston: WdC2	3o	Slight	Slight	Slight	Slight	Northern red oak Yellow-poplar Virginia pine	75 90 70	Eastern white pine, black walnut, yellow-poplar.
Westland: We	2w	Slight	Severe	Severe	Severe	Pin oak Sweetgum White oak	85 90 75	Eastern white pine, baldcypress, Norway spruce, red maple, white ash, sweetgum.
Whitaker: Wh	3w	Slight	Moderate	Slight	Slight	White oak Pin oak Yellow-poplar Sweetgum Northern red oak	75 85 85 80 75	Eastern white pine, baldcypress, white ash, red maple, yellow-poplar, American sycamore.

[2]This mapping unit is made up of two or more dominant soils. See description of the mapping unit for the composition and behavior characteristics of the mapping unit.

and high-growing broad-leaved and coniferous species provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field, the interval depending on erodibility of the soil. They protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. A healthy planting stock of suitable species planted properly on a well-prepared site and maintained in good condition can insure a high degree of plant survival.

The following paragraphs give the height that locally grown trees and shrubs are expected to reach on various kinds of soils in 20 years. The estimates, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from nurserymen.

The expected height, in feet, of species that are adapted to Brookston, Palms, Rensselaer, Shoals, Sloan, and Westland soils: Lombardy poplar—45, northern white-cedar—25, tall purple willow—23, medium purple willow—18, Amur honeysuckle—12, red-osier dogwood—9, silky dogwood—9, gray dogwood—7, dwarf purple willow—6.

The expected height, in feet, of species that are adapted to Crosby, Crosby-Miami, Fincastle, Sleeth, and Whitaker soils: eastern white pine—36, American basswood—32, Norway spruce—30, white spruce—30, blackhaw—14, arrowwood—13, Cornelian cherry dogwood—12, rose-of-sharon—11, Amur honeysuckle—11, American cranberrybush—9, autumn-olive—8, cutleaf stag sumac—7.

The expected height, in feet, of species that are adapted to Eel, Fox, Genesee, Hickory, Miami, Muskingum, Muren, Nineveh, Ockley, Parke, Ross, and Wellston soils: honeylocust (thornless)—40, eastern white pine—38, Norway spruce—30, eastern hemlock—25, European burningbush—15, blackhaw—14, late lilac—13, Amur honeysuckle—11, shadblow serviceberry—9, American cranberrybush—9, autumn-olive—8, mockorange—7.

The expected height, in feet, of species that are adapted to Hennepin soils: Virginia pine—28, red pine—26, scarlet oak—26, jack pine—24, Austrian pine—24, Russian-olive—17, blackhaw—14, cutleaf stag sumac—12, forsythia—9, autumn-olive—8, American hazel—7, flowering quince—6.

Engineering[3]

This section provides information about the use of soils for building sites, sanitary facilities, construction

[3]MAX L. EVANS, State conservation engineer, Soil Conservation Service, helped prepare this section.

material, and water management. Among those who can benefit from this section are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on 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 a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high 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.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to: (1) select potential residential, commercial, industrial, and recreational areas; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country 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, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 4 shows, for each kind of soil, the degree and kind of limitations for building site development; table 5, for sanitary facilities; and table 7, for water management. Table 6 shows the suitability of each kind of soil as a source of construction materials.

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 interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

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 4. A *slight* limitation indicates that soil properties are favorable for the specific 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 by special planning and design. A *severe* limitation indicates one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are used for pipelines, sewerlines, telephone and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by the soil wetness of a high seasonal water table, the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is defined, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 4 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

TABLE 4.—*Building site development*

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

Soil series and map symbols	Degree and kind of limitation for—				
	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Brookston: Br	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness, frost action.
Crosby:					
CrA	Severe: wetness	Moderate: wetness, shrink-swell, low strength.	Severe: wetness	Moderate: wetness, shrink-swell, low strength.	Severe: frost action.
CsB2[1]:					
Crosby part	Severe: wetness	Moderate: wetness, shrink-swell, low strength.	Severe: wetness	Moderate: wetness, shrink-swell, low strength.	Severe: frost action.
Miami part	Slight	Moderate: shrink-swell, low strength.	Slight	Moderate: shrink-swell, low strength.	Severe: low strength.
Eel: Ee	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods, frost action.
Fincastle: FnA	Severe: wetness	Moderate: wetness, shrink-swell.	Severe: wetness	Moderate: wetness, shrink-swell, low strength.	Severe: frost action, low strength.
Fox:					
FoA	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
FoB2	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Slight.
FxC2[1]	Severe: cutbanks cave.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Genesee: Ge	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods.
Hennepin: HeF	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Hickory: HkD2, HkF	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength, slope.
Miami:					
MnB2, MtB3	Slight	Moderate: shrink-swell, low strength.	Slight	Moderate: slope, shrink-swell, low strength.	Severe: low strength.
MnC2, MtC3	Moderate: slope	Moderate: slope, shrink-swell, low strength.	Moderate: slope	Severe: slope	Severe: low strength.
MnD2, MnE, MtD3	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope, low strength.
Muren: MuA	Moderate: wetness	Moderate: low strength.	Moderate: wetness, low strength.	Moderate: low strength.	Severe: frost action, low strength.
Muskingum: MxG	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Nineveh: NnA	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
Ockley:					
OcA	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Moderate: frost action, low strength.
OcB2	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Moderate: frost action, low strength.
Palms: Pa	Severe: wetness, excess humus, cutbanks cave.	Severe: wetness, frost action, excess humus.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, low strength.
Parke:					
PkB2	Slight	Slight	Slight	Moderate: slope	Severe: frost action.
PkC2	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Severe: frost action.

TABLE 4.—*Building site development*—Continued

Soil series and map symbols	Degree and kind of limitation for—				
	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Rensselaer: Re	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness, frost action.
Ross: Rs	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods.
Shoals: Sh	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods, frost action.
Sleeth: Sk	Severe: wetness, cutbanks cave.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness	Moderate: wetness, shrink-swell, low strength.	Severe: frost action, low strength.
Sloan: Sn	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods, frost action.
Wellston: WdC2	Moderate: depth to rock.	Moderate: slope	Moderate: depth to rock.	Severe: slope	Moderate: frost action.
Westland: We	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness, frost action.
Whitaker: Wh	Severe: wetness	Moderate: wetness, shrink-swell.	Severe: wetness	Moderate: wetness, shrink-swell.	Severe: frost action.

[1]This mapping unit is made up of two or more dominant soils. See the description of the mapping unit for the composition and behavior characteristics of the mapping unit.

from settling or shear failure of the foundation does 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, soil 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 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 4 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 classifications of the soil and the 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.

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 affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 5 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight,* soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate,* soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe,* soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. The terms *good, fair,* and *poor* have meanings about the same as *slight, moderate,* and *severe.*

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons

TABLE 5.—*Sanitary facilities*

["Percs slowly" and some of the other terms that describe restrictive soil feaures are defined in the Glossary. See text for definitions of "slight,"' "moderate," "good," "fair," and other terms used to rate soils]

Soil series and map symbols	Degree and kind of limitation for—				Suitability of the soil for daily cover for landfill
	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	
Brookston: Br	Severe: wetness, percs slowly.	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness.
Crosby:					
CrA	Severe: percs slowly, wetness.	Slight	Severe: wetness	Moderate: wetness	Fair: too clayey.
CsB2[1]:					
Crosby part	Severe: percs slowly, wetness.	Moderate: slope	Severe: wetness	Moderate: wetness	Fair: too clayey.
Miami part	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Eel: Ee	Severe: floods	Severe: floods	Severe: floods, wetness.	Severe: floods	Good.
Fincastle: FnA	Severe: percs slowly, wetness.	Slight	Severe: wetness	Moderate: wetness	Fair: too clayey.
Fox:					
FoA, FoB2	Slight	Severe: seepage	Severe: seepage	Slight	Fair: thin layer.
FxC2[1]	Moderate: slope	Severe: seepage, slope.	Severe: seepage	Moderate: slope	Fair: thin layer, slope.
Genesee: Ge	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Good.
Hennepin: HeF	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope, area reclaim.
Hickory:					
HkD2	Severe: slope	Severe: slope	Moderate: too clayey, slope.	Severe: slope	Fair: slope.
HkF	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope.
Miami:					
MnB2, MtB3	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Fair: too clayey.
MnC2, MtC3	Moderate: percs slowly, slope.	Severe: slope	Slight	Moderate: slope	Fair: slope, too clayey.
MnD2, MnE, MtD3	Severe: slope	Severe: slope	Moderate: slope	Severe: slope	Poor: slope.
Muren: MuA	Severe: percs slowly.	Slight	Severe: wetness	Slight	Good.
Muskingum: MxG	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
Nineveh: NnA	Slight	Severe: seepage	Severe: seepage	Slight	Fair: too clayey.
Ockley: OcA, OcB2	Slight	Severe: seepage	Severe: seepage	Slight	Good.
Palms: Pa	Severe: wetness, floods.	Severe: wetness, excess humus, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: excess humus, hard to pack.
Parke:					
PkB2	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
PkC2	Moderate: slope	Severe: slope	Slight	Moderate: slope	Fair: slope.
Rensselaer: Re	Severe: wetness, percs slowly.	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness.
Ross: Rs	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Good.
Shoals: Sh	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Good.
Sleeth: Sk	Severe: wetness	Severe: seepage	Severe: seepage, wetness.	Moderate: wetness	Fair: too clayey.

TABLE 5.—*Sanitary facilities*—Continued

Soil series and map symbols	Degree and kind of limitation for—				Suitability of the soil for daily cover for landfill
	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	
Sloan: Sn	Severe: wetness, floods, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
Wellston: WdC2	Moderate: depth to rock.	Severe: slope	Severe: depth to rock.	Moderate: slope	Fair: slope.
Westland: We	Severe: wetness	Severe: seepage, wetness.	Severe: wetness, seepage.	Severe: wetness	Poor: wetness.
Whitaker: Wh	Severe: wetness	Severe: seepage, wetness.	Severe: seepage, wetness.	Moderate: wetness	Good.

[1]This mapping unit made up of two or more dominant soils. See the description of the mapping unit for the composition and behavior characteristics of the mapping unit.

between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 5 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing

TABLE 6.—*Construction materials*

["Low strength" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor"]

Soil series and map symbols	Suitability of the soil as a source of—			
	Roadfill	Sand	Gravel	Topsoil
Brookston: Br	Poor: wetness, frost action	Unsuited	Unsuited	Poor: wetness.
Crosby:				
CrA	Poor: frost action	Unsuited	Unsuited	Fair: thin layer.
CsB2[1]:				
Crosby part	Poor: frost action	Unsuited	Unsuited	Fair: thin layer.
Miami part	Fair: frost action, low strength	Unsuited	Unsuited	Fair: thin layer.
Eel: Ee	Poor: frost action	Unsuited	Unsuited	Good.
Fincastle: FnA	Poor: frost action, low strength	Unsuited	Unsuited	Fair: thin layer.
Fox:				
FoA, FoB2	Good	Good	Good	Fair: thin layer.
FxC2[1]	Good	Good	Good	Fair: thin layer, slope.
Genesee: Ge	Fair: frost action, low strength	Unsuited	Unsuited	Good.
Hennepin: HeF	Poor: slope	Unsuited	Unsuited	Poor: slope, area reclaim.
Hickory:				
HkD2	Poor: low strength	Unsuited	Unsuited	Poor: slope.
HkF	Poor: low strength, slope	Unsuited	Unsuited	Poor: slope.
Miami:				
MnB2	Fair: frost action, low strength	Unsuited	Unsuited	Fair: thin layer.
MnC2	Fair: frost action, low strength	Unsuited	Unsuited	Fair: thin layer, slope.
MnD2, MnE, MtD3	Fair: frost action, low strength, slope	Unsuited	Unsuited	Poor: slope.
MtB3	Fair: frost action, low strength	Unsuited	Unsuited	Fair: too clayey.
MtC3	Fair: frost action, low strength	Unsuited	Unsuited	Fair: too clayey, slope.
Muren: MuA	Poor: frost action	Unsuited	Unsuited	Fair: thin layer.
Muskingum: MxG	Poor: slope	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Nineveh: NnA	Fair: frost action	Good	Good	Fair: thin layer.
Ockley: OcA, OcB2	Fair: frost action, low strength	Good	Good	Fair: thin layer.
Palms: Pa	Poor: wetness, excess humus	Unsuited	Unsuited	Poor: wetness.
Parke:				
PkB2	Poor: frost action	Unsuited	Unsuited	Good.
PkC2	Poor: frost action	Unsuited	Unsuited	Fair: slope.
Rensselaer: Re	Poor: wetness, frost action	Unsuited	Unsuited	Poor: wetness.
Ross: Rs	Fair: low strength	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Shoals: Sh	Poor: frost action	Unsuited	Unsuited	Good.
Sleeth: Sk	Poor: frost action, low strength	Good	Good	Fair: thin layer.
Sloan: Sn	Poor: wetness, frost action	Unsuited	Unsuited	Poor: wetness.
Wellston: WdC2	Fair: low strength	Unsuited	Unsuited	Fair: slope.
Westland: We	Poor: wetness, frost action	Good	Good	Poor: wetness.
Whitaker: Wh	Poor: frost action	Unsuited	Unsuited	Good.

[1]This mapping unit is made up of two or more dominant soils. See the description of the mapping unit for the composition and behavior characteristics of the mapping unit.

TABLE 7.—*Water management*

["Seepage," and some of the other terms that describe restrictive soil features are defined in the Glossary]

Soil series and map symbols	Soil features affecting—					
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Brookston: Br	Favorable	Low strength, piping.	Favorable	Favorable	Not needed	Wetness.
Crosby:						
CrA	Favorable	Compressible, low strength, piping.	Slow refill	Percs slowly, wetness.	Wetness	Wetness.
CsB2[1]:						
Crosby part	Favorable	Compressible, low strength, piping.	Slow refill	Percs slowly, wetness.	Wetness	Wetness.
Miami part	Seepage	Compressible, low strength.	No water	Not needed	Complex slope, erodes easily, slope.	Erodes easily, slope.
Eel: Ee	Seepage	Piping, low strength.	Deep to water	Not needed	Not needed	Not needed.
Fincastle: FnA	Favorable	Compressible, low strength, piping.	Slow refill	Percs slowly, wetness.	Not needed	Not needed.
Fox: FoA, FoB2, FxC2[1]	Seepage	Low strength	No water	Not needed	Piping, rooting depth.	Rooting depth.
Genesee: Ge	Seepage	Piping low strength, erodes easily.	Deep to water	Not needed	Not needed	Not needed.
Hennepin: HeF	Slope	Favorable	No water	Not needed	Slope	Slope, erodes easily.
Hickory: HkD2, HkF	Slope	Low strength, shrink-swell.	No water	Not needed	Slope, erodes easily.	Slope, erodes easily.
Miami: MnB2, MnC2, MnD2, MnE, MtB3, MtC3, MtD3.	Seepage	Compressible, low strength.	No water	Not needed	Complex slope, erodes easily, slope.	Erodes easily, slope.
Muren: MuA	Favorable	Low strength, erodes easily.	Deep to water, slow refill.	Percs slowly	Erodes easily, wetness.	Erodes easily, wetness.
Muskingum: MxG	Slope, seepage, depth to rock.	Seepage, piping	No water	Not needed	Slope, piping	Slope, erodes easily.
Nineveh: NnA	Seepage	Favorable	No water	Not needed	Not needed	Not needed.
Ockley:						
OcA	Seepage	Compressible, low strength.	No water	Not needed	Not needed	Favorable.
OcB2	Seepage	Compressible, low strength.	No water	Not needed	Slope, erodes easily.	Erodes easily, slope.
Palms: Pa	Seepage	Compressible, hard to pack, low strength.	Favorable	Wetness, floods, cutbanks cave.	Not needed	Not needed.
Parke: PkB2, PkC2	Seepage	Low strength	No water	Not needed	Complex slope, erodes easily.	Erodes easily.
Rensselaer: Re	Seepage	Compressible, shrink-swell, low strength.	Favorable	Percs slowly, wetness.	Not needed	Not needed.
Ross: Rs	Seepage	Piping, hard to pack.	Deep to water	Not needed	Not needed	Not needed.

TABLE 7.—*Water management*—Continued

Soil series and map symbols	Soil features affecting—					
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Shoals: Sh	Seepage	Piping, low strength.	Favorable	Floods, wetness	Not needed	Not needed.
Sleeth: Sk	Seepage	Low strength, shrink-swell.	Deep to water	Cutbanks cave	Not needed	Not needed.
Sloan: Sn	Favorable	Piping	Favorable	Wetness, floods, poor outlets.	Not needed	Wetness.
Wellston: WdC2	Seepage, depth to rock, slope.	Piping, hard to pack, erodes easily.	No water	Not needed	Erodes easily, slope.	Erodes easily, slope.
Westland: We	Seepage	Favorable	Favorable	Cutbanks cave	Not needed	Not needed.
Whitaker: Wh	Seepage	Compressible, shrink-swell.	Deep to water	Favorable	Wetness	Wetness.

[1]This mapping unit is made up of two or more dominant soils. See the description of the mapping unit for the composition and behavior characteristics of the mapping unit.

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. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 6 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, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where 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 some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material 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 their profile. The estimated engineering properties in table 10 in the section "Engineerng properties" provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They 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 moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 6 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 the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in tables 10 and 11 in the sections "Engineering properties" and "Physical and chemical properties."

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered

is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slopes, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very fine clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 7 the degree of soil limitation and soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Aquifer-fed excavated ponds are bodies of water made by excavating a pit or dugout into a groundwater aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Ratings in table 7 are for ponds that are properly designed, located, and constructed. Soil properties and site features that affect aquifer-fed ponds are depth to a permanent water table, permeability of the aquifer, quality of the water, and ease of excavation.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage (fig. 10).

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation uses. 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 recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed 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, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 5, and interpretations for dwellings without basements and for local roads and streets, given in table 4.

Camp areas require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensively used areas, and installing sani-

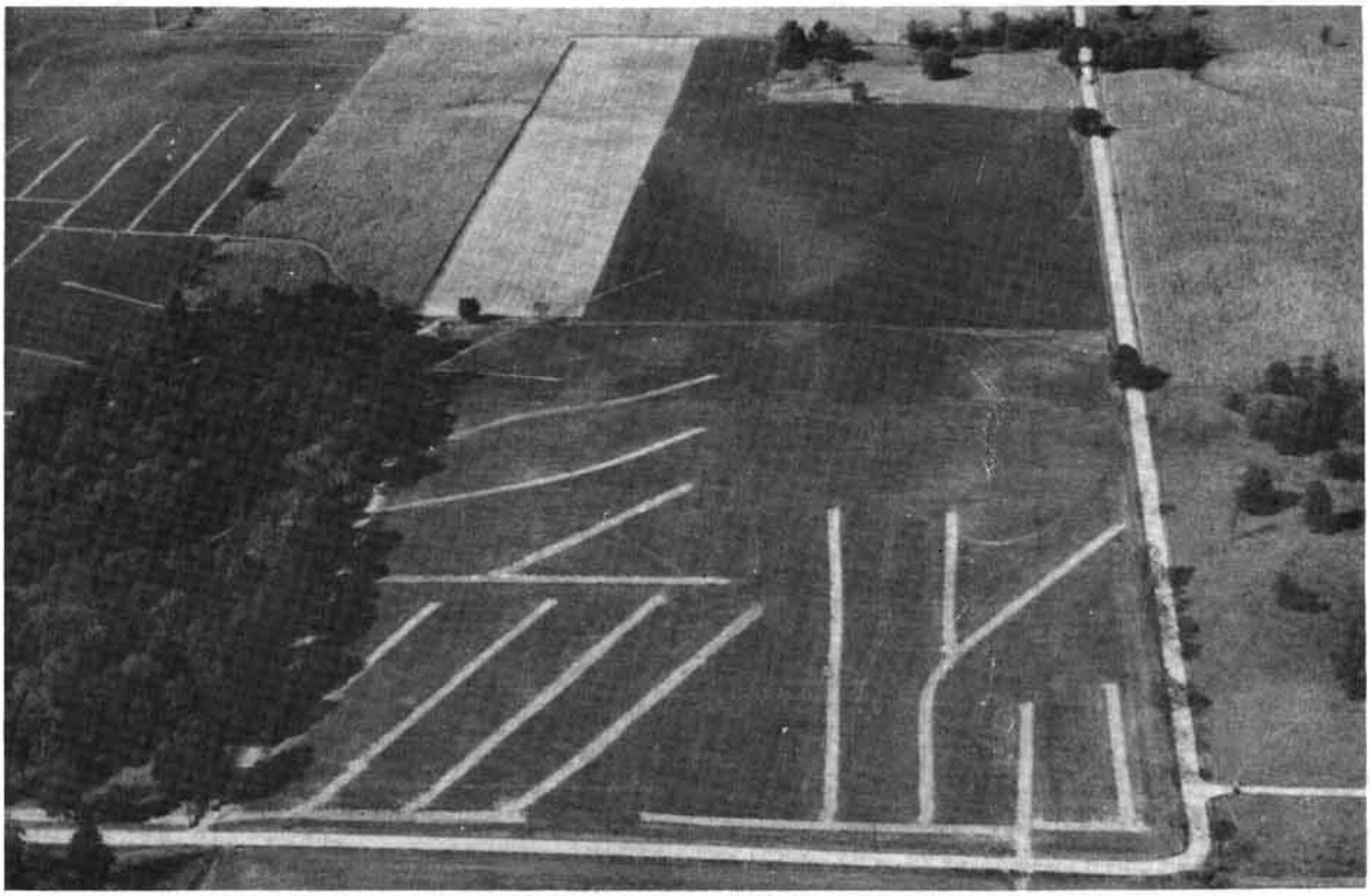


Figure 10.—A tile system on Crosby silt loam, 0 to 2 percent slopes.

tary 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 or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Wildlife habitat[4]

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments (fig. 11). The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vege-

[4]JAMES D. MCCALL, wildlife biologist, Soil Conservation Service, helped prepare this section.

Figure 11.—Stock water and wildlife-recreation pond on Miami silt loam, 6 to 12 percent slopes, eroded; Miami silt loam, 12 to 18 percent slopes, eroded; and Hennepin loam, 25 to 50 percent slopes.

tation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* 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. Moderately intensive management is 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 must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe,

TABLE 8.—*Recreational development*

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

Soil series and map symbols	Degree and kind of limitation for—			
	Camp areas	Picnic areas	Playgrounds	Paths and trails
Brookston: Br	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Crosby:				
CrA	Moderate: wetness, percs slowly.	Moderate: wetness	Moderate: wetness, percs slowly.	Moderate: wetness.
CsB2[1]:				
Crosby part	Moderate: wetness, percs slowly.	Moderate: wetness	Moderate: wetness, percs slowly, slope.	Moderate: wetness.
Miami part	Slight	Slight	Moderate: slope	Slight.
Eel: Ee	Severe: floods	Moderate: floods	Severe: floods	Moderate: floods.
Fincastle: FnA	Moderate: wetness, percs slowly.	Moderate: wetness	Moderate: wetness, percs slowly.	Moderate: wetness.
Fox:				
FoA	Slight	Slight	Slight	Slight.
FoB2	Slight	Slight	Moderate: slope	Slight.
FxC2[1]	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Genesee: Ge	Severe: floods	Severe: floods	Severe: floods	Moderate: floods.
Hennepin: HeF	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Hickory:				
HkD2	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
HkF	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Miami:				
MnB2	Slight	Slight	Moderate: slope	Slight.
MnC2	Moderate: slope	Moderate: slope	Severe: slope	Slight.
MnD2, MnE	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
MtB3	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey.
MtC3	Moderate: too clayey, slope.	Moderate: too clayey	Severe: slope	Moderate: too clayey.
MtD3	Severe: slope	Severe: slope	Severe: slope	Moderate: too clayey, slope.
Muren: MuA	Moderate: wetness, percs slowly.	Slight	Moderate: wetness, percs slowly.	Slight.
Muskingum: MxG	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Nineveh: NnA	Slight	Slight	Slight	Slight.
Ockley:				
OcA	Slight	Slight	Slight	Slight.
OcB2	Slight	Slight	Moderate: slope	Slight.
Palms: Pa	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.
Parke:				
PkB2	Slight	Slight	Moderate: slope	Slight.
PkC2	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Rensselaer: Re	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Ross: Rs	Severe: floods	Moderate: floods	Moderate: floods	Slight.
Shoals: Sh	Severe: wetness, floods	Moderate: wetness, floods.	Severe: wetness, floods	Moderate: wetness, floods.
Sleeth: Sk	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness.
Sloan: Sn	Severe: wetness, floods	Severe: wetness	Severe: wetness, floods	Severe: wetness.
Wellston: WdC2	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Westland: We	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Whitaker: Wh	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness.

[1]This mapping unit made up of two or more dominant soils. See the description of the mapping unit for the composition and behavior characteristics of the mapping unit.

TABLE 9.—*Wildlife habitat potentials*

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

Soil series and map symbols	Potential for habitat elements							Potential as habitat for—		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Brookston: Br	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Crosby:										
CrA	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
CsB2[1]:										
Crosby part	Fair	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Miami part	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Eel: Ee	Poor	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
Fincastle: FnA	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Fox:										
FoA, FoB2	Good	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
FxC2[1]	Fair	Good	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Genesee: Ge	Poor	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor
Hennepin: HeF	Very poor	Poor	Good	Good	Fair	Very poor	Very poor	Poor	Good	Very poor.
Hickory:										
HkD2	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
HkF	Very poor	Poor	Good	Good	Good	Very poor	Very poor	Poor	Good	Very poor.
Miami:										
MnB2, MtB3	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
MnC2, MtC3	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
MnD2, MnE, MtD3	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Muren: MuA	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Muskingum: MxG	Very poor	Poor	Good	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor.
Nineveh: NnA	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Ockley: OcA, OcB2	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Palms: Pa	Very poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Parke:										
PkB2	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
PkC2	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Rensselaer: Re	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Ross: Rs	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Shoals: Sh	Poor	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
Sleeth: Sk	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Sloan: Sn	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Wellston: WdC2	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Westland: We	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Whitaker: Wh	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

[1]This mapping unit is made up of two or more dominant soils. See description of the mapping unit for the composition and behavior characteristics of the mapping unit.

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. 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. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. 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. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. 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. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of native plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

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. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, and cordgrass and rushes, sedges, and reeds.

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

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, cottontail rabbit, and red fox.

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, more birds, muskrat, mink, and beaver.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of 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 soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifica-

tions, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present pertinent soil and water features, engineering test data, and data obtained from physical and chemical laboratory analyses of soils.

Engineering properties

Table 10 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 10 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 10 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in 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 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 system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

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 classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. 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 in group 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 higher for the poorest. The estimated AASHTO classification, without group index numbers, is given in table 10. Also in table 10 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) 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 consistence of soil. These indexes are used in both the Unified and 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.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 11 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 typical pedon 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 among 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 vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing 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 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.

TABLE 10.—*Engineering properties and classifications*

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil series and map symbols	Depth	USDA texture	Classification		Frag-ments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				*Pct*					*Pct*	
Brookston: Br	0–17	Silty clay loam	CL	A-6, A-7	0	100	98–100	95–100	75–95	36–48	15–20
	17–46	Clay loam	CL, CH	A-6, A-7	0	98–100	96–100	85–95	75–85	36–52	18–30
	46–60	Loam	CL	A-4, A-6	0–3	90–100	85–95	78–90	55–70	22–30	7–15
Crosby:											
CrA	0–13	Silt loam	CL, CL-ML	A-4, A-6	0	100	95–100	80–100	50–90	22–34	6–15
	13–30	Clay loam	CL, CH	A-6, A-7	0–3	92–99	89–97	78–93	64–76	37–55	17–31
	30–60	Loam	CL, ML, CL-ML	A-4, A-6	0–3	88–94	83–89	74–87	50–64	17–30	2–14
CsB2[1]:											
Crosby part	0–13	Silt loam	CL, CL-ML	A-4, A-6	0	100	95–100	80–100	50–90	22–34	6–15
	13–30	Clay loam	CL, CH	A-6, A-7	0–3	92–99	89–97	78–93	64–76	37–55	17–31
	30–60	Loam	CL, ML, CL-ML	A-4, A-6	0–3	88–94	83–89	74–87	50–64	17–30	2–14
Miami part	0–14	Silt loam	CL, CL-ML	A-4, A-6	0	100	95–100	80–100	50–90	22–34	6–15
	14–34	Clay loam	CL	A-6, A-7	0	92–99	89–97	78–95	64–95	37–50	17–31
	34–60	Loam	CL, CL-ML	A-4, A-6	0–3	88–94	83–89	74–87	50–64	17–30	2–14
Eel: Ee	0–17	Silt loam	ML, CL	A-4, A-6	0	----	100	90–100	75–85	26–40	5–15
	17–40	Silt loam, loam	ML, CL	A-4, A-6	0	----	100	90–100	75–85	26–40	5–15
	40–60	Stratified sandy loam to silt loam.	ML, CL	A-4, A-6	0	100	90–100	70–80	55–70	26–40	5–15
Fincastle: FnA	0–12	Silt loam	CL, ML	A-4, A-6	0	100	95–100	90–100	75–93	27–36	4–12
	12–33	Silty clay loam	CL, CH	A-6, A-7	0	----	100	95–100	85–95	38–54	20–32
	33–45	Clay loam	CH, CL	A-7	0	95–100	90–98	85–95	75–85	45–58	30–38
	45–60	Loam	CL, ML	A-4	0–3	88–96	82–90	70–86	50–66	18–24	6–10
Fox: FoA, FoB2, FxC2[1]	0–15	Loam	ML	A-4	0	95–100	90–100	75–95	55–90	20–30	2–4
	15–34	Sandy clay loam, gravelly sandy clay loam.	CL, SC	A-6	0	85–100	75–95	65–95	45–75	25–35	10–20
	34–60	Sand and gravel	SP, SP-SM	A-1	0–5	55–75	40–65	20–40	2–10	----	NP
Genesee: Ge	0–8	Loam	ML, CL	A-4, A-6	0	----	100	90–100	75–85	26–40	5–15
	8–40	Silt loam	ML, CL	A-4, A-6	0	----	100	90–100	75–85	26–40	5–15
	40–60	Stratified sandy loam to silt loam.	ML, CL	A-4, A-6	0	100	90–100	70–80	50–70	26–40	5–15
Hennepin: HeF	0–6	Loam	CL, CL-ML	A-4, A-6	0–5	90–100	85–100	70–100	60–95	25–40	5–20
	6–14	Loam	CL, CL-ML	A-4, A-6, A-7	0–5	85–100	80–100	65–100	60–95	20–50	5–25
	14–60	Loam	CL, CL-ML	A-4, A-6, A-7	0–5	85–100	80–100	65–100	60–95	20–50	5–25
Hickory: HkD2, HkF	0–13	Silt loam	CL-ML, CL	A-6, A-4	0–5	95–100	90–100	90–100	85–95	20–35	5–15
	13–63	Clay loam	CL	A-6, A-7	0–5	95–100	90–100	80–95	75–90	30–50	15–30
	63–73	Loam	CL-ML, CL	A-4, A-6	0–5	85–100	85–95	80–95	60–80	20–40	5–20

TABLE 10.—*Engineering properties and classifications*—Continued

Soil series and map symbols	Depth	USDA texture	Classification		Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				*Pct*					*Pct*	
Miami:											
MnB2, MnC2, MnD2, MnE.	0–14	Silt loam	CL, CL–ML	A–4, A–6	0	100	95–100	80–100	50–90	22–34	6–15
	14–34	Clay loam	CL	A–6, A–7	0	92–99	89–97	78–95	64–95	37–50	17–31
	34–60	Loam	CL, CL–ML	A–4, A–6	0–3	88–94	83–89	74–87	50–64	17–30	2–14
MtB3, MtC3, MtD3	0–7	Clay loam	CL	A–6, A–7	0	95–100	90–100	80–100	65–85	35–50	15–25
	7–34	Clay loam	CL	A–6, A–7	0	92–99	89–97	78–95	64–95	37–50	17–31
	34–60	Loam	CL, CL–ML	A–4, A–6	0–3	88–94	83–89	74–87	50–64	17–30	2–14
Muren: MuA	0–14	Silt loam	CL, CL–ML	A–4, A–6	0		100	90–100	70–90	25–35	5–15
	14–46	Silty clay loam	CL	A–6, A–7	0		100	90–100	80–95	35–50	15–30
	46–60	Silt loam	CL, CL–ML	A–4, A–6	0		100	90–100	70–90	25–35	5–15
Muskingum: MxG	0–10	Silt loam	ML, CL, SM, SC	A–2, A–4	0–10	75–100	70–95	50–90	30–80	20–35	2–10
	10–25	Silt loam, channery silt loam.	GM, SM, ML, CL	A–4	0–15	70–90	55–85	50–80	40–75	20–35	2–10
	25–34	Channery silt loam	GM, SM, ML	A–1, A–2, A–4	0–15	20–80	10–65	10–65	10–60	20–35	2–10
	34	Unweathered bedrock.									
Nineveh: NnA	0–8	Loam	CL	A–4, A–6	0	95–100	95–100	85–95	60–75	20–35	10–15
	8–27	Clay loam	CL	A–6, A–7	0	95–100	90–100	85–100	65–80	35–45	15–25
	27–36	Gravelly clay loam, gravelly loam.	SC, CL	A–6, A–7	0–5	65–75	60–70	50–60	40–60	30–45	15–25
	36–60	Stratified sand to very gravelly sand.	SP, GP, SP–SM	A–1	0–5	30–70	20–55	5–20	0–10		NP
Ockley: OcA, OcB2	0–11	Loam	CL, ML	A–4, A–6	0	100	95–100	80–100	60–90	22–33	4–12
	11–22	Clay loam	CL	A–4, A–6	0	100	75–100	65–90	50–90	20–35	8–17
	22–50	Clay loam, sandy clay loam, gravelly loam.	CL, SC	A–6, A–7	0–2	70–85	45–75	40–70	35–55	30–45	11–25
	50–60	Stratified sand to gravelly sand.	SP, SP–SM, GP	A–1	1–5	30–70	22–55	7–20	2–10	<20	NP
Palms: Pa	0–28	Muck	Pt.								
	28–60	Silt loam, fine sandy loam	CL–ML, CL	A–4, A–6	0	85–100	80–100	70–95	50–80	<30	5–15
Parke: PkB2, PkC2	0–13	Silt loam	CL, CL–ML	A–4, A–6	0		100	90–100	70–100	25–35	5–15
	13–36	Silty clay loam, loam, silt loam.	CL, CH	A–6, A–7	0	95–100	95–100	90–100	80–100	35–55	20–35
	36–60	Loam	CL–ML, CL	A–4, A–6	0–3	90–100	85–95	75–90	60–80	25–35	5–15
Rensselaer: Re	0–14	Silty clay loam	CL, CH	A–6, A–7	0		100	95–100	85–95	40–54	20–32
	14–42	Silty clay loam, loam	CL	A–6, A–7	0		100	90–100	70–80	33–47	15–26
	42–60	Stratified fine sand to clay loam.	CL, SC, CL–ML	A–4	0	98–100	98–100	94–100	40–60	<30	4–9
Ross: Rs	0–22	Loam	ML, CL–ML	A–4	0	90–100	90–100	80–100	65–90	<40	NP–10
	22–60	Sandy clay loam, sandy loam.	ML, CL–ML, SC, SM–SC	A–4, A–6, A–2	0	90–100	90–100	65–90	30–55	<40	NP–12
Shoals: Sh	0–8	Silt loam	ML, CL	A–4, A–6	0			90–100	65–90	22–36	6–15
	8–35	Silt loam, loam	ML, CL	A–4, A–6	0			90–100	75–85	26–33	6–11
	35–60	Stratified silt loam to sandy loam.	ML	A–4	0–3	95–100	90–100	70–80	55–70	32–40	3–8

Sleeth: Sk	0–17	Loam	CL, ML	A–4, A–6	0	100	90–100	75–95	50–85	22–30	4–12
	17–27	Clay loam	CL	A–6	0	85–95	85–95	80–90	65–75	30–40	20–30
	27–48	Gravelly clay loam	CL	A–6	0–3	65–75	60–70	55–70	50–70	30–40	20–30
	48–60	Stratified sand to gravelly sand.	SP, GP, SP–SM	A–1	1–5	30–70	22–55	7–20	2–10		NP
Sloan: Sn	0–14	Clay loam, silty clay loam	CL, ML	A–6, A–4, A–7	0	100	95–100	85–100	70–95	30–50	8–15
	14–38	Clay loam	CL, ML	A–6, A–7, A–4	0	100	90–100	85–100	75–95	30–45	8–18
	38–60	Stratified loam to silty clay loam.	ML, CL	A–4, A–6	0	95–100	90–100	80–95	65–90	25–40	6–1
Wellston: WdC2	0–8	Silt loam	ML	A–4	0	95–100	90–100	85–100	70–95	26–34	4–10
	8–27	Silt loam, silty clay loam	CL, ML	A–6, A–4	0–5	75–100	70–100	60–95	60–90	25–40	5–18
	27–52	Silt loam	ML, CL, GM	A–4, A–6	0–10	65–90	65–90	60–90	40–65	20–35	5–14
	52	Unweathered bedrock.									
Westland: We	0–15	Clay loam	CL	A–6	0	95–100	90–100	85–95	65–75	27–38	11–20
	15–38	Clay loam	CL	A–6	0	95–100	90–100	80–90	65–75	30–40	20–30
	38–48	Gravelly clay loam	CL	A–6	0–5	65–75	60–70	55–70	50–70	30–40	20–30
	48–60	Stratified sand to gravelly sand.	SP, GP, SP–SM	A–1	1–5	30–70	22–55	7–20	2–10		NP
Whitaker: Wh	0–12	Silt loam	CL, CL–ML	A–4, A–6	0	100	95–100	80–100	60–90	22–33	4–12
	12–46	Clay loam, loam	CL	A–6, A–7	0	100	95–100	90–100	70–80	30–47	12–26
	46–60	Stratified coarse sand to silt clay loam.	CL, SC, CL, ML, SM	A–4	0	98–100	98–100	94–100	40–60	5–21	4–9

[1]This mapping unit is made up of two or more dominant soils. See description of the mapping unit for the composition and behavior characteristics of the mapping unit.

Soil reaction is expressed as a 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, ornamental plants, 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 degrees C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 11. 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 the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also 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 11, 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 rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is 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

TABLE 11.—*Physical and chemical properties of soils*

[Dashes indicate data were not available. The symbol < means less than; > means more than. The erosion tolerance factor (T) is for the entire profile]

Soil series and map symbols	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
							Uncoated steel	Concrete	K	T	
	In	*In/hr*	*In/in*	*pH*	*Mmhos/cm*						
Brookston: Br	0–17	0.6–2.0	0.21–0.24	6.6–7.3	<2	Moderate	High	Low			7
	17–46	0.6–2.0	0.15–0.19	6.6–7.3	<2	Moderate	High	Low			
	46–60	0.2–0.6	0.05–0.19	7.4–8.4	<2	Moderate	High	Low			
Crosby:											
CrA	0–13	0.6–2.0	0.20–0.24	5.1–6.5	<2	Low	High	Moderate	0.37	3–2	5
	13–30	0.06–0.2	0.15–0.20	5.1–7.3	<2	Moderate	High	Moderate	0.37		
	30–60	0.06–0.6	0.05–0.19	7.9–8.4	<2	Low	High	Low	0.37		
CsB2[1]:											
Crosby part	0–13	0.6–2.0	0.20–0.24	5.1–6.5	<2	Low	High	Moderate	0.37	3–2	5
	13–30	0.06–0.2	0.15–0.20	5.1–7.3	<2	Moderate	High	Moderate	0.37		
	30–60	0.06–0.6	0.05–0.19	7.9–8.4	<2	Low	High	Low	0.37		
Miami part	0–14	0.6–2.0	0.20–0.24	5.6–7.3	<2	Low	Low	Moderate	0.32	4–3	5
	14–34	0.6–2.0	0.15–0.20	5.6–6.0	<2	Moderate	Moderate	Moderate	0.32		
	34–60	0.06–2.0	0.05–0.19	6.6–8.4	<2	Low	Low	Low	0.43		
Eel: Ee	0–17	0.6–2.0	0.20–0.24	6.6–7.3	<2	Low	Moderate	Low			5
	17–40	0.6–2.0	0.17–0.22	6.6–7.8	<2	Low	Moderate	Low			
	40–60	0.6–2.0	0.19–0.21	7.4–7.8	<2	Low	Moderate	Low			
Fincastle: FnA	0–12	0.6–2.0	0.22–0.24	5.1–6.5	<2	Low	High	Moderate	0.37	4–3	5
	12–33	0.2–0.6	0.18–0.20	5.1–5.5	<2	Moderate	High	Moderate	0.37		
	33–45	0.06–0.6	0.15–0.19	5.1–6.0	<2	Moderate	High	Moderate	0.37		
	45–60	0.06–0.6	0.05–0.19	7.4–8.4	<2	Low	High	Low	0.37		
Fox: FoA, FoB2, FxC2[1]	0–15	0.6–2.0	0.20–0.22	5.6–6.5	<2	Low	Low	Low	0.32	3–2	6
	15–34	0.6–2.0	0.12–0.14	6.1–7.8	<2	Moderate	Low	Low	0.32		
	34–60	>20	0.02–0.04	7.9–8.4	<2	Low	Low	Low	0.10		
Genesee: Ge	0–8	0.6–2.0	0.20–0.24	6.1–7.8	<2	Low	Low	Low			5
	8–40	0.6–2.0	0.17–0.22	6.1–8.4	<2	Low	Low	Low			
	40–60	0.6–2.0	0.19–0.21	7.4–8.4	<2	Low	Low	Low			
Hennepin: HeF	0–6	0.6–2.0	0.18–0.24	6.1–7.8	<2	Low	Low	Low	0.32	5–4	5
	6–14	0.2–2.0	0.14–0.22	6.1–7.8	<2	Low	Low	Low	0.32		
	14–60	0.2–2.0	0.07–0.11	6.1–8.4	<2	Low	Low	Low	0.32		
Hickory: HkD2, HkF	0–13	0.6–2.0	0.20–0.22	4.5–6.0	<2	Low	Low	High	0.32	5–4	6
	13–63	0.6–2.0	0.15–0.19	5.1–5.5	<2	Moderate	Modreate	Moderate	0.32		
	63–73	0.6–2.0	0.11–0.19	5.1–8.4	<2	Low	Low	Low	0.32		
Miami:											
MnB2, MnC2, MnD2, MnE.	0–14	0.6–2.0	0.20–0.24	5.6–7.3	<2	Low	Low	Moderate	0.32	4–3	5
	14–34	0.6–2.0	0.15–0.20	5.6–6.0	<2	Moderate	Moderate	Moderate	0.32		
	34–60	0.06–2.0	0.05–0.19	6.6–8.4	<2	Low	Low	Low	0.43		
MtB3, MtC3, MtD3	0–7	0.6–2.0	0.17–0.19	5.6–7.3	<2	Moderate	Moderate	Moderate	0.32		4
	7–34	0.6–2.0	0.15–0.20	5.6–6.0	<2	Moderate	Moderate	Moderate	0.32		
	34–60	0.06–2.0	0.05–0.19	6.6–8.4	<2	Low	Low	Low	0.43		
Muren: MuA	0–14	0.6–2.0	0.22–0.24	5.1–6.0	<2	Low	Moderate	Moderate	0.37	4–3	5
	14–46	0.2–0.6	0.18–0.20	5.1–6.0	<2	Low	High	Moderate	0.43		
	46–60	0.6–2.0	0.20–0.22	5.6–7.3	<2	Low	Moderate	Moderate	0.43		

Muskingum: MxG	0–10	2.0–6.0	0.12–0.18	4.5–6.0	<2	Low	Low	High	0.28	3	5
	10–25	0.6–2.0	0.08–0.14	4.5–5.5	<2	Low	Low	High	0.28		
	25–34	0.6–2.0	0.02–0.12	4.5–5.5	<2	Low	Low	High	0.17		
	34										
Nineveh: NnA	0–8	0.6–2.0	0.20–0.22	6.6–7.3	<2	Low	Low	Low	0.28	3–2	5
	8–27	0.6–2.0	0.15–0.19	6.6–7.3	<2	Low	Low	Low	0.28		
	27–36	0.6–2.0	0.13–0.16	6.6–7.8	<2	Low	Low	Low	0.28		
	36–60	>20	0.02–0.04	7.4–8.4	<2	Low	Low	Low	0.10		
Ockley: OcA, OcB2	0–11	0.6–2.0	0.20–0.24	5.6–6.5	<2	Low	Low	Moderate	0.37	4–3	5
	11–22	0.6–2.0	0.15–0.20	4.5–6.0	<2	Moderate	Moderate	Moderate	0.37		
	22–50	0.6–2.0	0.12–0.14	5.6–6.5	<2	Moderate	Moderate	Moderate	0.24		
	50–60	>20	0.02–0.04	7.4–8.4	<2	Low	Low	Low	0.10		
Palms: Pa	0–28	2.0–6.0	0.35–0.45	5.1–7.8	<2		High	Moderate			3
	28–60	0.6–2.0	0.05–0.19	6.1–8.4	<2	Low	High	Low			
Parke: PkB2, PkC2	0–13	0.6–2.0	0.22–0.24	5.1–6.5	<2	Low	Moderate	Moderate	0.37	4–3	5
	13–36	0.6–2.0	0.18–0.20	4.5–5.0	<2	Low	Moderate	High	0.37		
	36–60	0.6–2.0	0.16–0.18	4.5–5.5	<2	Low	Moderate	High	0.28		
Rensselaer: Re	0–14	0.06–0.2	0.21–0.23	6.6–7.3	<2	Moderate	High	Low			7
	14–42	0.06–0.2	0.15–0.19	6.6–7.3	<2	Moderate	High	Low			
	42–60	0.6–2.0	0.19–0.21	7.9–8.4	<2	Low	High	Low			
Ross: Rs	0–22	0.6–2.0	0.16–0.22	6.1–7.8	<2	Low	Low	Low			5
	22–60	0.6–2.0	0.16–0.22	6.1–7.8	<2	Low	Low	Low			
Shoals: Sh	0–8	0.6–2.0	0.22–0.24	6.6–7.3	<2	Low	High	Low			5
	8–35	0.6–2.0	0.20–0.22	6.6–7.3	<2	Low	High	Low			
	35–60	0.6–2.0	0.19–0.21	6.6–7.3	<2	Low	High	Low			
Sleeth: Sk	0–17	0.6–2.0	0.20–0.24	6.6–7.3	<2	Low	High	Low			5
	17–27	0.6–2.0	0.15–0.19	5.6–6.5	<2	Moderate	High	Low			
	27–48	0.6–2.0	0.14–0.16	6.6–8.4	<2	Moderate	High	Low			
	48–60	>20	0.02–0.04	7.9–8.4	<2	Low	Low	Low			
Sloan: Sn	0–14	0.6–2.0	0.20–0.24	6.1–7.8	<2	Moderate	High	Low			5
	14–38	0.2–2.0	0.15–0.19	6.1–7.8	<2	Moderate	High	Low			
	38–60	0.2–2.0	0.16–0.20	6.6–7.8	<2	Low	High	Low			
Wellston: WdC2	0–8	0.6–2.0	0.18–0.22	5.1–6.5	<2	Low	Moderate	Moderate	0.32	4–3	5
	8–27	0.6–2.0	0.17–0.21	4.5–6.0	<2	Low	Moderate	High			
	27–52	0.6–2.0	0.12–0.17	4.5–6.0	<2	Low	Moderate	High			
	52										
Westland: We	0–15	0.6–2.0	0.18–0.21	5.6–7.3	<2	Moderate	High	Low			6
	15–38	0.06–0.2	0.15–0.19	5.6–7.3	<2	Moderate	High	Low			
	38–48	0.06–0.2	0.14–0.16	5.6–7.3	<2	Moderate	High	Low			
	48–60	>20	0.02–0.04	7.4–8.4	<2	Low	High	Low			
Whitaker: Wh	0–12	0.6–2.0	0.20–0.24	5.6–7.3	<2	Low	Moderate	Moderate	0.37	5	5
	12–46	0.6–2.0	0.15–0.19	5.1–6.0	<2	Moderate	High	Moderate	0.37		
	46–60	0.6–6.0	0.19–0.21	6.6–8.4	<2	Low	High	Low	0.37		

[1]This mapping unit is made up of two or more dominant soils. See description of the mapping unit for the composition and behavior characteristics of the mapping unit.

have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions.

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is diffcult to establish. They are generally not suitable for crops.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.
4. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.
4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 12 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep to deep, moderately well drained to well drained soils that have moderately fine texture to modrately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding; and information that relates the position of each soil on the landscape to historic floods.

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.

High water table is the highest level of a saturated zone more than 8 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal 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 in many borings made during the course of the soil survey. Indicated are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal 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 construction of basements is feasible and to determine how septic tank absorption fields and

TABLE 12.—*Soil and water features*

[Dashes indicate that the feature is not a concern. See text for descriptions of hydrologic groups. The symbol < means less than; > means greater than]

Soil series and map symbols	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	
					Ft			*In*		
Brookston: Br	B/D	Frequent	Brief	Dec.–May	0–1.0	Apparent	Dec.–May	>60		High.
Crosby:										
CrA	C	None			1.0–3.0	Apparent	Jan.–Apr.	>60		High.
CsB2[1]:										
Crosby part	C	None			1.0–3.0	Apparent	Jan.–Apr.	>60		High.
Miami part	B	None			>6.0			>60		Moderate.
Eel: Ee	C	Frequent	Brief	Oct.–June	3.0–6.0	Apparent	Jan.–Apr.	>60		High.
Fincastle: FnA	C	None			1.0–3.0	Apparent	Jan.–Apr.	>60		High.
Fox: FoA, FoB2, FxC2[1]	B	None			>6.0			>60		Moderate.
Genesee: Ge	B	Frequent	Brief	Oct.–June	>6.0			>60		Moderate.
Hennepin: HeF	B	None			>6.0			>60		Moderate.
Hickory: HkD2, HkF	C	None			>6.0			>60		Moderate.
Miami: MnB2, MnC2, MnD2, MnE, MtB3, MtC3, MtD3.	B	None			>6.0			>60		Moderate.
Muren: MuA	B	None			3.0–6.0	Apparent	Mar.–Apr.	<60		High.
Muskingum: MxG	C	None			>6.0			20–40	Rippable	Moderate.
Nineveh: NnA	B	None			>6.0			>60		Moderate.
Ockley: OcA, OcB2	B	None			>6.0			>60		Moderate.
Palms: Pa	A/D	Frequent	Long	Nov.–May	0–1.0	Apparent	Nov.–May	>60		High
Parke: PkB2, PkC2	B	None			>6.0			>60		High.
Rensselaer: Re	B/D	Frequent	Brief	Dec.–May	0–1.0	Apparent	Dec.–May	>60		High.
Ross: Rs	B	Common	Brief	Jan.–Apr.	4.0–6.0	Apparent	Feb.–Apr.	>60		Moderate.
Shoals: Sh	C	Frequent	Brief	Jan.–May	1.0–3.0	Apparent	Jan.–Apr.	>60		High.
Sleeth: Sk	C	None			1.0–3.0	Apparent	Jan.–Apr.	>60		High.
Sloan: Sn	B/D	Frequent	Brief	Oct.–June	0–0.5	Apparent	Nov.–June	>60		High.
Wellston: WdC2	B	None			>3.0	Apparent	Mar.–May	>60	Hard	Moderate.
Westland: We	B/D	Frequent	Brief	Dec.–May	0–1.0	Apparent	Dec.–May	>60		High.
Whitaker: Wh	C	None			1.0–3.0	Apparent	Jan.–Apr.	>60		High.

[1]This mapping unit is made up of two or more dominant soils. See description of the mapping unit for the composition and behavior characteristics of the mapping unit.

other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soil. The kind of bedrock and its 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 results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. 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.

Formation and classification of the soils

In this section the factors that affected the formation of soils in Johnson County are discussed. The processes of soil formation are described, and the physical and chemical properties of selected soils in Johnson County are analyzed. The soil series in the county, including a representative profile of each series, are described in the section "Description of the soils." The last part of this section explains the current system of soil classification and places the soils of the county in the higher categories of that system.

Factors of soil formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of soil are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks, and they slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Generally, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil formation are unknown.

Parent material

Parent material is the unconsolidated mass from which a soil is formed. The parent material of the soils of Johnson County was deposited by glaciers, by melt water from the glaciers, by loess or windblown silt, or formed from residual bedrock. The glaciers that covered the county were from the Wisconsin Age, about 10,000 to 12,000 years ago, and from the Illinois Age, more than 200,000 years ago. Some of the glacial materials are reworked and redeposited by subsequent actions of water and wind.

Parent material determines the limits of the chemical and mineralogical composition of the soil. Although parent materials are of common glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited. The dominant parent materials in Johnson County were deposited as glacial till, outwash deposits, alluvium, and organic material.

Glacial till is material laid down directly by glaciers with a minimum of water action. It is a mixture of particles of different sizes. The small pebbles in glacial till have sharp corners, which show that they have not been worn by water washing. The glacial till in Johnson County is calcareous and firm. Its texture is loam. Soils of the Miami series are examples of soils that formed in glacial till. They typically are medium textured and have well developed structure.

Outwash materials are deposited by running water from melting glaciers. The size of the particles that make up outwash material varies according to the speed of the stream of water that carried them. When the water slows down, the coarser particles are deposited. Finer particles, such as very fine sand, silt, and clay, can be carried by slowly moving water. Outwash deposits generally form layers of particles of similar size, such as sandy loam, sand, gravel, and, dominantly, other coarse particles. Soils of the Ockley series, for example, formed in deposits of outwash material in Johnson County.

As the glaciers receded, dry periods occurred on the glacial flood plains. These dry periods were in winter when the melting of ice diminished. During these periods, silt was blown from the west, probably from the Wabash or White River Valleys, and some of the silt was deposited in Johnson County. This windblown silt, or loess, ranges from 0 to more than 60 inches in thickness; the thicker deposits are in the southwest

corner of the county. The Muren and Wellston soils formed in deposits of silt over glacial till or bedrock.

Alluvial material has been deposited by floodwaters in recent time. The texture of this material depends on the speed of the water that deposits the material. The alluvium deposited along a swift stream like the White River is coarser textured than that deposited along a slow, sluggish stream like Stotts Creek. Examples of alluvial soils are Genesee and Shoals soils.

Organic material consists of deposits of plant remains. After the glaciers withdrew from the area, water was left standing in depressions in outwash and till plains. Grasses and sedges growing around the edges of these depressions died, and their remains fell to the bottom. While water filled the depressions, the plant remains did not decompose but remained on the bottom of these shallow lakes. Later, white cedar and other water-tolerant trees grew in the areas. As these trees died, their residues became a part of the organic accumulation. The lakes were eventually filled with organic material and developed into areas of muck and peat. In some of these areas, the plant remains have decomposed. In others, the material has changed little. Soils of the Palms series are examples of soils that formed in organic material.

Plant and animal life

Plants are principal organisms influencing the soils in Johnson County; however, bacteria, fungi, earthworms, and the activities of man have also been important. The chief contribution of plants and animals is that they add organic matter and nitrogen to the soil. The remains of plants accumulate on the surface, decay, and eventually become organic matter. Roots of the plants provide channels for downward movement of water through the soil and also add organic matter, and this is then used by growing plants.

The vegetation in Johnson County was mainly deciduous forests. Differences in natural soil drainage and minor changes in parent material affected the composition of the forest species.

In general, well drained upland soils such as Miami and Wellston soils, were covered mainly by sugar maple, beech, oak, and similar trees. Wet soils were covered mostly by such trees as pin oak, red maple, and willow. A few wet soils also had sphagnum moss and other mosses, which contributed substantially to the accumulation of organic matter. Brookston and Rensselaer soils are examples of soils that formed under wet conditions, and they contain considerable amounts of organic matter. The soils in Johnson County that formed mostly under forest generally have less organic matter than soils in other parts of the state that formed under dominantly grass vegetation.

Climate

Climate is important in the formation of soils. It determines the kind of plant and animal life on and in the soil and the amount of water available for weathering of minerals and transporting of soil materials. Climate, through its influence on soil temperatures, determines the rate of chemical reaction in the soil. The influences of climate are important, but they affect large areas rather than a relatively small area such as a county.

Johnson County has a humid continental climate. This is presumably similar to that which existed when the soils were forming. The soils in Johnson County differ from soils formed in a dry, warm climate or from those that formed in a hot, moist climate. Climate is uniform throughout the county, although its effect is modified locally by runoff and proximity to large bodies of water. The differences in the soils of Johnson County are therefore to a minor extent the results of the difference in climate. For more detailed information on the climate of this county, see the section "Environmental factors affecting soil use."

Relief

Relief, or topography, has a marked influence on the soils of Johnson County through its effect on natural drainage, erosion, plant cover, and soil temperature. In Johnson County, slopes range from 0 to more than 50 percent. Natural soil drainage ranges from well drained on ridgetops to very poorly drained in depressions.

Relief influences the formation of soils by affecting runoff and drainage. Drainage in turn, through its effect on aeration of the soil, determines the color of the soil. Runoff is greatest on the steeper slopes. In low areas through soils that are well drained but slowly through soils that are very poorly drained. In soils that are well aerated, the iron and aluminum compounds that give most soils their color are brightly colored and oxidized, and in poorly aerated soils the compounds are dull gray and mottled.

Ockley soils are examples of well drained, well aerated soils, and Rensselaer soils are examples of poorly aerated, very poorly drained soils. Intermediate between these are the somewhat poorly drained and moderately well drained soils.

Leaching of bases and translocation of silicate clays are important processes in horizon differentiation in the soils of this county. Clay particles accumulate in pores and form films on the surfaces along which water moves. Miami soils are examples of soils in which translocated silicate clays have accumulated in the B2t horizon in the form of clay films.

The reduction and transfer of iron, or gleying, has occurred in all of the very poorly drained and somewhat poorly drained soils of this county. In the naturally wet soils, this process has been significant in horizon differentiation. The gray color of the subsoil indicates the reduction of iron oxides. The reduction is commonly accompanied by some transfer of the iron, either from upper horizons to lower horizons or completely out of the profile. Mottles, which are in some horizons, indicate segregation of iron.

Time

Agents of soil formation require time, generally a long time, to form distinct horizons from parent mate-

rial. The differences in length of time that the parent material has been in place are commonly reflected in the degree of development of the soil profile. Some soils develop rapidly, others slowly.

The soils in Johnson County range from young to mature. The glacial deposits which many of the soils formed have been exposed to soil-forming factors for a long enough time to allow distinct horizons to develop within the soil profile. Some soils forming in recent alluvial sediments, however, have not been in place long enough for distinct horizons to develop.

Genesee soils are examples of young soils formed in alluvial material. Miami and Ockley soils show the effect time has on leaching of lime from the soil.

Processes of soil formation

Several processes have been involved in the formation of the soils of this county. These processes are the accumulation of organic matter; the solution, transfer, and reprecipitation of calcium carbonates and bases; and the liberation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in horizon differentiation.

Some organic matter has accumulated in the surface layer of all the soils of this county. The organic-matter content of some soils is low, and of others is high. Generally, the soils that have the most organic matter, such as Brookston or Rensselaer soils, have a thick black surface layer.

Carbonates and bases have been leached from the upper horizons of nearly all the soils of this county, but leaching has had little direct effect on horizon differentiation. The effect has been indirect. Leaching is generally believed to precede the translocation of silicate clay minerals. Most of the well drained soils have been completely leached of carbonates and bases. Even in the wettest soils, the absence of carbonates and the acid reaction indicate some leaching. Leaching of wet soils is slow because water moves slowly through them.

Laboratory data[5]

The physical and chemical properties of the Fox, Rensselaer, Crosby, Ross, and Sleeth series in Johnson County are shown in table 13. Samples of these soils were selected for analyses during the period 1970-73. The analyses are from the profiles described in the section "Descriptions of the soils." Analyses for particle-size distribution and for organic carbon content were determined in the Purdue laboratory, and those for soil reaction, extractable phosphorus, and extractable potassium were determined by the Purdue Plant and Soil Analysis Laboratory.

Methods of sampling and analysis

All samples were taken from carefully selected pits. Each soil sample was thoroughly mixed, air dried, and crushed by hand or by a rolling pin. Coarse fragments more than 2 millimeters in size were removed from the sample and recorded as a volume estimate or as a weighed percentage of the sample. The soil material that subsequently passed through a 2-millimeter, roundhole sieve was used for laboratory analyses. These samples were weighed in the laboratory to obtain the percentage of 2 millimeter to ¾ inch material. The " > ¾ inch" percentages in table 13 are on the whole soil basis; the " 2mm. – ¾ inch" are on the < ¾ inch basis; all other values are on the < 2mm basis. All results in table 13 are reported on an oven-dry basis. Methods that were used in obtaining the data are described as follows.

The texture and pH values given in table 13 may differ somewhat from those estimated in the field and recorded in profile descriptions.

To obtain particle size distribution, organic matter in the sample was destroyed if the organic-carbon content was more than 2 percent. Clay content was determined after dispersion by a sodium metaphosphate solution and overnight shaking. Following the clay determination the suspension was passed through selected sieves to separate particles of various sizes and the separated fractions were dried and weighed. The percentage of silt was determined by weight difference. All particle sizes in table 13, unless noted otherwise, are reported on the basis of the less than 2-millimeter soil material.

Organic carbon was determined by the Walkley-Black method, which involved oxidation of organic carbon by potassium dichromate and sulfuric acid.

Soil reaction, expressed as a pH value, was obtained by using a glass electrode pH meter and mixture of 1 part soil and 1 part water or 1 part soil and 1 part normal potassium chloride solution.

Extractable phosphorus was determined by the Bray P-1 test. The soil was leached with a 0.025 normal hydrochloric acid and 0.3 normal ammonium fluoride solution and the amount of phosphorus was determined by the molybdo-phosphoric blue colorimetric method.

Extractable potassium was extracted with neutral, normal ammonium acetate and determined using an atomic absorption spectrophotometer.

The phosphorus and potassium determinations are reported as pounds per acre. It was assumed that the plow layer for an acre of soil weighs 2,000,000 pounds.

Classification

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to the latest literature available (*5, 3*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other

[5]DR. DONALD P. FRANZMEIER, associate professor of agronomy, Purdue University helped prepare this section.

properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 14, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol.* An example is Entisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu,* meaning water, plus *ent,* from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a subsorder and a prefix that suggests something about the properties of the soil. An example is Haplaquents (*Hapl,* meaning simple horizons, plus *aquent,* the suborder of Entisols that have an aquic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies for the subgroup that is thought to typify the great group. An example is Typic Haplaquents.

FAMILY. 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 activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, nonacid, mesic, Typic Haplaquents.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characterstics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Environmental factors affecting soil use

The first part of this section describes natural features in Johnson County that have an effect on soil use. Features include relief, water, and climate. The second part describes cultural features in the county that have some effect on soil use. These include transport facilities, manufacturing and business services of agriculture, and trends in population and land use.

Relief, physiography, and drainage

The highest point in Johnson County is about 1,002 feet above sea level on a high ridge west of Peoga. The lowest point is about 635 feet above sea level in the northeastern part of the county where the East Fork of White River leaves Johnson County and enters Morgan County. In the southwestern part of the county, the maximum relief is about 367 feet and the maximum local relief is 225 feet.

The county lies within three distinct physiographic regions. The Tipton Till Plain, which includes more than three-fourths of the county, is mostly nearly level to moderately sloping modified ground moraine, and several terminal moraines, knolls, and kames rise tens of feet above the adjacent ground level.

The Scottsburg Lowland, in the eastern part of the county, is mostly nearly level to gently sloping terraces and outwash plains and nearly level river bottomland along Sugar Creek and Blue River.

The Norman Upland in the southwestern part of the county is characterized by gently sloping to moderately sloping, high, narrow ridgetops and strongly sloping to very steep, deep, V-shaped valleys.

Two major drainage systems within the State drain Johnson County. These are the East Fork and the West Fork of the White River. A line drawn from just east of Greenwood to Bargersville and south to a point slightly east of Peoga divides the county into the two drainage areas.

Most of the area lying to the east is drained by Sugar Creek and Youngs Creek and their tributaries, which join the Blue River at Edinburg to form Driftwood River. Driftwood River in turn joins Flatrock Creek at Columbus, Bartholomew County, to form the East Fork of White River. The southern part of Nineveh Township is drained by small tributaries that flow into Driftwood River in Bartholomew County.

The area lying to the west drains into the West Fork of White River, which flows through the extreme northwestern part of the county. Stream dissection is more complete in the western and southwestern parts than elsewhere.

Water supply

Wells supply most of the water for industry and homes in Johnson County. The best sources of water are the areas underlain by gravelly sand and sand along White River and Blue River, Sugar Creek, and the lower reaches of Hurricane Creek and Youngs

TABLE 13.—*Physical and chemical*

[Tests performed in the Purdue University Laboratory and the Purdue Plant and

Soil name and location	Report no.	Depth from surface	Particle size distribution of <2 mm fraction							
			Very coarse sand (2 to 1 mm)	Coarse sand (1 to 0.5 mm)	Medium sand (0.5 to 0.25 mm)	Fine sand (0.25 to 0.1 mm)	Very fine sand (0.1 to 0.05 mm)	Total sand	Silt (0.05 to 0.002 mm)	Clay less than 0.002 mm)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Crosby silt loam: NW¼ NE¼ sec. 21, T. 13 N., R. 4 E. (Modal)	71-3-1	0-8	1.5	2.5	7.7	13.0	7.8	32.5	55.8	11.7
	71-3-2	8-13	1.7	3.0	8.1	12.9	7.6	33.3	56.0	10.7
	71-3-3	13-19	1.0	1.6	5.3	8.7	5.9	22.5	48.8	28.7
	71-3-4	19-30	1.0	1.4	3.8	6.5	4.6	17.3	43.4	39.3
	71-3-5	30-38	2.2	3.1	9.1	16.1	10.6	41.1	34.7	24.2
	71-3-6	38-60	3.8	5.0	10.3	16.3	10.9	46.3	39.9	13.8
NW¼ NE¼ sec. 31, T. 12 N., R. 5 E. (Coarser textured than modal)	71-4-1	0-8	1.1	3.5	10.9	19.1	10.6	45.2	47.0	7.8
	71-4-2	8-12	1.5	3.5	11.5	18.6	10.7	45.8	45.1	9.1
	71-4-3	12-17	1.6	2.4	7.8	13.6	8.4	33.8	45.6	20.6
	71-4-4	17-29	.6	2.1	7.2	13.3	8.5	31.7	37.1	31.2
	71-4-5	29-34	2.3	3.0	10.0	17.6	12.1	45.0	29.5	25.5
	71-4-6	34-60	4.0	6.2	11.6	18.7	11.8	52.3	36.3	11.4
Fox loam: NE¼ NW¼ sec. 29, T. 11 N., R. 5 E. (Modal)	73-6-1	0-8	1.5	5.5	21.6	9.8	6.3	44.7	39.9	15.4
	73-6-2	8-15	2.0	5.3	21.1	9.5	6.6	44.5	36.1	19.4
	73-6-3	15-22	3.3	6.8	23.6	9.3	4.6	47.6	25.1	27.3
	73-6-4	22-27	6.3	10.5	30.1	11.0	3.0	60.9	12.0	27.1
	73-6-5	27-34	12.5	18.3	24.8	6.8	2.3	64.7	10.3	25.0
	73-6-6	34-39	10.0	26.5	28.3	11.0	4.3	80.1	16.5	3.4
	73-6-7	39-60	1.0	5.0	56.4	26.0	3.8	92.2	6.4	1.4
Rensselaer silty clay loam: NE¼ NW¼ sec. 30, T. 13 N., R. 5 E. (Modal)	71-2-1	0-8	2.7	3.2	3.1	3.4	3.6	16.0	52.3	31.7
	71-2-2	8-14	2.4	5.5	4.2	4.0	2.6	18.7	45.8	35.5
	71-2-3	14-25	2.8	5.2	4.0	3.3	1.9	17.2	44.7	38.1
	71-2-4	25-36	1.6	3.2	3.0	3.6	2.0	13.4	57.9	28.7
	71-2-5	36-42	5.5	10.7	7.8	9.4	6.1	39.5	43.5	17.0
	71-2-6	42-47	5.8	20.7	19.9	9.6	6.6	62.6	28.2	9.2
	71-2-7	47-60	6.3	20.2	27.0	7.8	5.5	66.8	25.7	7.5
NW¼ NE¼ sec. 15, T. 13 N., R. 5 E. (Coarser textured than modal)	71-1-1	0-8	1.4	3.5	13.3	13.7	5.2	37.1	49.2	13.7
	71-1-2	8-14	2.4	3.3	15.1	16.3	5.0	42.1	40.9	17.0
	71-1-3	14-20	1.4	3.1	14.2	14.6	4.8	38.1	40.6	21.3
	71-1-4	20-32	1.2	2.0	11.2	10.9	3.3	28.6	41.2	30.2
	71-1-5	32-41	.5	2.4	13.2	13.3	4.2	33.6	38.2	28.2
	71-1-6	41-49	1.3	3.5	22.3	17.1	4.2	48.4	29.6	22.0
	71-1-7	49-60	14.5	19.6	22.0	16.7	4.8	77.6	16.7	5.7
Ross loam: NE¼ NW¼ sec. 14, T. 12 N., R. 5 E. (Modal)	73-5-1	0-8	1.5	5.3	19.6	11.5	7.8	45.7	34.7	19.6
	73-5-2	8-15	1.5	4.5	19.8	11.8	7.0	44.6	32.6	22.8
	73-5-3	15-22	2.3	5.8	24.4	12.0	5.3	49.8	30.4	19.8
	73-5-4	22-36	1.5	6.5	27.6	13.0	5.6	54.2	24.3	21.5
	73-5-5	36-49	1.5	4.0	26.8	15.2	6.0	53.5	24.6	21.9
	73-5-6	49-60	6.7	12.3	26.8	11.3	8.3	65.4	24.5	10.1
Sleeth loam: SE¼ SW¼ sec. 13, T. 12 N., R. 4 E. (finer textured than modal)	73-7-1	0-8	5.5	11.8	20.6	6.5	2.8	47.2	41.4	11.4
	73-7-2	8-14	2.3	5.5	17.6	6.0	2.1	33.5	43.1	23.4
	73-7-3	14-18	3.0	5.8	17.1	6.0	2.6	34.5	36.3	29.2
	73-7-4	18-28	2.5	5.3	23.9	10.5	2.6	44.8	23.8	31.4
	73-7-5	28-36	2.7	8.7	47.4	12.5	2.6	73.9	8.9	17.2
	73-7-6	36-44	4.4	13.3	38.7	10.0	2.7	69.1	9.1	21.8
	73-7-7	44-60	1.6	14.6	52.6	12.0	3.2	84.0	12.0	4.0

Creek. Wells for the city of Franklin are in terraces and bottom lands along Hurricane Creek and Youngs Creek about a mile from the city; wells for Greenwood are in terraces about five miles west of the city; and wells for Edinburg are in terraces within the city limits.

The amount of water available to wells depends on the type of geologic formation in the area. Some wells in the county yield more than 2,000 gallons of water per minute. Wells in about the western one-third of the county are the least productive; with few exceptions these are "seep wells." In this area, more and more ponds are being dug to supplement the water supply.

properties of selected soils

Soil Analysis Laboratory. The symbol > means more than; < means less than]

>¾ in (volume of whole soil)	2 mm-¾ in (weighed percentage of <¾ in fraction)	Textural class	Reaction (1:1 soil-water)	Reaction (1:1 soil-KC1 solution)	Extractable Phosphorus	Extractable Potassium	Organic carbon
Percent	*Percent*		*pH*	*pH*	*Pounds per acre*	*Pounds per acre*	*Percent*
		Silt loam	5.8		97	240	
		Silt loam	5.6		90	165	
		Clay loam	5.3		8	135	
		Silty clay loam	6.1		2	225	
		Loam	7.0		2	150	
		Loam	8.0		2	90	
		Loam	5.8		27	210	
		Loam	5.5		18	90	
		Loam	5.9		4	135	
		Clay loam	6.5		3	195	
		Loam	6.9		2	150	
		Sandy loam	8.1		1	60	
	3.5	Loam	6.7		15	180	1.23
	15.5	Loam	6.7		13	120	
4.2	21.6	Sandy clay loam	6.6		18	180	
8.7	19.9	Gravelly sandy clay loam	6.8		40	195	
17.4	28.7	Gravelly sandy clay loam	6.9		37	165	
7.7	26.1	Gravelly loamy sand	8.2		11	45	
	2.3	Sand	8.5		4	30	
	16	Silty clay loam	8.1		123	375	2.4
	8	Silty clay loam	7.4		23	255	1.5
		Silty clay loam	7.6		10	225	
	10	Silty clay loam	7.7		12	225	
		Loam	7.7		17	210	
	10	Sandy loam	8.1		34	90	
	14	Sandy loam	8.2		24	105	
		Loam	7.3		168	375	2.2
		Loam	7.1		24	240	1.4
		Loam	7.1		8	180	.5
		Clay loam	7.0		6	225	
		Clay loam	7.0		11	210	
		Loam	7.3		18	210	
		Loamy sand	7.2		28	105	
	1.0	Loam	7.4		36	270	1.75
	1.4	Loam	7.5		10	150	1.61
	4.3	Loam	7.4		5	105	1.10
	3.1	Sandy clay loam	7.4		4	120	.76
	.7	Sandy clay loam	7.4		2	135	.54
3.7	15.6	Sandy loam	7.9		10	90	.48
	5.9	Loam	7.2		75	285	.89
	4.2	Loam	6.9		13	315	
	11.7	Clay loam	5.4	6.4	11	240	
1.4	9.4	Clay loam (sandy clay loam)	5.2	6.2	9	270	
	3.9	Sandy loam	5.7	6.8	9	165	
2.0	9.1	Sandy clay loam	6.3	7.2	8	240	
	1.7	Loamy sand	8.2		11	60	

Climate[6]

Johnson County has a humid continental climate. It is on the fringe of the area influenced by the Great Lakes. Cool Canadian air masses alternating with tropical air masses from the south bring changes in climate within days and account for the variability of the seasons.

During the growing season, rainfall is generally adequate for diversified farming. In midsummer, however, evaporation from soils exceeds rainfall for brief periods, affecting lawns, pastures, and crops.

[6] LAWRENCE A. SCHAAL, state climatologist, Department of Agronomy, Purdue University.

TABLE 14.—*Classification of the soils*

Soil series	Family or higher taxonomic class
Brookston	Fine-loamy, mixed, mesic Typic Argiaquolls.
Crosby	Fine, mixed, mesic Aeric Ochraqualfs.
Eel	Fine-loamy, mixed, nonacid, mesic Aquic Udifluvents.
Fincastle	Fine-silty, mixed, mesic Aeric Ochraqualfs.
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludalfs.
Genesee	Fine-loamy, mixed, nonacid, mesic Typic Udifluvents.
Hennepin	Fine-loamy, mixed, mesic Typic Eutrochrepts.
Hickory	Fine-loamy, mixed, mesic Typic Hapludalfs.
Miami	Fine-loamy, mixed, mesic Typic Hapludalfs.
Muren	Fine-silty, mixed, mesic Aquic Hapludalfs.
Muskingum	Fine-loamy, mixed, mesic Typic Dystrochrepts.
Nineveh	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiudolls.
Ockley	Fine-loamy, mixed, mesic Typic Hapludalfs.
Palms	Loamy, mixed, euic, mesic Terric Medisaprists.
Parke	Fine-silty, mixed, mesic Ultic Hapludalfs.
Rensselaer	Fine-loamy, mixed, mesic Typic Argiaquolls.
Ross	Fine-loamy, mixed, mesic Cumulic Hapludolls.
Shoals	Fine-loamy, mixed, nonacid, mesic Aeric Fluvaquents.
Sleeth	Fine-loamy, mixed, mesic Aeric Ochraqualfs.
Sloan	Fine-loamy, mixed, mesic Fluvaquentic Haplaquolls.
Wellston	Fine-silty, mixed, mesic Ultic Hapludalfs.
Westland	Fine-loamy, mixed, mesic Typic Argiaquolls.
Whitaker	Fine-loamy, mixed, mesic Aeric Ochraqualfs.

Weather changes every few days as a result of passing weather fronts and associated centers of low and high air pressure. In general, a high brings lower temperatures, lower humidity, and sunny days. An approaching low brings increasing temperatures, increasing southerly winds, higher humidity, and rain or showers. This activity is greatest in the winter and spring and least late in summer and early in fall. Arctic air masses cover the county during much of the winter; air masses out of the tropics prevail in the summer.

Temperature data were recorded at the National Weather Service Cooperative Station at Franklin and are considered representative for Johnson County. Temperatures over a 27-year period ranged from −17° to 104° F. About 32 days per year have temperatures of 90° or higher, and on 23 days a year the temperature does not rise above 32°. Probable dates for the last freezing temperature in spring and the first freezing temperature in fall are given in table 15.

Average annual precipitation is rather evenly distributed throughout a year; however, spring and early summer rainfall generally exceeds winter precipitation. The spring rains can generally be relied upon to provide nearly all of the soil moisture required for an excellent summer growing season. Sometimes wet fields in the spring delay planting. The least precipitation usually falls in one of the winter months. Temperature and precipitation data for the county are given in table 16.

A study of rainfall in the area shows that over a period of 100 years there are 4 occurrences of 2.5 inches of rainfall in 1 hour, 4.0 inches in 6 hours, and 4.7 inches in 12 hours. In the same period there are 10 occurrences of 2.1 inches of rainfall in 1 hour, 3.4 inches in 6 hours, and 3.8 inches of rainfall in 1 hour, 2.8 inches in 6 hours, and 3.1 inches in 12 hours.

Snowfall averages 18 inches a year. The months of December through April each receives an average of 4 inches of snow. In 1961, 19 inches of snow fell in February. In a 27-year period the most snow that fell in one day was 9.5 inches on March 1, 1963. Snow is usually welcomed by farmers because it protects winter grain from the severe cold which invariably follows.

Cloud observations at Indianapolis, which are representative for Johnson County, show that 172 days a year are cloudy and 91 days are clear. The sun shines for 59 percent of the daylight hours. Sunshine ranges from 40 percent of the amount possible in December to 72 percent in August.

Relative humidity at noon averages about 58 percent in the summer and 68 percent in the winter. On most nights relative humidity increases to the 90's, and is associated with frequent dew or frost.

Winds are most frequently from the southwest, however, in a couple of winter months the dominant direction is from the northwest. The average windspeed is 7 miles per hour in September and ranges to 11 miles

TABLE 15.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Franklin in Johnson County]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	March 25	April 7	April 17	April 27	May 15
2 years in 10 later than	March 18	April 1	April 12	April 23	May 10
5 years in 10 later than	March 6	March 20	April 1	April 15	April 28
Fall:					
1 year in 10 earlier than	November 12	October 29	October 23	October 10	September 28
2 years in 10 earlier than	November 18	November 4	October 27	October 15	October 2
5 years in 10 earlier than	December 1	November 15	November 3	October 27	October 11

per hour in winter and early in spring at 20 feet above the ground. Damaging winds may originate from thunderstorms or tornadoes. In a 53-year period 8 tornadoes were reported. Thunderstorms occur on about 44 days a year.

Weather during the growing season in Johnson County is generally favorable to agriculture.

Transportation

Johnson County is served by road, rail, and air. Interstate Highway 65 and U.S. Highway 31 cross the county from north to south. State Roads 37, 44, 135, 144, and 252 cross the county, and there are also about 560 miles of county roads. More than 500 miles of these county roads are black topped. Two railroads, the Illinois Central and the Penn Central, traverse the county, and three bus lines also serve the county. Two light plane airports are in the county; one in the north part on the east edge of the city of Greenwood, and the other about 4 miles south of the city of Franklin. The Indianapolis airport is about 25 miles from Franklin.

Trends in population and land use

The total population of Johnson County was more than 61,000 in 1970. Population has grown steadily, with the biggest gains between 1950 and 1970. Townships adjacent to Marion County are experiencing the greatest gain in population and the most drastic changes in land use.

The number of farms has decreased sharply in recent years; total acreage in farms has also decreased but not as sharply. The average farm size has increased.

TABLE 16.—*Temperature and precipitation data*

[All data from Franklin, Indiana, elevation 740 feet. Statistics cover the period 1937-1970]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Average monthly maximum	Average monthly minimum	Average monthly total	One year in 10 will have— Less than—	One year in 10 will have— More than—	Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover of 1 inch or more
	°F	°F	°F	°F	Inches	Inches	Inches		Inches
January	39	21	61	—3	2.8	0.8	6.0	7	2.7
February	42	24	64	2	2.5	0.7	4.8	4	2.2
March	52	31	75	12	3.6	1.2	8.2	2	3·6
April	65	41	84	25	3.8	1.5	7.3	1	0.5
May	75	51	89	34	4.5	1.9	7.5	0	0
June	84	61	94	45	4.1	1.9	7.7	0	0
July	88	63	96	50	3.8	1.7	7.3	0	0
August	86	61	96	48	3.2	1.2	5.6	0	0
September	80	54	93	37	3.1	0.8	6.8	0	0
October	69	43	85	26	2.1	0.5	4.3	0	0
November	53	32	74	14	3.3	1.2	6.5	1	2.2
December	41	23	63	3	2.8	0.9	4.0	5	2.1
Year	65	42	[1]98	[2]—6	39.6	31.1	48.8	20	2.4

[1]Average annual highest maximum.

[2]Average annual lowest minimum.

References

(1) AMERICAN ASSOCIATION OF STATE HIGHWAY [AND TRANSPORTATION] OFFICIALS.
1970. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 10, 2 vol., illus.

(2) AMERICAN SOCIETY FOR TESTING AND MATERIALS.
1974. METHOD FOR CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) SIMONSON, ROY W.
1962. SOIL CLASSIFICATION IN THE UNITED STATES. Sci. 137: 1027-1034.

(4) UNITED STATES DEPARTMENT OF AGRICULTURE.
1951. SOIL SURVEY MANUAL. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

(5) 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.]

Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in

a characteristic repeating pattern and defined and delineated as a single mapping unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composite of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

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

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

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

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

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion. (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. None means that flooding is not probable; rare that it is unlikely but possible under unusual weather conditions; occasional that it occurs on an average of once or less in 2 years; and frequent that it occurs on an average of more than once in 2 years. Duration is expressed as very brief if less than 2 days, brief if 2 to 7 days, and long if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited by streams flowing from glaciers.

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, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II preceeds the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Immature soil. A soil with indistinct or only slightly developed horizons because of the relatively short time it has been subjected to the various soil-forming processes. A soil that has not reached equilibrium with its environment.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Leaching. The removal of soluble material from soil or other material by percolating water.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind

Low strength. Inadequate strength for supporting loads.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material mixed with mineral soil material. The content of organic matter is more than 200 percent.

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), slow (0.06 to 0.20 inch), moderately slow (0.2 to 0.6 inch), moderate (0.6 to 2.0 inches), moderately rapid (2.0 to 6.0), rapid (6.0 to 20 inches), and very rapid (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

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 precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface stream is called groundwater runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

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.

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.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: very coarse sand (2.0 millimeters to 1.0 millimeter); coarse sand (1.0 to 0.5 millimeter); medium sand (0.5 to 0.25 millimeter); fine sand (0.25 to 0.10 millimeter); very fine sand (0.10 to 0.05 millimeter); silt (0.005 to 0.002 millimeter); and clay (less than 0.002 millimeter).

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.

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

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

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

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 adquate 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.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1979 O—223-363

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read the description of the mapping unit and the description of the soil series to which the mapping unit belongs.

Map symbol	Mapping unit	Page	Capability unit		Woodland suitability subclass
			Symbol	Page	Symbol
Br	Brookston silty clay loam	13	IIw-1	35	2w
CrA	Crosby silt loam, 0 to 2 percent slopes	14	IIw-2	36	3w
CsB2	Crosby-Miami silt loams, 2 to 4 percent slopes, eroded	14	IIe-12	34	--
	Crosby part	--	------	--	3w
	Miami part	--	------	--	1o
Ee	Eel silt loam	15	I-2	34	1o
FnA	Fincastle silt loam, 0 to 3 percent slopes	15	IIw-2	36	3w
FoA	Fox loam, 0 to 2 percent slopes	16	IIs-1	35	1o
FoB2	Fox loam, 2 to 6 percent slopes, eroded	17	IIIe-9	37	1o
FxC2	Fox complex, 6 to 12 percent slopes, eroded	17	IIIe-9	37	1o
Ge	Genesee loam	18	I-2	34	1o
HeF	Hennepin loam, 25 to 50 percent slopes	18	VIIe-2	38	1r
HkD2	Hickory silt loam, 12 to 18 percent slopes, eroded	19	IVe-1	37	1o
HkF	Hickory silt loam, 18 to 40 percent slopes	19	VIe-1	37	1r
MnB2	Miami silt loam, 2 to 6 percent slopes, eroded	20	IIe-1	34	1o
MnC2	Miami silt loam, 6 to 12 percent slopes, eroded	20	IIIe-1	36	1o
MnD2	Miami silt loam, 12 to 18 percent slopes, eroded	20	IVe-1	37	1o
MnE	Miami silt loam, 18 to 25 percent slopes, eroded	21	VIe-1	37	1r
MtB3	Miami clay loam, 2 to 6 percent slopes, severely eroded	21	IIIe-1	36	1c
MtC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	21	IVe-1	37	1c
MtD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	21	VIe-1	37	1c
MuA	Muren silt loam, 0 to 3 percent slopes	22	I-1	33	1o
MxG	Muskingum silt loam, 25 to 50 percent slopes	23	VIIe-2	38	3f
NnA	Nineveh loam, 0 to 2 percent slopes	24	IIs-1	35	1o
OcA	Ockley loam, 0 to 2 percent slopes	24	I-1	33	1o
OcB2	Ockley loam, 2 to 6 percent slopes, eroded	24	IIe-3	34	1o
Pa	Palms muck	25	IIw-10	36	4w
PkB2	Parke silt loam, 2 to 6 percent slopes, eroded	26	IIe-1	34	1o
PkC2	Parke silt loam, 6 to 12 percent slopes, eroded	26	IIIe-1	36	1o
Re	Rensselaer silty clay loam	27	IIw-1	35	2w
Rs	Ross loam	27	I-2	34	1o
Sh	Shoals silt loam	28	IIw-7	36	2w
Sk	Sleeth loam	29	IIw-2	36	3w
Sn	Sloan clay loam	30	IIIw-9	37	2w
WdC2	Wellston silt loam, 6 to 12 percent slopes, eroded	30	IIIe-3	36	3o
We	Westland clay loam	31	IIw-1	35	2w
Wh	Whitaker silt loam	32	IIw-2	36	3w

Accessibility Statement

The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.