SOIL SURVEY OF

Marion 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, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1970–74. Soil names and descriptions were approved in 1975. 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 Marion County Soil and Water Conservation District.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

All the soils of Marion 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.

One 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 "Index to Mapping Units" on page ii lists all the soils in the county by map symbol and shows the page where each soil is described. The capability unit and woodland subclass to which each soil has been assigned are specified at the end of the soil description.

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

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

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

Game managers, sportsmen, 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 dwellings, commercial buildings, and for waste disposal facilities in the sections "Building Site Development" and "Sanitary Facilities."

Engineers and builders can find, under "Engineering Properties," "Physical and Chemical Properties," and "Water Management," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

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

Newcomers in Marion County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They will also be interested in the information about the county given in the section "Environmental Factors Affecting Soil Use."

Cover: **Changing land use from agricultural to urban.**

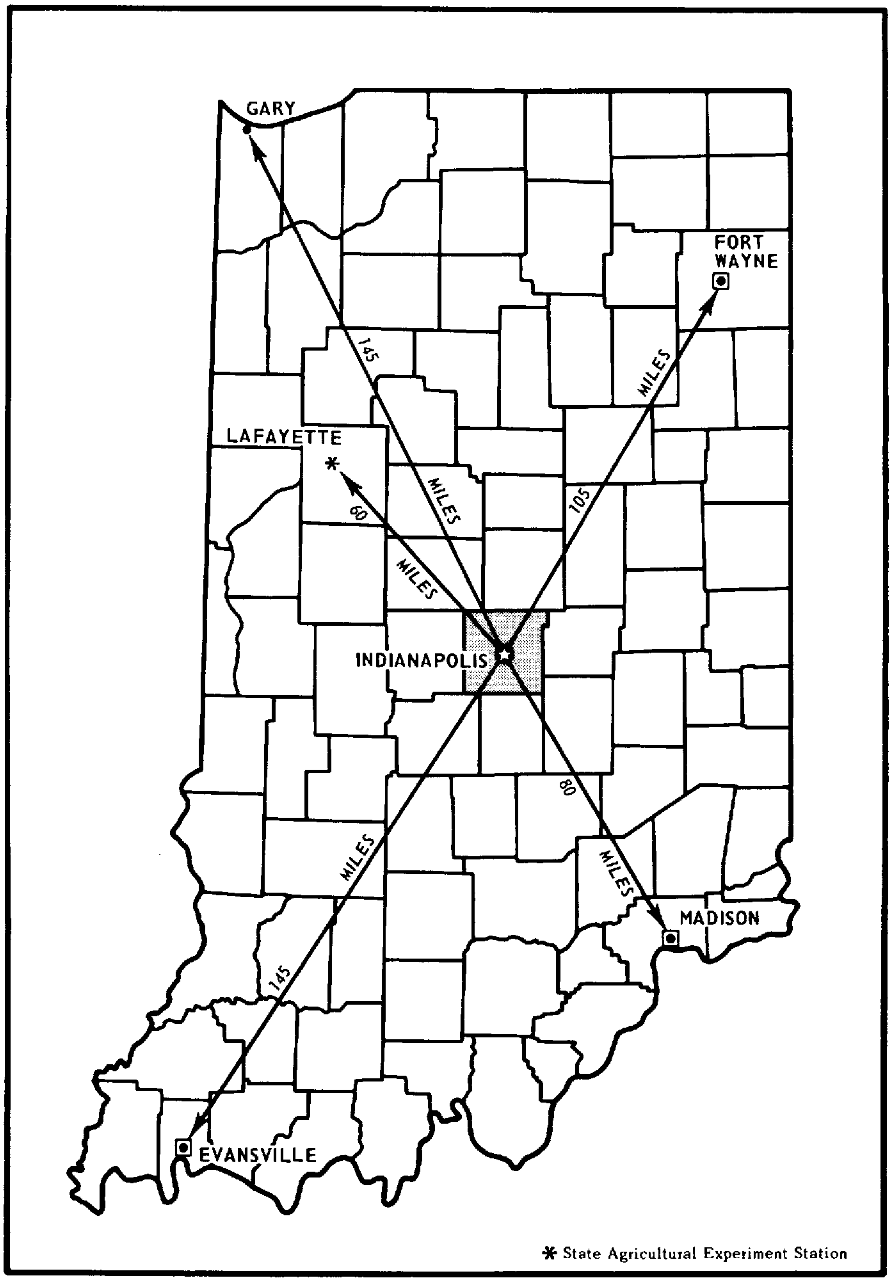
Contents

Issued September 1978

Reissued October 1991

Index to Mapping Units

Summary of Tables



Location of Marion County in Indiana.

SOIL SURVEY OF MARION COUNTY, INDIANA

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

MARION COUNTY is in the center of Indiana (see facing page). It has a land area of 402 square miles, or 257,280 acres. The county extends about 20 miles from north to south and 20 miles from west to east. Indianapolis, the capital of Indiana and the largest city in the State, is the county seat. By an act of the Indiana General Assembly in 1969, the city boundaries were extended to include all of the county except certain areas already incorporated into towns and cities.

The population is about 800,000. Businesses within the county employ nearly the entire work force of the county and much of that in the surrounding counties. About one-quarter of the work force is engaged in manufacturing.

About 25 percent of the county is actively farmed. Corn, soybeans, and wheat are the principal crops. Small but productive truck farms and orchards are in the southern part of the county. Nearly as much land is idle as is farmed. Urban development is decreasing the acreage in farms.

The soil survey provides information on both farm and nonfarm uses of soils in the county.

How This Survey Was Made

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

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

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

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Miami silt loam, 0 to 2 percent slopes, gravelly substratum, 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. Two such kinds of mapping units are shown on the soil map of Marion County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Urban land-Crosby complex and Crosby-Miami silt loams, 2 to 4 percent slopes, eroded, are examples.

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

Soil scientists observe how soils behave when used as a growing medium for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this failure to slow permeability or a high water table. They see that streets, road pavements, and foundations for houses crack on a given kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their study and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

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

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

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

1. *Crosby-Brookston association*

Deep, somewhat poorly drained and very poorly drained, nearly level and gently sloping soils formed in a thin silty layer and the underlying glacial till

This association is on gently undulating upland till plains. Approximately 15 percent of this association is in urban areas.

This association makes up about 40 percent of the county. It is approximately 45 percent Crosby soils (fig. 1), 30 percent Brookston soils, and 25 percent minor soils.

Crosby soils are nearly level and gently sloping and are somewhat poorly drained. They are on the higher, irregularly shaped flats and low knolls of the association. The surface layer is grayish brown silt loam 6 inches thick. The subsurface layer is mottled yellowish brown, friable silt loam about 3 inches thick. The subsoil is about 25 inches thick. The upper 11 inches is mottled grayish brown, firm silty clay loam; the next 7 inches is mottled yellowish brown, firm clay loam; and the lower 7 inches is mottled dark grayish brown, firm loam. The underlying material to a depth of about 60 inches is mottled yellowish brown and grayish brown loam.

Brookston soils are nearly level and very poorly drained. They are in depressions or narrow, shallow drainageways. The surface layer is silty clay loam 14 inches thick. The upper 10 inches is very dark gray, and the lower 4 inches is black. The subsoil is about 40 inches thick. The upper 5 inches is mottled dark gray, friable silty clay loam; the next 15 inches is mottled dark grayish brown, firm clay loam; the next 8 inches is mottled grayish brown, firm clay loam; and the lower 12 inches is mottled yellowish brown, firm clay loam. The underlying material to a depth of about 60 inches is mottled grayish brown loam.

Minor in this association are Miami, Eel, Genesee, and Shoals soils. The well drained Miami soils are on sides of knolls and in the larger drainageways. The moderately well drained Eel soils, the well drained Genesee soils, and the somewhat poorly drained Shoals soils are on bottom land along those drainageways.

This association is used mainly for farming. Corn and soybeans are the principal crops. Minor acreages are used for small grain and meadow. Large scattered acreages on either side of Interstate Highway 465 are used for urban development.

If adequately drained, Crosby and Brookston soils are well suited to farming. Because of wetness or slow permeability, they are severely or moderately limited for most nonfarm uses.

2. *Miami-Crosby association*

Deep, well drained and somewhat poorly drained, nearly level to moderately steep soils formed in a thin silty layer and the underlying glacial till

This association is on slightly dissected and moderately dissected upland plains between broad, nearly level and gently sloping ground moraines and bottom land or between terraces and outwash plains. Approximately 20 percent of this association is in urban areas.

This association makes up about 30 percent of the

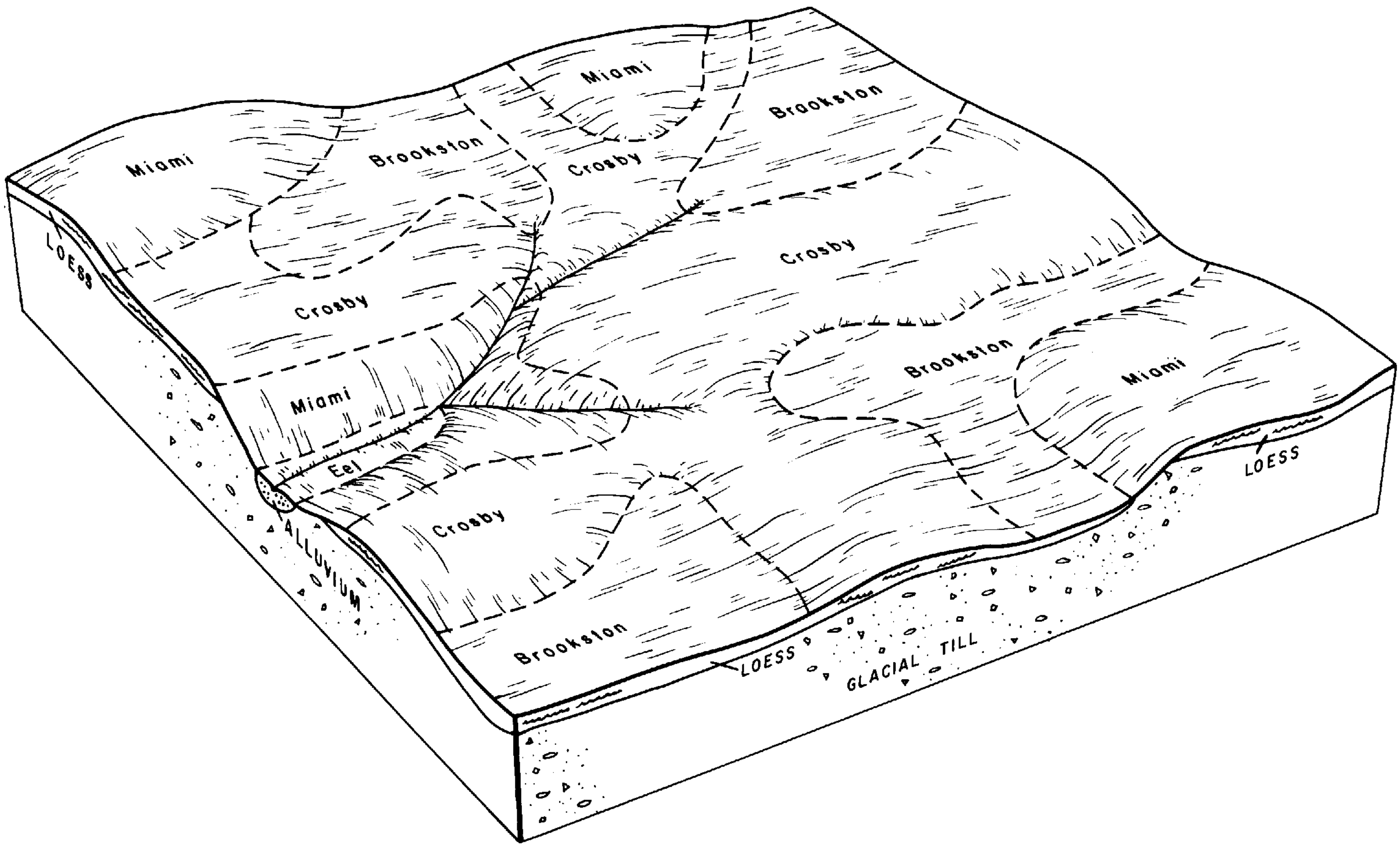

Figure 1.—**Pattern of soils and underlying material in Crosby-Brookston association.**

county. It is approximately 60 percent Miami soils (fig. 2), 20 percent Crosby soils, and 20 percent minor soils.

Miami soils are nearly level to moderately steep and are well drained. They are on the sides and tops of the hills and knolls that characterize the association. The surface layer is dark yellowish brown silt loam 8 inches thick. The subsoil is firm clay loam about 24 inches thick. The upper 4 inches is dark brown, and the lower 20 inches is dark yellowish brown. The underlying material to a depth of about 60 inches is brown loam.

Crosby soils are nearly level to gently sloping and are somewhat poorly drained. They are on irregularly shaped flats and broad ridgetops. The surface layer is grayish brown silt loam 6 inches thick. The subsurface layer is mottled yellowish brown, friable silt loam about 3 inches thick. The subsoil is about 25 inches thick. The upper 11 inches is mottled grayish brown, firm silty clay loam; the next 7 inches is mottled yellowish brown, firm clay loam; and the lower 7 inches is mottled dark grayish brown, firm loam. The underlying material to a depth of about 60 inches is mottled yellowish brown and grayish brown loam.

Minor in this association are Brookston, Genesee, Hennepin, and Shoals soils. The very poorly drained Brookston soils are in narrow drainageways and shallow depressions in uplands. The well drained Hennepin soils are on moderately steep to steep side slopes and breaks adjacent to bottom land. The well drained Genesee soils and somewhat poorly drained Shoals soils are on narrow bottom land.

This association is used mainly for parks and recreational areas and subdivisions. Some areas are used for farming. Corn, soybeans, and hay are the principal crops.

Wetness and erosion are the main hazards on this association. Water often ponds in low pockets for several days following a rain. If adequately drained, Crosby soils are well suited to farming. If erosion is adequately controlled, the nearly level to moderately sloping Miami soils are also well suited to farming. The strongly sloping and moderately steep Miami soils are best suited to pasture or woodland. Because of wetness and slow permeability, Crosby soils are severely limited for most nonfarm uses. The strongly sloping and moderately steep Miami soils are severely limited for most nonfarm uses, the nearly level Miami soils slightly limited, and the gently sloping and moderately sloping Miami soils moderately limited.

3. *Urban land-Fox-Ockley association*

Urban land and well drained, nearly level to moderately sloping soils that are moderately deep and deep over sand and gravel and formed in loamy outwash

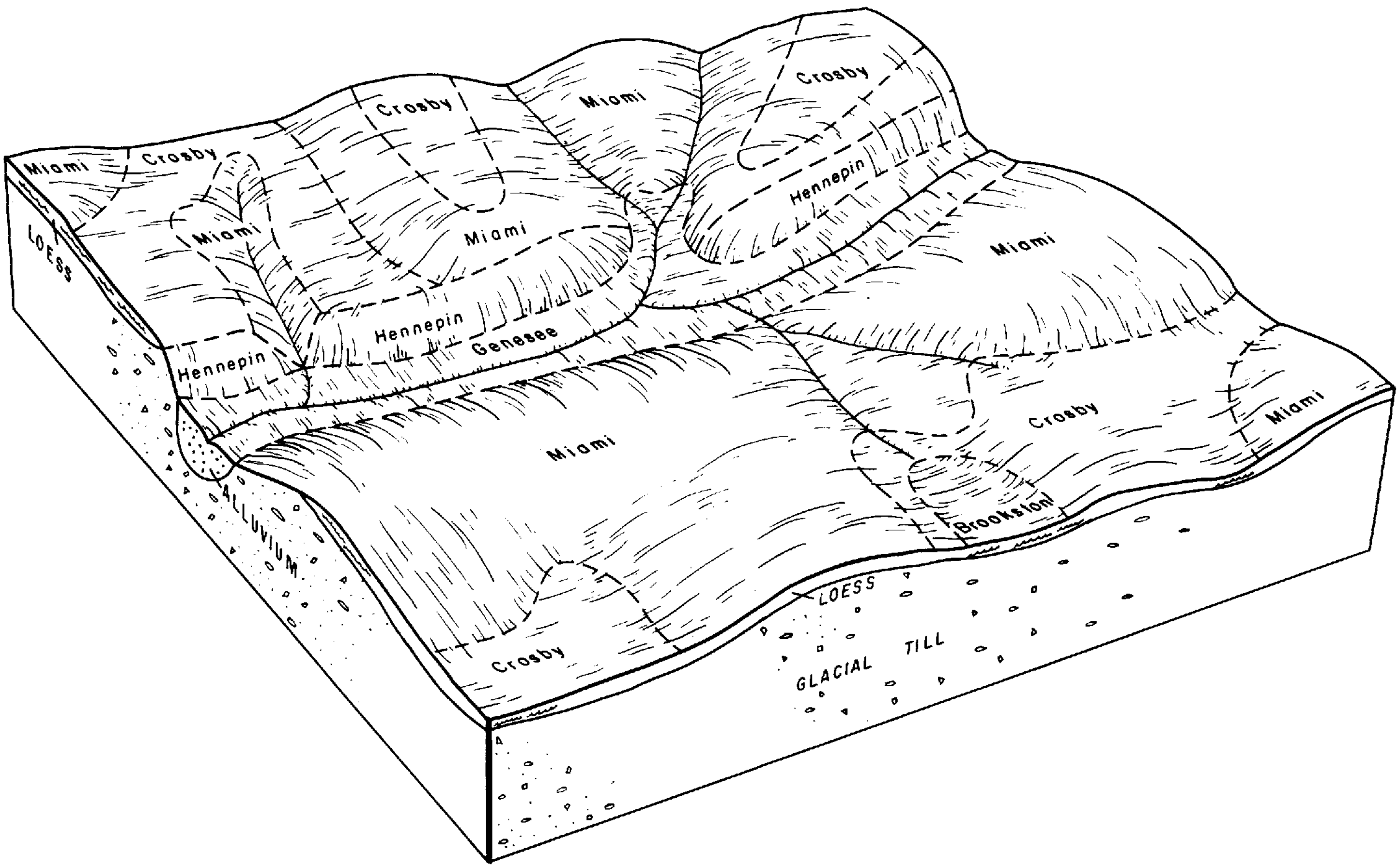

Figure 2.—**Pattern of soils and underlying material in Miami-Crosby association.**

and the underlying gravelly sand and sand or in loamy outwash over the gravelly sand and sand

This association is on broad outwash plains and terraces adjacent to the larger bottom land. Prior to urban development it was mainly a Fox-Ockley association (fig. 3).

This association makes up about 18 percent of the county. It is approximately 33 percent Urban land, 28 percent Fox soils, 7 percent Ockley soils, and 32 percent minor soils.

Urban land is covered by streets, parking lots, buildings, and other structures that obscure or alter the soils so that identification is not feasible.

Fox soils are well drained, moderately deep over gravelly sand and sand, and nearly level to moderately sloping. They are on broad, irregularly shaped flats, on sides of drainageways and knolls, and on breaks adjacent to bottom land. The surface layer is dark brown loam 8 inches thick. The subsoil is about 30 inches thick. The upper 10 inches is dark brown, friable loam; the next 6 inches is dark brown, firm sandy clay loam; and the lower 14 inches is dark brown, firm gravelly clay loam. The underlying material to a depth of about 60 inches is yellowish brown gravelly sand and sand.

Ockley soils are well drained, deep, and nearly level and gently sloping. They are on broad, irregularly shaped flats and on short side slopes of drainageways and low knolls that characterize the association. The surface layer is dark yellowish brown silt loam 9 inches thick. The subsoil is about 47 inches thick. The upper 8 inches is dark brown, friable light silty clay loam; the next 10 inches is dark reddish brown, firm clay loam; the next 25 inches is dark reddish brown, firm gravelly clay loam; and the lower 4 inches is reddish brown, firm gravelly clay loam. The underlying material to a depth of about 60 inches is dark brown gravelly sand and sand.

Minor in this association are Martinsville. Rensselaer, Sleeth, Westland, and Whitaker soils. The well drained Martinsville soils are on flats and side slopes. The somewhat poorly drained Sleeth and Whitaker soils and the very poorly drained Rensselaer and Westland soils are on broad flats and in drainageways. Also included among the minor soils are areas of Gravel pits, Cut and fill land, and borrow pits that are filled with water.

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

The nearly level Fox and Ockley soils are well suited to farming. If erosion is adequately controlled, the gently sloping Fox and Ockley soils and the moderately

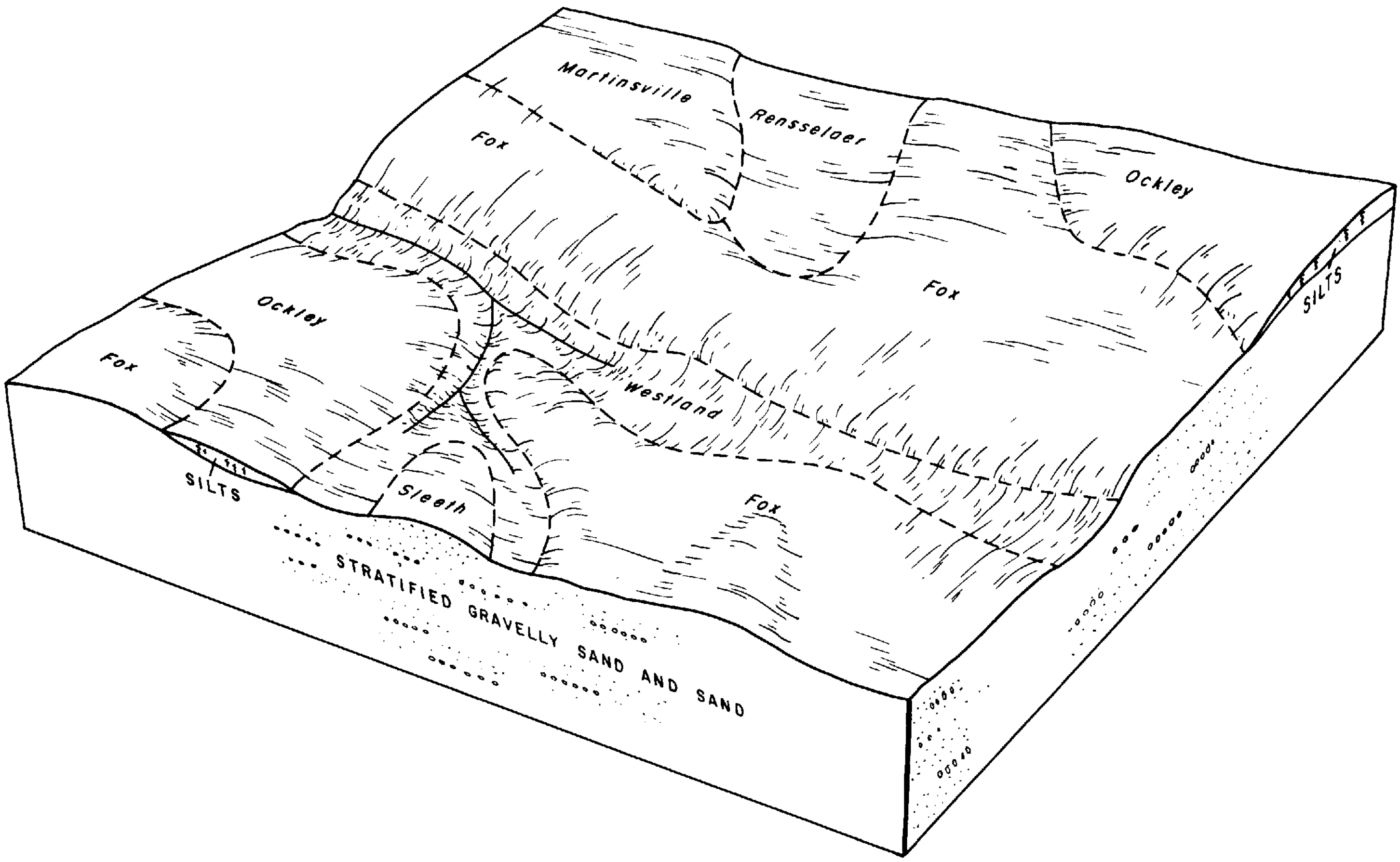

Figure 3.—**Pattern of Fox and Ockley soils and underlying material in Urban land-Fox-Ockley association. This association is about one-third Urban land.**

sloping Fox soils are also suited to farming. Droughtiness is the major limitation on Fox soils that are moderately deep over gravelly sand and sand. Erosion is also a hazard on the gently sloping and moderately sloping Fox soils. Erosion is the major limitation on the gently sloping Ockley soils. The nearly level Ockley soils are only slightly limited. The nearly level and gently sloping Fox and Ockley soils are only slightly limited for most nonfarm uses, and the moderately sloping Fox soils moderately limited.

4. *Genesee-Sloan association*

Deep, well drained and very poorly drained, nearly level soils formed in loamy alluvium

This association is on flood plains along the White River and the larger creeks. A large part is in urban areas.

This association makes up about 12 percent of the county. It is approximately 46 percent Genesee soils (fig. 4), 10 percent Sloan soils, and 44 percent minor soils.

Genesee soils are well drained. They are mainly on bottom land along the river and the larger creeks. The surface layer is dark grayish brown silt loam 6 inches thick. In sequence downward, the underlying material is 17 inches of dark grayish brown, firm silt loam; 9 inches of brown, friable loam; and 2 inches of brown heavy sandy loam. Below this to a depth of about 60 inches is brown, stratified silt loam and heavy silt loam.

Sloan soils are very poorly drained. They are mostly in low swales or oxbows of old river channels. The surface layer is 14 inches thick. The upper 8 inches is very dark gray heavy silt loam, and the lower 6 inches is very dark grayish brown silty clay loam. The subsoil is about 19 inches thick. The upper 7 inches is mottled very dark gray, firm silty clay loam, and the lower 12 inches is mottled gray, firm clay loam. The underlying material to a depth of 45 inches is mottled gray heavy silt loam. Below this to a depth of 60 inches is gray, stratified gravelly loamy sand, loamy sand, and sand.

Areas of Urban land, made land, and Cut and fill land are included with the minor soils in this association. Their total acreage is more than twice that of the minor soils. Among the minor soils are small areas of Eel, Fox, and Shoals soils. The moderately well drained Eel soils and somewhat poorly drained Shoals soils are mainly in shallow drainageways of the broad bottom land along the river and narrow, meandering creeks. The well drained Fox soils are on low terraces adjacent to the bottom land.

Large areas of this association are used for indus-

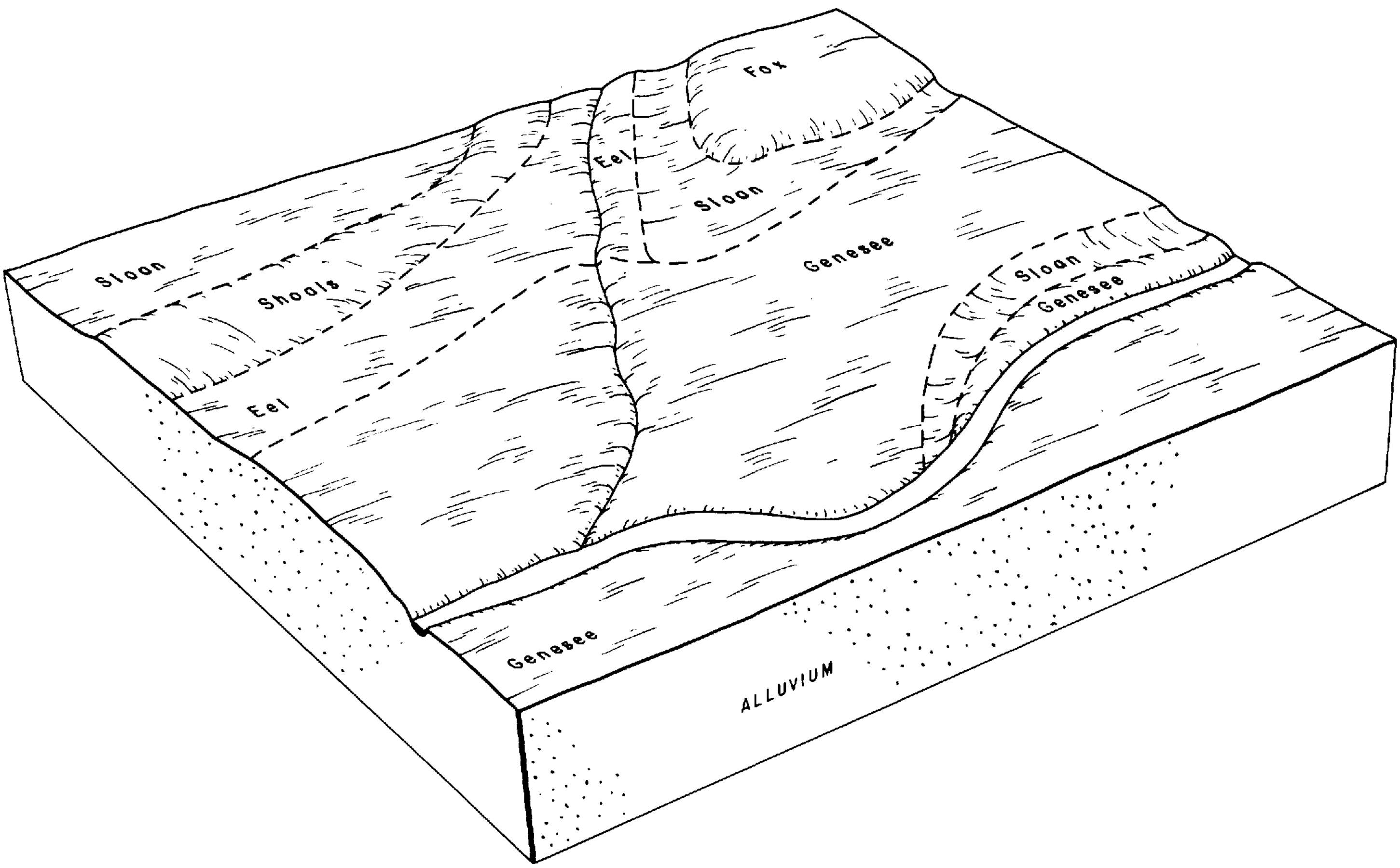

Figure 4.—Pattern of soils and underlying material in Genesee-Sloan association.

trial development and recreation because the frequency of flooding has been greatly reduced by terraces along the White River. Where urban pressure is less and protection against flooding has not been adequately provided, the association is used for farming. Cash-grain farming is the major farm enterprise. Corn and soybeans are the principal crops. Small grain is subject to water damage unless it is protected against flooding or is only occasionally flooded. Some small, narrow areas adjacent to the creeks or the White River, some low and wet areas along channels of meandering creeks, and some small irregularly shaped areas are in woodland or grass.

Genesee soils are well suited to farming. If adequately drained, Sloan soils are also well suited to farming, but crops are subject to damage from flooding. Because of flooding, both soils have severe limitations for most nonfarm uses.

Descriptions of the Soils

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

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. The symbol following color names in the representative profile descriptions refers to a standard color notation. The profile described in the series is representative of mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit.

Preceding the name of each mapping unit is a symbol. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and woodland suitability subclass to which the mapping unit has been assigned. Each capability unit is listed in the section "Management by capability units" and each woodland suitability subclass in table 3.

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 at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*7*).[1]

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

Brookston Series

The Brookston series consists of deep, nearly level, very poorly drained soils on broad, gently undulating till plains. These soils formed in loess and the underlying calcareous glacial till. The native vegetation is water-tolerant grasses and hardwoods.

In a representative profile, the surface layer is silty clay loam 14 inches thick. The upper 10 inches is very dark gray, and the lower 4 inches is black. The subsoil is about 40 inches thick. The upper 5 inches is mottled dark gray, friable silty clay loam; the next 15 inches is mottled dark grayish brown, firm clay loam; the next 8 inches is mottled grayish brown, firm clay loam; and the lower 12 inches is mottled yellowish brown, firm clay loam. The underlying material to a depth of about 60 inches is mottled grayish brown loam.

Permeability is moderate. Available water capacity is high. Organic-matter content of the surface layer is high. The seasonal high water table is at the surface or within a depth of 1 foot during some parts of the year (fig. 5).

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

Representative profile of Brookston silty clay loam, in a cultivated field 1,400 feet west and 1,690 feet north of the southeast corner of sec. 34, T. 15 N., R. 2 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

A12—10 to 14 inches; black (10YR 2/1) silty clay loam; common medium faint dark grayish brown (10YR 4/2) mottles; weak fine subangular blocky structure; friable; common fine roots; slightly acid; abrupt wavy boundary.

B21tg—14 to 19 inches; dark gray (10YR 4/1) silty clay loam; common fine faint dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable; few fine roots; discontinuous distinct thin gray (10YR 5/1) clay films on faces of peds; neutral; clear wavy boundary.

IIB22tg—19 to 34 inches; dark grayish brown (10YR 4/2) clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; few medium roots; continuous faint thin dark gray (10YR 4/1) clay films on faces of peds; old root channels and krotovinas filled

[1] Italic numbers in parentheses refer to Literature Cited, p. 61.

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

Map symbol	Soil name	Acres	Percent	Map symbol	Soil name	Acres	Percent
Br	Brookston silty clay loam	38,036	14.8	OcA	Ockley silt loam, 0 to 2 percent slopes	2,407	0.9
CrA	Crosby silt loam, 0 to 2 percent slopes	63,947	24.9	OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	835	0.3
CsB2	Crosby-Miami silt loams, 2 to 4 percent slopes, eroded	3,530	1.4	Re	Rensselaer clay loam	1,289	0.5
Ee	Eel silt loam	1,875	0.7	Sh	Shoals silt loam	2,132	0.8
FoA	Fox loam, 0 to 2 percent slopes	2,642	1.0	Sk	Sleeth loam	587	0.2
FoB2	Fox loam, 2 to 6 percent slopes, eroded	2,094	0.8	Sn	Sloan silt loam	3,525	1.4
FxC2	Fox complex, 6 to 15 percent slopes, eroded	1,457	0.6	Ub	Urban land-Brookston complex	4,659	1.8
Ge	Genesee silt loam	11,374	4.4	Uc	Urban land-Crosby complex	13,438	5.2
HeF	Hennepin loam, 25 to 50 percent slopes	1,971	0.8	UfA	Urban land-Fox complex, 0 to 3 percent slopes	13,998	5.4
MgA	Martinsville silt loam, 0 to 2 percent slopes	402	0.2	UfC	Urban land-Fox complex, 6 to 12 percent slopes	812	0.3
MgB2	Martinsville silt loam, 2 to 6 percent slopes, eroded	923	0.4	Ug	Urban land-Genesee complex	6,789	2.6
MmA	Miami silt loam, 0 to 2 percent slopes, gravelly substratum	2,959	1.2	UmB	Urban land-Miami complex, 0 to 6 percent slopes	10,226	4.0
MmB2	Miami silt loam, 2 to 6 percent slopes, eroded	29,928	11.6	UmC	Urban land-Miami complex, 6 to 12 percent slopes	1,272	0.5
MmC2	Miami silt loam, 6 to 12 percent slopes, eroded	7,930	3.1	Uw	Urban land-Westland complex	1,281	0.5
MxD2	Miami complex, 12 to 18 percent slopes, eroded	3,588	1.4	We	Westland clay loam	1,166	0.5
MxE2	Miami complex, 18 to 24 percent slopes, eroded	1,564	0.6	Wh	Whitaker silt loam	1,011	0.4
					Cut and fill land	9,872	3.8
					Gravel pits	2,318	0.9
					Water	5,443	2.1
					Total	257,280	100.0

Figure 5.—**Ponding on Brookston silty clay loam.**

with very dark gray (10YR 3/1) silt; few pebbles; neutral; clear wavy boundary.

IIB23t—34 to 42 inches; grayish brown (10YR 5/2) clay loam; many medium faint yellowish brown (10YR 5/4 and 5/8) mottles; moderate coarse subangular blocky structure; firm; few fine roots; continuous distinct thin gray (10YR 6/2) clay films on faces of peds; old root channels and krotovinas filled with dark gray (10YR 3/1) silt; 4 percent coarse gravel; neutral; gradual wavy boundary.

IIB3—42 to 54 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct gray (10YR 5/1) mottles; weak coarse subangular blocky structure; firm; old root channels and krotovinas filled with very dark gray (10YR 3/1) silt; 5 percent coarse gravel; neutral; clear irregular boundary.

IIC—54 to 60 inches; grayish brown (10YR 5/2) loam; few fine faint brown (10YR 5/3) mottles; massive; friable; 5 percent coarse gravel; strong effervescence; moderately alkaline.

The solum is 30 to 60 inches thick. The loess mantle is up to 20 inches thick.

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

The B2 horizon is gray (10YR 5/1), dark gray (10YR 4/1), dark grayish brown (10YR 4/2), or grayish brown (10YR 5/2). It has medium or coarse subangular blocky structure or angular blocky structure. Mottles are few to many, fine to coarse, and faint to prominent. The B3 horizon is yellowish brown (10YR 5/4–5/8) or gray (10YR 5/1) loam or clay loam. It has weak moderate to coarse subangular blocky structure.

The C horizon is grayish brown (10YR 5/2), pale brown (10YR 6/3), light gray (10YR 6/1), or gray (10YR 5/1). It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence. The C horizon and the lower part of the B horizon have few to common cobbles and are 1 to 5 percent fine and coarse gravel.

Brookston soils are similar in drainage to Rensselaer, Sloan, and Westland soils. They have a loam substratum, whereas Rensselaer soils have a substratum of stratified silt and very fine sand. They have less gravel in the B horizon than Westland soils. In contrast with Sloan soils, they have an argillic horizon.

Br—Brookston silty clay loam. This nearly level soil is in depressions, on flats, and in narrow drainageways between better drained soils on broad, undulating plains. Slopes are 0 to 2 percent. Areas range from 2 to 250 acres in size. Most are irregularly shaped, but some are long or round. In some small areas, this soil has a silt loam or clay loam surface layer.

Included with this soil in mapping are small areas of somewhat poorly drained Crosby and Shoals soils; small areas of very poorly drained Sloan soils; small areas of Brookston soils, which have a grayish brown or brownish gray silt loam surface layer 10 to 20 inches thick; and small areas of very poorly drained soils that have discontinuous strata of loamy sand, sandy loam, and loam in the underlying material. Also included in the predominantly urban parts of the county are Brookston soils that have been mixed or disturbed in areas of community development.

Runoff is very slow. Some areas are ponded or flooded for brief periods during winter and spring. Wetness is the main limitation. Because of wetness, the soil has severe limitations for most nonfarm uses. If adequately drained, it is well suited to corn, soybeans, and other crops. Most areas are cultivated. A few are wooded. Wooded areas support fair stands of hardwoods, but some are 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 on broad, gently undulating till plains. These soils formed in loess and the underlying calcareous glacial till. The native vegetation is hardwoods.

In a representative profile, the surface layer is grayish brown silt loam 6 inches thick. The subsurface layer is mottled yellowish brown, friable silt loam about 3 inches thick. The subsoil is about 25 inches thick. The upper 11 inches is mottled grayish brown, firm silty clay loam; the next 7 inches is mottled yellowish brown, firm clay loam; and the lower 7 inches is mottled dark grayish brown, firm loam. The underlying material to a depth of about 60 inches is mottled yellowish brown and grayish brown loam.

Permeability is slow. Available water capacity is high. Organic-matter content of the surface layer is low. The seasonal high water table is 1 foot to 3 feet below the surface during some part of the year.

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

Representative profile of Crosby silt loam, 0 to 2 percent slopes, in a hayfield 1,800 feet south and 100 feet east of the northwest corner of sec. 4, T. 16 N., R. 2 E.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam; weak fine granular structure; friable; many fine roots; abrupt smooth boundary.

A2—6 to 9 inches; grayish brown (10YR 5/2) silt loam; common fine distinct yellowish brown (10YR 5/8) mottles; moderate medium platy structure; friable; common fine roots; discontinuous distinct thin gray (10YR 5/2) silt films on faces of peds; strongly acid; clear smooth boundary.

IIB21t—9 to 13 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; few fine pebbles; few fine black (10YR 2/1) iron and manganese oxide concretions; strongly acid; clear wavy boundary.

IIB22t—13 to 20 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; strong medium subangular blocky structure; firm; few fine pebbles; discontinuous faint gray (10YR 5/1) clay films on faces of peds; many medium black (10YR 2/1) iron and manganese oxide concretions; strongly acid; clear wavy boundary.

IIB23t—20 to 27 inches; yellowish brown (10YR 5/8) clay loam; common medium distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; 1 to 3 percent fine and coarse gravel; many medium black (10YR 2/1) iron and manganese oxide concretions; slightly acid; clear wavy boundary.

IIB3—27 to 34 inches; dark grayish brown (10YR 4/2) loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm, many medium black (10YR 2/1) iron and manganese oxide concretions; neutral; abrupt smooth boundary.

IIC—34 to 60 inches; mottled yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) loam; massive; 3 to 5 percent fine gravel; few cobbles; strong effervescence; moderately alkaline.

The solum is typically 25 to 40 inches thick, but ranges from 20 to 40 inches. The loess mantle is up to 18 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2) loam or silt loam. The A2 horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), and light brownish gray (10YR 6/2) with mottles of yellowish brown or brownish yellow. Texture is loam or silt loam. The A2 horizon has weak or moderate medium or thick platy structure parting to weak or moderate fine or medium granular structure.

The B2 horizon is grayish brown (10YR 5/2), brown (10YR 5/3), yellowish brown (10YR 5/4-5/8), or pale brown (10YR 6/3). It has weak to strong fine to coarse subangular blocky structure or moderate medium or coarse prismatic structure parting to weak or moderate fine or medium granular structure. Mottles are common or many, fine or medium, and faint or distinct.

The C horizon is yellowish brown (10YR 5/4-5/8), grayish brown (10YR 5/2), brown (10YR 5/3, 4/3), or light brownish gray (10YR 6/2), or a mixture of these colors. It is mildly alkaline or moderately alkaline and has slight 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.

Crosby soils are similar in drainage to Sleeth, Shoals, and Whitaker soils. They do not have the stratified solum and underlying material typical of Sleeth and Whitaker soils. Unlike Shoals soils, Crosby soils have an argillic horizon.

CrA—Crosby silt loam, 0 to 2 percent slopes. This nearly level soil is on broad plains, on ridgetops in rolling areas, or in low drainageways. Areas range from 2 to 450 acres in size. Most are irregularly shaped, but some on ridgetops or in drainageways are long. This soil has the profile described as representative of the series. In some small areas it has a loam or fine sandy loam surface layer.

Included with this soil in mapping are small areas of very poorly drained Brookston soils in depressions and narrow watercourses; small and intricately associated areas of somewhat poorly drained soils that contain less clay in the subsoil; small areas of soils that have calcareous underlying material within a depth of 24 inches; and small areas of very poorly drained soils that have thin, discontinuous strata of loamy sand, sandy loam, and loam in the underlying material. Also included in the predominantly urban parts of the county are Crosby soils that have been mixed or disturbed in areas of community development.

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

CsB2—Crosby-Miami silt loams, 2 to 4 percent slopes, eroded. This gently sloping mapping unit is on broad, slightly undulating plains; on low knolls of broad, nearly level plains; and at the heads of drainageways. Areas range from 2 to 30 acres in size. Most are irregularly shaped or round. Some are long or fan shaped.

This mapping unit is about 60 percent a somewhat poorly drained Crosby soil, 30 percent a well drained Miami soil, and 10 percent other soils. In areas where slopes are uniform, the Crosby soil is on the lower and upper parts of slopes and the Miami soil is at mid-slope. In hummocky areas, the Crosby soil is on the lower knolls and ridges and the lower parts of the higher knolls and ridges and the Miami soil is on the upper parts of the higher knolls and ridges. The Crosby soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and contains some clay loam.

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

Runoff is medium. Moderate erosion is the main limitation of these soils. Wetness is also a limitation of the Crosby soil. Because of wetness and slow permeability, the Crosby soil has severe limitations for most nonfarm uses. The Miami soil has moderate limitations for most nonfarm uses. If erosion is controlled and drainage is adequate, both soils are well suited to corn, soybeans, small grain, grasses, and legumes. Most areas are cultivated. The few wooded areas support fair stands of hardwoods. Capability unit IIe-12; woodland suitability subclass 3w.

Eel Series

The Eel series consists of deep, nearly level, moderately well drained soils on the flood plains along the White River and the larger creeks. These soils formed in loamy alluvium. The native vegetation is hardwoods.

In a representative profile, the surface layer is dark grayish brown silt loam 9 inches thick. The underlying material to a depth of 60 inches is brown silt loam in the upper 6 inches; mottled brown loam in the next 10 inches; and mottled grayish brown, stratified silt loam and loam below a depth of 25 inches.

Permeability is moderate. Available water capacity is high. Organic-matter content of the surface layer is moderate. The seasonal high water table is 3 to 6 feet below the surface during some part of the year.

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.

Representative profile of Eel silt loam in a cultivated field 2,400 feet east and 50 feet south of the northwest corner of sec. 16, T. 14 N., R. 3 E.

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

C1—9 to 15 inches; brown (10YR 5/3) silt loam; weak medium subangular blocky structure; friable; common fine roots; continuous prominent dark grayish brown (10YR 4/2) organic coatings on faces of peds; neutral; clear wavy boundary.

C2—15 to 25 inches; brown (10YR 5/3) loam; common faint fine light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; few fine roots; common fine dark yellowish brown (10YR 3/4) iron and manganese oxide concretions; neutral; clear wavy boundary.

C3—25 to 60 inches; grayish brown (10YR 5/2) stratified silt loam and loam; common medium distinct brown (10YR 5/3) and yellowish brown (10YR 5/8) mottles; few fine yellowish brown (10YR 3/4) iron and manganese oxide concretions; slight effervescence; mildly alkaline.

Reaction throughout the profile is neutral to moderately alkaline.

The Ap horizon is dark grayish brown (10YR 4/2), brown (10YR 5/3, 4/3), or very dark grayish brown (10YR 3/2) silt loam. It has weak or moderate fine or medium granular structure.

The upper part of the C horizon is brown (10YR 5/3), pale brown (10YR 6/3), or yellowish brown (10YR 5/4) silt loam, loam, or light silty clay loam. The lower part is grayish brown (10YR 5/2) or dark grayish brown (10YR 4/2), stratified silt loam, loam, sandy loam, and some thin strata of sand.

Eel soils are in the same positions on the landscape as well drained Genesee soils. The somewhat poorly drained Shoals soils and very poorly drained Sloan soils are in depressional areas. Shoals and Sloan soils have mottles at a depth of 8 to 10 inches.

Ee—Eel silt loam. This nearly level soil is on broad flood plains along the river and on narrow flood plains along the meandering creeks. Areas range from 2 to 200 acres in size. Most are long and narrow, but some are irregularly shaped. Slopes are 0 to 2 percent. In some small areas, this soil has a silty clay loam surface layer.

Included with this soil in mapping are small areas of well drained Genesee soils and somewhat poorly drained Shoals soils. Small sandbars and sand spots are identified by spot symbols on the soil map.

Runoff is slow. Flooding is the main limitation. Because of flooding, this soil has severe limitations for most nonfarm uses. It is subject to flooding in winter and early in spring and to flooding during some growing seasons. This soil is well suited to corn, soybeans, and other crops. Most areas are cultivated. Wooded areas support poor to fair stands of hardwoods. Capability unit IIw-7; woodland suitability subclass 1o.

Fox Series

The Fox series consists of nearly level to moderately sloping, well drained soils that are moderately deep over sand and gravelly sand. These soils are on outwash plains and terraces, kames, and eskers. They formed in loamy outwash and the underlying gravelly sand and sand. The native vegetation is hardwoods.

In a representative profile, the surface layer is dark brown loam 8 inches thick. The subsoil is about 30 inches thick. The upper 10 inches is dark brown, friable loam; the next 6 inches is dark brown, firm sandy clay loam; and the lower 14 inches is dark brown, firm gravelly clay loam. The underlying material to a depth of about 60 inches is yellowish brown gravelly sand and sand.

Permeability is moderate in the solum and rapid in the underlying material. Available water capacity is moderate. Organic-matter content of the surface layer is moderate.

Fox soils are suited to all crops commonly grown in the county. They have only slight limitations for most nonfarm uses. Most gravel and sand in the county pits are in areas of Fox soils.

Representative profile of Fox loam, 0 to 2 percent slopes, in a hayfield 2,140 feet west and 1,000 feet north of the southeast corner of sec. 27, T. 15 N., R. 3 E.

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

B1—8 to 18 inches; dark brown (7.5YR 4/4) loam; weak medium subangular blocky structure; friable; few fine roots; medium acid; clear smooth boundary.

B21t—18 to 24 inches; dark brown (7.5YR 4/2) sandy clay loam; moderate medium subangular blocky structure; firm; discontinuous faint thin dark brown (7.5YR 4/2) clay films on faces of peds; medium acid; gradual wavy boundary.

IIB22t—24 to 38 inches; dark brown (7.5YR 4/4) gravelly clay loam; moderate medium subangular blocky structure; firm; continuous distinct thick dark brown (7.5YR 3/2) clay films on faces of peds and on surfaces of gravel; slightly acid; abrupt irregular boundary.

IIC—38 to 60 inches; yellowish brown (10YR 5/4) gravelly sand and sand; weakly stratified; single grained; loose; strong effervescence; moderately alkaline.

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

The Ap horizon is dark brown (10YR 4/3), dark grayish brown (10YR 4/2), or brown (10YR 5/3) silt loam, loam, or fine sandy loam. It has weak or moderate fine or medium granular structure. The A2 horizon, if present, is brown (10YR 5/3) or grayish brown (10YR 5/2) silt loam, loam, or fine sandy loam. It has weak or moderate fine or medium granular or platy structure.

The B2t horizon is dark brown (7.5YR 4/2, 4/4), dark yellowish brown (10YR 4/4), or reddish brown (5YR 4/4) silty clay loam, clay loam, sandy clay loam, or gravelly clay loam. It has patchy to continuous, thin to thick clay films. The B3 horizon, if present, is dark reddish brown (5YR 3/3) or reddish brown (5YR 4/4) light clay loam, loam, gravelly loam, or gravelly sandy clay loam. It has weak or moderate medium or coarse subangular blocky structure. In places, tongues of the B2 or B3 horizon extend 1 foot to 4 feet into the C horizon. Gravel content in the lower part of the B2 horizon and in the B3 horizon ranges from less than 1 to 25 percent and increases with increasing depth.

The C horizon is yellowish brown (10YR 5/4-5/8), pale brown (10YR 6/3), or very pale brown (10YR 7/3).

Fox soils are similar in drainage to Martinsville and Ockley soils. They have a thinner solum than Ockley soils. Fox soils have more gravel in the lower part of the solum than Martinsville soils.

FoA—Fox loam, 0 to 2 percent slopes. This nearly level soil is on broad outwash plains and terraces adjacent to the bottom land along the river and creeks. Areas range from 2 to 200 acres in size. Most are irregularly shaped, but some are round or long. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of well drained Martinsville and Ockley soils; small areas of very poorly drained Westland soils in long, very narrow, faintly defined drainageways; small areas of soils that are underlain by less than 12 inches of gravelly sand and sand over loam till; and areas of soils that have gravel and sand on the surface.

Runoff is slow. Droughtiness is the main limitation. This soil has only slight limitations for most nonfarm uses. It is suited to corn, soybeans, small grain, grasses, and legumes. Most areas are cultivated. Wooded areas support fair stands of hardwoods. Capability unit IIs-1; woodland suitability subclass 2o.

FoB2—Fox loam, 2 to 6 percent slopes, eroded. This gently sloping soil is on the side slopes of drainageways within broad outwash plains and terraces and on the tops and upper sides of kames and eskers. Slopes are short and dominantly 4 percent. Areas range from 2 to 30 acres in size. Most are irregularly shaped, but some are round or long. This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner, is heavier, and incorporates more of the dark brown subsoil; scattered pebbles are on the surface; and depth to the underlying gravelly sand and sand is 30 to 36 inches. Small areas of this soil that have been wooded or pastured many years are not eroded.

Included with this soil in mapping are small areas of soils that have a moderate amount of gravel and cobbles on the surface and in the plow layer; small areas of gently sloping, well drained Martinsville and Ockley soils; and small areas of very poorly drained Westland and Rensselaer soils and somewhat poorly drained Sleeth soils in weakly defined drainageways.

Runoff is medium. Moderate erosion is the main limitation. Droughtiness is also a limitation. This soil has only slight limitations for most nonfarm uses. If erosion is adquately controlled, the soil is well suited to small grain, grasses, and legumes and is moderately well suited to corn and soybeans. Most areas are cultivated or in pasture. The few small wooded areas support poor to fair stands of hardwoods. Capability unit IIe-9; woodland suitability subclass 2o.

FxC2—Fox complex, 6 to 15 percent slopes, eroded. This moderately sloping and strongly sloping mapping unit is on side slopes of drainageways, on steep breaks, and on side slopes of hummocky kames and eskers. Areas range from 2 to 30 acres in size. Most are long, but some are round or irregularly shaped.

This mapping unit is about 30 percent Fox loam and 30 percent soils that are similar to Fox loam but are less than 24 inches deep over the underlying sand and gravel. Texture of the surface layer is dominantly loam and clay loam, but ranges from sandy loam to gravelly clay loam. Fox loam has a profile similar to the one described as representative of the series, but the surface layer is thinner, is heavier, and incorporates more of the dark brown subsoil; scattered pebbles are on the surface; and depth to the underlying gravelly sand and sand is 24 to 32 inches. In some areas are Fox soils that are severely eroded and have a surface layer of clay loam or gravelly clay loam. The similar soils have a surface layer of loam, clay loam, sandy clay loam, and gravelly clay loam. Depth to the underlying gravelly sand and sand ranges from 8 to 24 inches.

Included with this unit in mapping are small areas of gently sloping, steep, and very steep soils and small areas where calcareous gravelly sand and sand is exposed. Small areas of severely eroded soils and small areas of steep and very steep soils that are shallow to gravelly sand and sand are identified by spot symbols on the soil map.

Runoff is medium. Moderate erosion is the main limitation. Droughtiness is also a limitation. Because of slope, limitations for most nonfarm uses are moderate. If erosion is adequately controlled, this mapping unit is suited to all crops grown in the area. It is best suited to small grain, grasses, and legumes. Most areas are cultivated or in pasture. The few small wooded areas support poor to fair stands of hardwoods. Capability unit IIIe-9; woodland suitability subclass 2o.

Genesee Series

The Genesee series consists of deep, nearly level, well drained soils on flood plains along the White River and the larger creeks. These soils formed in loamy alluvium. The native vegetation is hardwoods.

In a representative profile, the surface layer is dark grayish brown silt loam 6 inches thick. The upper 17 inches of the underlying material is dark grayish brown, firm silt loam; the next 9 inches is brown, friable loam; and the next 2 inches is brown, heavy sandy loam. Below this to a depth of about 60 inches is brown stratified silt loam and heavy silt loam.

Permeability is moderate. Available water capacity is high. Organic-matter content of the surface layer is moderate.

Genesee 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.

Representative profile of Genesee silt loam in a hayfield 1,650 feet east and 990 feet south of the northwest corner of sec. 5, T. 14 N., R. 3 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; common fine roots; mildly alkaline; abrupt smooth boundary.

C1—6 to 23 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium subangular blocky structure; firm; moderately alkaline; clear wavy boundary.

C2—23 to 32 inches; brown (10YR 4/3) loam; moderate fine subangular blocky structure; friable; moderately alkaline; abrupt smooth boundary.

C3—32 to 34 inches; brown (10YR 5/3) heavy sandy loam; weak fine granular structure; very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

C4—34 to 60 inches; brown (10YR 4/3) stratified silt loam and heavy silt loam; massive; 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) silt loam, loam, or fine sandy loam. An A12 horizon is present in some profiles. It has weak or moderate fine or medium granular structure.

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

The pH range in most profiles is higher than is defined as the range for the series, but this difference does not alter the use or behavior of the soils. In some areas, these soils lack carbonates in some part of the profile, but are within the defined range for the series.

Genesee soils are similar to Fox, Martinsville, and Ockley soils. They are less acid and have weaker structure than those soils.

Ge—Genesee silt loam. This nearly level soil is on broad flood plains along the river and the larger creeks and on narrow flood plains along meandering creeks. Areas range from 2 to more than 350 acres in size. Most are long and broad, but some are long and narrow or irregularly shaped. Slopes are 0 to 2 percent. In some small areas this soil has a loam or fine sandy loam surface layer, and in some areas it lacks carbonates in all parts of the profile.

Included with this soil in mapping are small areas of moderately well drained Eel soils, somewhat poorly drained Shoals soils, and well drained Fox soils; small areas of well drained alluvial soils that are less than 24 inches deep over thick strata of fine sand and loamy sand or that are sandier throughout the profile; and small sandbars and sand spots, both of which are indicated by spot symbols on the soil map.

Runoff is slow. Flooding is the main limitation of this soil. Because of flooding, limitations for most nonfarm uses are severe. The soil is subject to flooding in winter and early in spring and to flooding of short duration during some growing seasons. It is well suited to corn, soybeans, and other crops. Most areas are cultivated. Wooded areas support poor to fair stands of hardwoods. Capability unit IIw-7; woodland suitability subclass 1o.

Hennepin Series

The Hennepin series consists of deep, steep and very steep, well drained soils on side slopes and escarpments along creeks and drainageways of the till plains. These soils formed in calcareous glacial till. The native vegetation is hardwoods.

In a representative profile, the surface layer is dark grayish brown loam 3 inches thick. The subsoil is yellowish brown, friable loam about 11 inches thick. The underlying material to a depth of about 60 inches is brown loam.

Permeability is moderate. Available water capacity is high. Organic-matter content of the surface layer is moderate.

Hennepin soils are best suited to trees. Because of steepness of slope, these soils have severe limitations for most nonfarm uses.

Representative profile of Hennepin loam, 25 to 50 percent slopes, in a wooded area 490 feet west and 60 feet south of the northeast corner of sec. 9, T. 16 N., R. 2 E.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) loam; weak fine granular structure; friable; many fine and coarse roots; neutral; abrupt wavy boundary.

B2—3 to 14 inches; yellowish brown (10YR 5/4) loam; weak medium granular structure; friable; many fine roots; 2 percent fine gravel; neutral; gradual wavy boundary.

C—14 to 60 inches; brown (10YR 5/3) loam; few fine faint gray (10YR 5/1) silt flows; massive; friable; 2 percent fine and coarse gravel; strong effervescence; moderately alkaline.

The solum is typically 12 to 15 inches thick, but ranges from 10 to 20 inches. Thickness of the solum coincides with depth to effervescent material.

The A1 or Ap horizon is dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2) silt loam, loam, or fine sandy loam.

The B2 horizon is brown (10YR 4/3) or yellowish brown (10YR 5/4) loam 6 to 12 inches thick.

The C horizon is brown (10YR 5/3), yellowish brown (10YR 5/4), dark yellowish brown (10YR 4/4), or light yellowish brown (10YR 5/6). 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 to common cobbles and are 1 to 5 percent fine and coarse gravel.

Hennepin soils in most places are near well drained Miami soils and somewhat poorly drained Crosby soils. They have less clay in the B horizon and have a thinner solum than Miami or Crosby 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 soils on uplands and on bottom land or terraces. Slopes range from 30 to 300 feet in length; they average 120 feet long. Areas range from 2 to 120 acres in size. Most are narrow and long, but some are irregularly shaped.

Included with this soil in mapping are small areas of moderately steep Miami soils; small areas of soils that have a gravelly loam surface layer or have large glacial stones partially or fully exposed on the surface; small areas of soils that have 1 to 3 inches of partially decomposed leaf litter on the surface; and small pastured areas where rills and gullies have formed.

Runoff is very rapid. Erosion and steepness of slope are the main limitations (fig. 6). Because of steepness of slope, this soil has severe limitations for most nonfarm uses. It is best suited to trees. Wooded areas support fair stands of hardwoods. Capability unit VIIe-2; woodland suitability subclass 1r.

Martinsville Series

The Martinsville series consists of deep, nearly level or gently sloping, well drained soils on broad outwash plains and terraces. These soils formed in loamy outwash. The native vegetation is hardwoods.

In a representative profile, the surface layer is dark brown silt loam 8 inches thick. The subsurface layer is brown silt loam about 2 inches thick. The subsoil is about 40 inches thick. The upper 5 inches is brown, friable silty clay loam; the next 9 inches is dark brown, firm silty clay loam; the next 13 inches is dark brown, firm clay loam; and the lower 13 inches is brown, firm sandy clay loam. The underlying material to a depth of

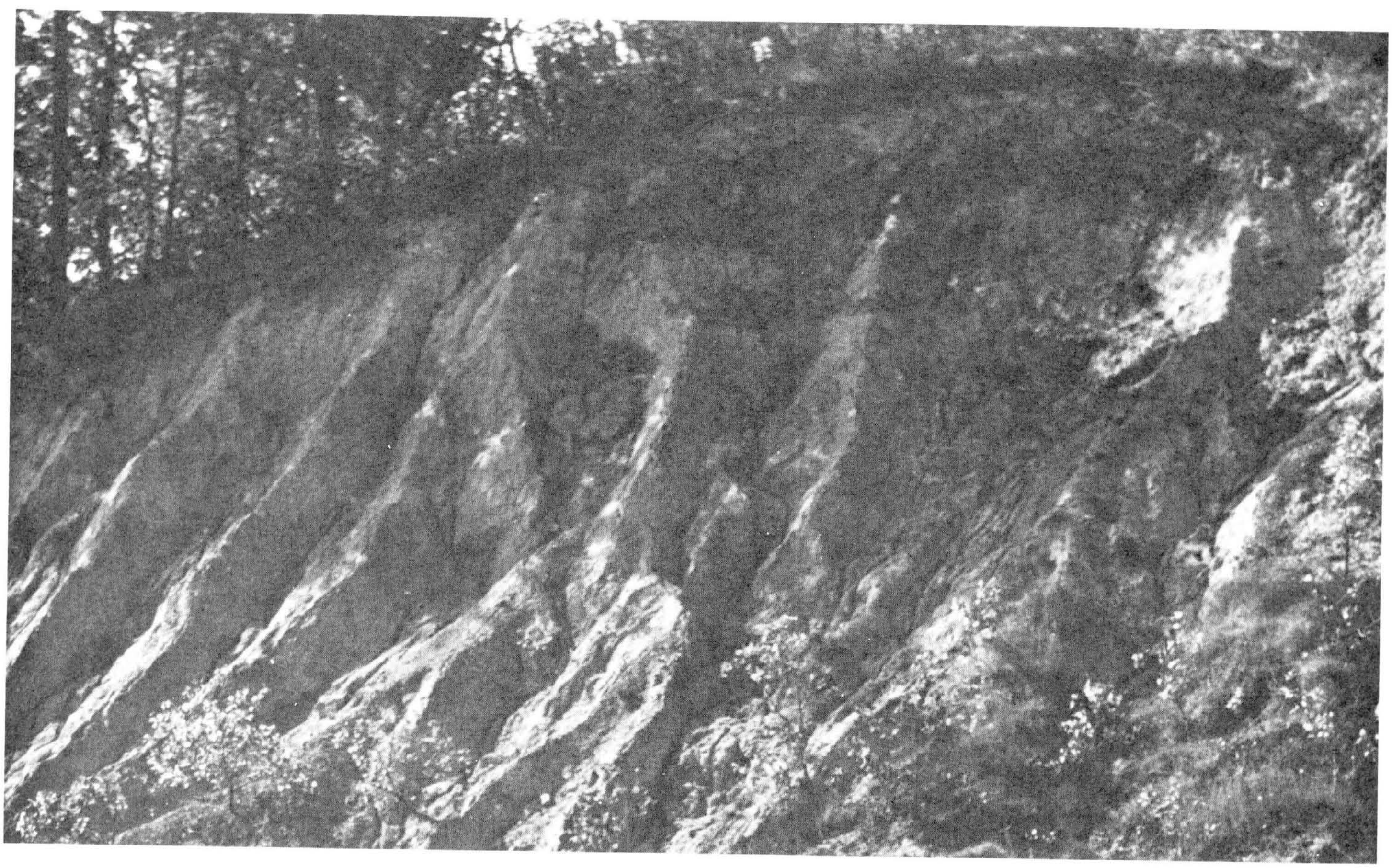

Figure 6.—**Roadbank erosion on Hennepin loam, 25 to 50 percent slopes.**

about 60 inches is yellowish brown stratified sandy loam and sand.

Permeability is moderate. Available water capacity is high. Organic-matter content of the surface layer is moderate.

Martinsville soils are well suited to farming. They have slight limitations for most nonfarm uses.

Representative profile of Martinsville silt loam, 0 to 2 percent slopes, in a cultivated area 100 feet north and 500 feet west of the southeast corner of sec. 15, T. 14 N., R. 3 E.

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

A2—8 to 10 inches; brown (10YR 4/3) silt loam; weak medium platy.

B1t—10 to 15 inches; brown (10YR 4/3) silty clay loam; medium subangular blocky structure; friable; dark yellowish brown (10YR 4/3) organic coatings on faces of peds; slightly acid; clear wavy boundary.

B21t—15 to 24 inches; dark brown (7.5YR 4/4) silty clay loam; moderate medium and coarse subangular blocky structure; firm; continuous distinct thin dark brown (7.5YR 4/2) clay films on faces of peds; medium acid; clear wavy boundary.

IIB22t—24 to 37 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; continuous distinct thin dark brown (7.5YR 4/2) clay films on faces of peds; medium acid; gradual wavy boundary.

IIB3—37 to 50 inches; brown (7.5YR 4/2) sandy clay loam; moderate coarse subangular blocky structure; firm; neutral; abrupt wavy boundary.

IIC—50 to 60 inches; yellowish brown (10YR 5/4) stratified sandy loam and sand; very friable; strong effervescence; moderately alkaline.

The solum is typically 45 to 55 inches thick, but ranges from 36 to 60 inches.

The Ap horizon is dark brown (10YR 3/3), brown (10YR 4/3, 5/3), or dark grayish brown (10YR 4/2) fine sandy loam, loam, or silt loam. The A2 horizon is brown (10YR 4/3, 5/3) or dark yellowish brown (10YR 3/4) silt loam or loam. The A2 horizon has weak medium or thick platy structure parting to weak or moderate fine or medium granular structure.

The B2 horizon is brown (10YR 5/3, 4/3) or dark brown (10YR 4/3, 10YR 3/3, or 7.5YR 4/4) silty clay loam, clay loam, or sandy clay loam. The B3 horizon is brown (7.5YR 4/2), dark brown (7.5YR 4/2, 4/4), or reddish brown (5YR 4/4) sandy loam, loam, or sandy clay loam.

The C horizon is yellowish brown (10YR 5/4) or dark yellowish brown (10YR 4/4), stratified sandy loam, sand, silt loam, and silty clay loam. Some profiles have scattered fine gravel in the lower part of the B3 horizon and in the C horizon.

Martinsville soils are similar in drainage to Fox, Miami, and Ockley soils. They have less gravel in the lower part of the solum than Fox and Ockley soils and a thicker solum than Miami soils. Unlike Miami soils, they are stratified in the solum and in the underlying material.

MgA—Martinsville silt loam, 0 to 2 percent slopes. This nearly level soil is on broad outwash plains and terraces; on isolated more highly elevated knolls; and on flats within areas of very poorly drained Rensselaer and Westland soils. Areas range from 2 to 60 acres in size. Most are irregularly shaped, but some are long or round. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of well drained Fox and Ockley soils; somewhat poorly drained Whitaker soils; very poorly drained Rensselaer soils that are in discontinuous, narrow, slightly depressed drainageways; and small areas of well drained soils that have loam till at a depth of 3 to 4 feet. Also included are tracts of this soil that have been mixed or disturbed in areas of community development.

Runoff is slow. This soil has slight limitations for most nonfarm uses. It is well suited to corn, soybeans, and other crops. Most areas are cultivated. The few wooded areas support fair stands of hardwoods. Capability unit I-1; woodland suitability subclass 1o.

MgB2—Martinsville silt loam, 2 to 6 percent slopes, eroded. This gently sloping soil is on side slopes of drainageways; on slightly higher knolls on flat, broad outwash plains and terraces; and on toe slopes of kames and eskers. Areas range from 2 to 75 acres in size. Most are irregularly shaped, but some are long or round. This soil has a profile similar to the one described as representative of the series, but the surface layer is dark brown, incorporates some silty clay loam, and is not so thick. Some small areas have scattered gravel and cobbles on the surface. Small areas that have been wooded or pastured many years are not eroded.

Included with this soil in mapping are small areas of well drained Fox and Ockley soils and small areas of somewhat poorly drained Whitaker soils and very poorly drained Rensselaer soils in weakly defined, discontinuous, narrow, slightly depressed drainageways.

Runoff is medium. Moderate erosion is the main limitation. This soil has slight limitations for most nonfarm uses. If erosion is adequately controlled, it is well suited to corn, soybeans, small grain, and other crops. Most areas are cultivated. The few wooded areas support fair stands of hardwoods. Capability unit IIe-3; woodland suitability subclass 1o.

Miami Series

The Miami series consists of deep, nearly level to moderately steep, well drained soils on gently undulating till plains. These soils formed in loess and the underlying calcareous glacial till. The native vegetation is hardwoods.

In a representative profile, the surface layer is brown silt loam 8 inches thick. The subsoil is firm clay loam about 24 inches thick. The upper 4 inches is dark brown, and the lower 20 inches is dark yellowish brown. The underlying material is brown loam to a depth of about 60 inches.

Permeability is moderate in the solum and moderate to moderately slow in the underlying material. Available water capacity is high. Organic-matter content of the surface layer is moderate.

Miami soils are suited to all crops commonly grown in the county. They have slight to severe limitations for nonfarm uses.

Representative profile of Miami silt loam, 2 to 6 percent slopes, eroded, in a hayfield 2,400 feet south and 50 feet east of the northwest corner of sec. 10, T. 16 N., R. 4 E.

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

B21t—8 to 12 inches; dark brown (7.5YR 4/4) clay loam;

moderate fine and medium subangular blocky structure; firm; common fine roots; discontinuous distinct thin brown (10YR 4/3) clay films on faces of peds; few pebbles; slightly acid; clear wavy boundary.

B22t—12 to 26 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; common fine roots; continuous distinct thin brown (10YR 4/3) clay films on faces of peds; few pebbles; neutral; clear wavy boundary.

B3—26 to 32 inches; dark yellowish brown (10YR 4/4) clay loam; weak coarse subangular blocky structure; firm; few fine roots; discontinuous distinct thin brown (10YR 4/3) clay films on faces of peds; 5 percent fine gravel; mildly alkaline in matrix of peds, neutral on faces of peds; clear irregular boundary.

C—32 to 60 inches; brown (10YR 5/3) loam; massive; friable; 5 percent fine gravel; strong effervescence; moderately alkaline.

The solum is typically 28 to 36 inches thick, but ranges from 24 to 40 inches. The loess mantle is up to 20 inches thick.

The Ap horizon is brown (10YR 4/3), very dark grayish brown (10YR 3/2), or dark grayish brown (10YR 4/2) silt loam or loam. An A2 horizon is in some profiles. It is brown (10YR 5/3) or yellowish brown (10YR 5/4) silt loam or loam and has weak or moderate thin or medium platy structure or granular structure.

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

The C horizon is pale brown (10YR 6/3), brown (10YR 5/3), light yellowish brown (10YR 6/4), or very pale brown (10YR 7/3). It is mildly alkaline or moderately alkaline and has slight or strong effervescence. The C horizon and the lower part of the B horizon have few to common cobbles and are 1 to 5 percent fine and coarse gravel.

Miami soils are similar in drainage to Fox, Martinsville, and Ockley soils. They have less gravel in the lower part of the solum than Fox and Ockley soils. Miami soils have a thinner solum than Martinsville soils.

MmA—Miami silt loam, 0 to 2 percent slopes, gravelly substratum. This nearly level soil is on till plains near or adjacent to the river or the larger creeks. Areas range from 2 to 120 acres in size. Most are irregularly shaped, but some are round. This soil has a profile similar to the one described as representative of the series, but the surface layer is very dark grayish brown; the subsoil is thicker, has more gravel, and is reddish brown in the lower part; and there is as much as 6 inches of gravelly sand and sand between the subsoil and the underlying loam till.

Included with this soil in mapping are small areas of somewhat poorly drained Crosby soils, well drained Ockley and Fox soils, and gently sloping Miami soils. Also included are areas under community development where the soil that has been mixed or disturbed.

Runoff is slow. This soil has slight or moderate limitations for most nonfarm uses. It is well suited to corn, soybeans, deep-rooted legumes, and other crops. About half of the acreage is farmed or idle. The few small wooded areas support fair stands of hardwoods. Capability unit I-1; woodland suitability subclass 1o.

MmB2—Miami silt loam, 2 to 6 percent slopes, eroded. This gently sloping soil is along drainageways that cross areas of somewhat poorly drained Crosby soils; on small isolated knolls on broad, nearly level till plains; on gently rolling moraines; and on narrow to broad ridgetops. Areas range from 2 to 200 acres in size. Most are irregularly shaped, but some are long or round. This soil has the profile described as representative of the series. Small areas that have been in woodland or 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 narrow, weakly defined drainageways; small areas of moderately sloping Miami soils; small areas of severely eroded soils, which are identified by a spot symbol on the soil map; and small areas of moderately well drained soils that are somewhat similar to the Miami soil but differ in internal drainage. Also included are areas under community development where the soil has been mixed or disturbed.

Runoff is medium. Moderate erosion is the main limitation. Limitations for most nonfarm uses are moderate. If erosion is adequately controlled, this soil is well suited to corn, soybeans, deep-rooted legumes, and other crops. The few wooded areas support poor to fair stands of hardwoods. Capability unit IIe-1; woodland suitability group 1o.

MmC2—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; along drainageways leading to terraces or bottom land; and on undulating moraines. Areas range from 2 to 80 acres in size. Most are irregularly shaped, but some are round or long.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and depth to the underlying material averages about 30 inches. There are many shallow drainageways. In some small severely eroded areas, the surface layer has been mixed with the upper part of the subsoil. As a result, a dark brown to dark yellowish brown clay loam plow layer about 7 inches thick has formed and scattered pebbles, stones, and cobbles are on the surface and in the plow layer. Small areas that have been in woodland or pasture for many years are not eroded. The soil on the undulating moraines has a thicker silt mantle and a larger number of isolated pockets of outwash material than the soil on the flat till plains in the southeastern and southwestern parts of the county.

Included with this soil in mapping are small areas of gently sloping Miami soils; areas where small rills have formed; small areas of somewhat poorly drained Crosby soils and very poorly drained Brookston soils in drainageways; and small areas of well drained Fox, Ockley, and Martinsville soils.

Runoff is medium. Moderate erosion is the main limitation. Limitations for most nonfarm uses are moderate. If erosion is adequately controlled, this soil is suited to small grain, deep-rooted legumes, and some row crops. Wooded areas support poor to fair stands of hardwoods. Capability unit IIIe-1; woodland suitability subclass 1o.

MxD2—Miami complex, 12 to 18 percent slopes, eroded. This strongly sloping mapping unit is along drainageways and on the upper slopes of breaks between less sloping soils on uplands and soils on bottom land and terraces. Slopes are short, are irregularly shaped, and are dominantly 14 to 16 percent. Areas range from 2 to 80 acres is size. Most are long and irregularly shaped.

This mapping unit is about 45 percent Miami soils that have a profile similar to the one described as representative of the series, but the surface layer and the solum are thinner; 15 percent severely eroded Miami soils that have a clay loam surface layer, and 20 percent soils that are similar to Miami soils, but the subsoil is thinner and the underlying till is at a depth of 10 to 24 inches. Texture of the surface layer ranges from loam to clay loam.

Included with this unit in mapping are small areas of Fox, Ockley, and Hennepin soils. Also included are small areas of moderately sloping and moderately steep soils.

Runoff is rapid on the eroded soils and very rapid on the severely eroded soils. Erosion is the main limitation. Because of slope, limitations for most nonfarm uses are severe. This mapping unit is well suited to small grain, grasses, and legumes. If the unit is used for row crops, erosion control is needed to prevent excessive soil loss. Most areas are in pasture or are wooded. The wooded areas support fair stands of hardwoods. Capability unit IVe-1; woodland suitability subclass 1o.

MxE2—Miami complex, 18 to 24 percent slopes, eroded. This moderately steep mapping unit is on short side slopes and on breaks between broad areas of nearly level soils on uplands and soils on bottom land and terraces. It is also on side slopes of strongly dissected uplands. Areas range from 10 to 60 acres in size. Most are irregularly shaped, but some are long.

This mapping unit is about 45 percent Miami soils that have a profile similar to the one described as representative of the series, but the surface layer is very dark grayish brown, more leaf litter is in the top 2 or 3 inches, and the underlying loam till is at a depth of 24 to 28 inches; 15 percent severely eroded Miami soils that have a clay loam surface layer; and soils that are similar to Miami soils, but the subsoil is thinner and the underlying till is at a depth of 10 to 24 inches. Texture of the surface layer ranges from loam to clay loam.

Included with this unit in mapping are areas of Hennepin soils and a few small areas of Fox and Ockley soils where there is a smear of gravelly outwash. Also included are small areas of strongly sloping, steep, and very steep soils.

Runoff is rapid. Slope is the main limitation. Because of slope, limitations for most nonfarm uses are severe (fig. 7). This mapping unit is best suited to

Figure 7.—**Accelerated erosion in unprotected cut in Miami complex, 18 to 24 percent slopes, eroded.**

woodland and wildlife. Most areas are wooded with fair stands of hardwoods. Capability unit VIe-1; woodland suitability subclass 1r.

Ockley Series

The Ockley series consists of deep, nearly level and gently sloping, well drained soils on broad outwash plains and terraces. These soils formed in loamy outwash over gravelly sand and sand. The native vegetation is hardwoods.

In a representative profile, the surface layer is dark yellowish brown silt loam 9 inches thick. The subsoil is about 47 inches thick. The upper 8 inches is dark brown, friable light silty clay loam; the next 10 inches is dark reddish brown, firm clay loam; the next 25 inches is dark reddish brown, firm gravelly clay loam; and the lower 4 inches is reddish brown, firm gravelly clay loam. The underlying material to a depth of about 60 inches is dark brown gravelly sand and sand.

Permeability is moderate. Available water capacity is high. Organic-matter content of the surface layer is moderate.

Ockley soils are well suited to farming. They have only slight limitations for most nonfarm uses. Some gravel and sandpits are in areas of Ockley soils.

Representative profile of Ockley silt loam, 0 to 2 percent slopes, in a cultivated field 2,480 feet east and 2,140 feet south of the northwest corner of sec. 16, T. 14 N., R. 3 E.

Ap—0 to 9 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine granular structure; friable; common fine roots; strongly acid; abrupt smooth boundary.

B1t—9 to 17 inches; dark brown (10YR 4/3) light silty clay loam; moderate fine subangular blocky structure; friable; common fine roots; strongly acid; clear wavy boundary.

IIB21t—17 to 27 inches; dark reddish brown (5YR 3/4) clay loam; moderate fine subangular blocky structure; firm; discontinuous distinct thin dark brown (10YR 4/3) clay films on faces of peds; 5 percent fine gravel; very strongly acid; clear wavy boundary.

IIB22t—27 to 52 inches; dark reddish brown (5YR 3/4) gravelly clay loam; moderate medium subangular blocky structure; firm; continuous distinct thin dark brown (10YR 4/3) clay films on faces of peds; medium acid; gradual wavy boundary.

IIB3t—52 to 56 inches; reddish brown (5YR 4/3) gravelly clay loam; weak moderate and coarse subangular blocky structure; firm; wedge-shaped tongues extend 3 to 10 inches into underlying gravelly sand and sand; slightly acid; abrupt irregular boundary.

IIIC—56 to 60 inches; dark brown (10YR 4/3) gravelly sand and sand; single grained; loose; strong effervescence; moderately alkaline.

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

The Ap horizon is dark brown to brown (10YR 5/3, 4/3), dark grayish brown (10YR 4/2), or dark yellowish brown (10YR 4/4) silt loam, loam, or fine sandy loam. An A2 horizon, if present, is dark brown (10YR 4/3) or brown (10YR 5/3) silt loam or loam. It has weak or moderate fine or medium granular structure.

The B2t horizon is dark yellowish brown (10YR 3/4, 4/4), dark brown (7.5YR 4/4), or dark reddish brown (5YR 3/4) silty clay loam, clay loam, or gravelly clay loam. It has moderate fine and medium subangular blocky structure or blocky structure.

The C horizon is dark brown (10YR 4/3) or yellowish brown (10YR 5/4).

Ockley soils are similar in drainage to Fox and Martinsville soils. They have a thicker solum than Fox soils, and they have more gravel in the lower part of the solum than Martinsville soils.

OcA—Ockley silt loam, 0 to 2 percent slopes. This nearly level soil is on broad outwash plains and terraces adjacent to the bottom land along the river and creeks. Areas range from 2 to 150 acres in size. Most are irregularly shaped, but some are long. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of well drained Fox and Martinsville soils; small areas of somewhat poorly drained Sleeth soils and very poorly drained Westland soils in discontinuous, narrow, slightly depressed drainageways; and small areas of well drained soils that have loam till at a depth of 3 or 4 feet. Also included are areas under community development where the soil has been mixed or disturbed.

Runoff is slow. This soil has only slight limitations for most nonfarm uses. It is well suited to corn, soybeans, small grain, and other crops. Wooded areas support fair stands of hardwoods. Capability unit I-1; woodland suitability subclass 1o.

OcB2—Ockley silt loam, 2 to 6 percent slopes, eroded. This gently sloping soil is on ridgelike knolls and on side slopes of drainageways within broad areas of nearly level Ockley soils. Areas range from 2 to 15 acres in size. Most are long, but some are irregularly shaped. This soil has a profile similar to the one described as representative of the series, but the surface layer is 6 to 7 inches thick and incorporates some dark brown subsoil and the subsoil is 35 to 40 inches thick.

Included with this soil in mapping are small areas of nearly level, well drained Ockley soils; moderately sloping, well drained Fox soils; and very poorly drained Westland and Rensselaer soils in long narrow drainageways.

Runoff is medium. Moderate erosion is the main limitation of this soil. Limitations for most nonfarm uses are only slight. If erosion is adequately controlled, this soil is well suited to corn, soybeans, small grain, and other crops. The few small wooded areas support poor stands of hardwoods. Capability unit IIe-3; woodland suitability subclass 1o.

Rensselaer Series

The Rensselaer series consists of deep, nearly level, very poorly drained soils on broad outwash plains and in old glacial drainageways and lake basins. These soils formed in loamy outwash sediment. The native vegetation is water-tolerant grasses and hardwoods.

In a representative profile, the surface layer is clay loam 15 inches thick. The upper 9 inches is black, and the lower 6 inches is very dark gray. The subsoil is about 27 inches thick. The upper 7 inches is mottled dark gray, firm clay loam; the next 14 inches is mottled grayish brown, firm clay loam; and the lower 6 inches is mottled dark grayish brown, firm, weakly stratified clay loam, sandy loam, and loam. The underlying material to a depth of about 60 inches is mottled gray, grayish brown, and yellowish brown, stratified silt, silt loam, very fine sand, and clay loam.

Permeability is slow. Available water capacity is high. Organic-matter content of the surface layer is high. The seasonal high water table is at the surface or 1 foot below the surface during some part of the year.

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

Representative profile of Rensselaer clay loam in a cultivated field 100 feet east and 60 feet south of the northwest corner of sec. 14, T. 14 N., R. 3 E.

Ap—0 to 9 inches; black (10YR 2/1) clay loam; moderate medium granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

A12—9 to 15 inches; very dark gray (10YR 3/1) clay loam; moderate medium subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

B21tg—15 to 22 inches; dark gray (10YR 4/1) clay loam; common medium distinct yellowish brown (10YR 5/8) or grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; patchy distinct thin very dark gray (10YR 3/1) clay films on faces of peds; neutral; clear smooth boundary.

B22tg—22 to 36 inches; grayish brown (2.5Y 5/2) clay loam; many fine distinct yellowish brown (10YR 5/8) mottles; moderate coarse prismatic structure parting to moderate coarse subangular blocky; firm; discontinuous distinct thin dark gray (10YR 4/1) clay films on faces of peds; 5 percent fine gravel; neutral; clear smooth boundary.

B3tg—36 to 42 inches; dark grayish brown (2.5Y 5/2) weakly stratified clay loam, sandy loam, and loam; common fine distinct yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; firm; neutral; clear smooth boundary.

C1—42 to 54 inches; gray (10YR 5/1) stratified silt loam, very fine sand, and clay loam; common fine distinct yellowish brown (10YR 5/8) mottles; massive; friable; 3 percent fine gravel; slight effervescence; mildly alkaline; clear smooth boundary.

C2—54 to 60 inches; mottled grayish brown (2.5Y 5/2), yellowish brown (10YR 5/6), and light gray (10YR 7/1) stratified silt and very fine sand; massive; friable; strong effervescence; moderately alkaline.

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

The Ap and A12 horizons are black (10YR 2/1), very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2)), or very dark gray (10YR 3/1) loam, clay loam, or silty clay loam. The Ap horizon has moderate fine and medium granular structure. The A12 horizon has weak or moderate fine and medium granular structure or subangular blocky structure.

The B2t horizon is dark gray (10YR 4/1), gray (10YR 5/1), grayish brown (10YR 5/2 or 2.5Y 5/2), light gray (10YR 6/1), or olive gray (5Y 5/2) clay loam or silty clay loam. Some subhorizons are silt loam or loam. The B2t horizon has weak or moderate medium or coarse prismatic structure or subangular blocky structure. Mottles are few to many, fine to coarse, and distinct or prominent. Clay films are patchy to continuous, faint to prominent, and thin to thick.

The C horizon is dark gray (10YR 4/1), gray (10YR 5/1), yellowish brown (10YR 5/6), light gray (10YR 7/1), or grayish brown (2.5Y 5/2), stratified silt, silt loam, fine sand, sand, very fine sand, and very thin strata of silty clay loam or clay loam.

Rensselaer soils are similar in drainage to Brookston, Sloan, and Westland soils. Unlike Brookston soils, they are stratified in the solum and underlying material. In contrast to Sloan soils, they have an argillic horizon. They have less gravel in the lower part of the solum than Westland soils.

Re—Rensselaer clay loam. This nearly level soil is in slightly depressional areas of broad outwash plains and in old glacial drainageways and lake basins. Areas range from 2 to 250 acres in size. Most are irregularly shaped, but some are long. Slopes are 0 to 2 percent. In some small areas this soil is underlain by loam till 2 to 6 inches below the subsoil.

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

Runoff is very slow or ponded. Wetness is the main limitation of this soil. Because of wetness and slow permeability, limitations for most nonfarm uses are severe. If adequately drained, this soil is well suited to corn, soybeans, and other crops. Most areas are cultivated. Wooded areas support poor to fair stands of hardwoods. Capability unit IIw-1; woodland suitability subclass 2w.

Shoals Series

The Shoals series consists of deep, nearly level, somewhat poorly drained soils on flood plains along the White River and the larger creeks. These soils formed in loamy alluvium. The native vegetation is hardwoods.

In a representative profile, the surface layer is dark grayish brown, heavy silt loam 10 inches thick. The underlying material is, in sequence downward, 5 inches of mottled grayish brown silt loam; 12 inches of mottled grayish brown loam; 8 inches of mottled dark grayish brown, heavy sandy loam; and 4 inches of mottled dark grayish brown loamy sand. Below this to a depth of about 60 inches it is mottled pale brown gravelly sandy loam.

Permeability is moderate. Available water capacity is high. Organic-matter content of the surface layer is moderate. The seasonal high water table is 1 foot to 3 feet below the surface during some part of the year.

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

Representative profile of Shoals silt loam in a cultivated field 1,900 feet west and 400 feet north of the southeast corner of sec. 14, T. N., R. 2 E.

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

C1—10 to 15 inches; grayish brown (10YR 5/2) silt loam; few fine faint yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; friable; few fine roots; few fine worm holes; neutral; gradual smooth boundary.

C2—15 to 27 inches; grayish brown (10YR 5/2) loam; common medium faint brownish yellow (10YR 6/6) mottles; weak fine subangular blocky structure; friable; few fine roots in the upper 5 inches; mildly alkaline; gradual smooth boundary.

C3—27 to 35 inches; dark grayish brown (10YR 4/2) heavy sandy loam; few fine faint yellowish brown (10YR 5/4) mottles; weak medium granular structure; friable; thin clay coatings on pebbles; 7 percent coarse gravel; mildly alkaline; clear wavy boundary.

IIC4—35 to 39 inches; dark grayish brown (10YR 4/2) loamy sand; few fine faint yellowish brown (10YR 5/4) mottles; single grained; loose; 5 percent coarse gravel; strong effervescence; moderately alkaline; clear wavy boundary.

IIC5—39 to 60 inches; pale brown (10YR 6/3) gravelly sandy loam; common medium faint yellowish brown (10YR 5/4, 5/6), mottles; single grained; loose; strong effervescence; moderately alkaline.

Reaction throughout the profile is neutral to moderately 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), brown (10YR 5/3), pale brown (10YR 6/3), yellowish brown (10YR 5/4), or dark grayish brown (10YR 4/2) silt loam, loam, sandy loam, or heavy silt loam to light clay loam. Mottles are few to many and faint to prominent.

Shoals soils are similar in drainage to Crosby, Sleeth, and Whitaker soils. They have less clay, are less acid, and have weaker structure in the control section than those soils.

Sh—Shoals silt loam. This nearly level soil is on narrow flood plains along meandering streams and in low-lying, weakly defined drainageways of large river bottom land. Areas range from 10 to 60 acres in size. Most are long, but some are irregularly shaped. 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 very slow. Flooding and wetness are the main limitations. This soil is subject to flooding in winter and early in spring and to flooding during some parts of the growing season. Because of flooding and wetness, limitations for most nonfarm uses are severe. If adequately drained, this soil is well suited to corn, soybeans, and other crops, but crops are subject to damage during periods of flooding. Wooded areas support 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 on broad outwash plains and terraces and in old glacial drainageways. These soils formed in loamy outwash over gravelly sand and sand. The native vegetation is hardwoods.

In a representative profile, the surface layer is dark grayish brown loam 9 inches thick. The subsurface layer is grayish brown, friable loam about 2 inches thick. The subsoil is about 43 inches thick. The upper 9 inches is mottled grayish brown, firm clay loam; the next 8 inches is mottled dark yellowish brown and dark grayish brown, firm gravelly clay loam; and the lower 26 inches is mottled dark gray, friable sandy clay loam. The underlying material to a depth of about 70 inches is brown, stratified gravelly sand and sand.

Permeability is moderate. Available water capacity is high. Organic-matter content of the surface layer is moderate. The seasonal high water table is 1 foot to 3 feet below the surface during some part of the year.

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

Representative profile of Sleeth loam in a cultivated field 1,050 feet south and 2,100 feet east of the northwest corner of sec. 10, T. 14 N., R. 3 E.

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

A2—9 to 11 inches; grayish brown (10YR 5/2) loam; common medium distinct brown (10YR 4/3) mottles; weak medium platy structure; friable; few fine roots; medium acid; clear smooth boundary.

B21t—11 to 20 inches; grayish brown (10YR 5/2) clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; discontinuous distinct thin dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; clear wavy boundary.

B22t—20 to 28 inches; mottled dark yellowish brown (10YR 4/4) and dark grayish brown (10YR 4/2) gravelly clay loam; moderate medium subangular blocky structure; firm; discontinuous distinct thin dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; clear wavy boundary.

B3t—28 to 54 inches; dark gray (10YR 4/1) sandy clay loam; many medium distinct dark brown (10YR 3/3) or dark yellowish brown (10YR 3/4) mottles; weak medium and coarse subangular blocky structure; friable; 10 percent fine and coarse gravel; moderately alkaline; abrupt wavy boundary.

IIC—54 to 70 inches; brown (10YR 5/3) stratified gravelly sand and sand; single grained; loose; strong effervescence; moderately alkaline.

The solum is typically 40 to 55 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 5/3) loam, fine sandy loam, or silt loam. It has weak or moderate fine or medium granular structure. The A2 horizon is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2) loam or silt loam. It has weak or moderate thin to thick platy structure or weak or moderate fine or medium granular structure.

The B2 horizon is grayish brown (10YR 5/2), brown (10YR 5/3), yellowish brown (10YR 5/4), or dark yellowish brown (10YR 4/4). It is dominantly clay loam or gravelly clay loam. It has weak or moderate medium or coarse prismatic structure or subangular blocky structure. The B3 horizon is gray (10YR 5/1) or dark gray (10YR 4/1) sandy loam, gravelly loam, gravelly clay loam, or sandy clay loam. Mottles throughout the B2 and B3 horizons are few to many, fine to coarse, and faint to prominent.

The C horizon is light gray (10YR 6/1), gray (10YR 5/1), dark gray (10YR 4/1), or brown (10YR 5/3), stratified gravelly sand, loamy sand, and sand.

Sleeth soils are similar in drainage to Crosby and Whitaker soils. Unlike Crosby soils, they have a stratified solum. Sleeth soils have more gravel in the solum than Whitaker soils.

Sk—Sleeth loam. This nearly level soil is surrounded by very poorly drained Rensselaer or Westland soils or is surrounded by or is at toe slopes of well drained Ockley or Fox soils on outwash plains and terraces and in old glacial drainageways. Areas range from 2 to 50 acres in size. Most are irregularly shaped, but some are islandlike. Slopes are 0 to 2 percent.

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

Runoff is slow. Wetness is the main limitation of this soil. Because of wetness and permeability of the underlying material, limitations for most nonfarm uses are severe. If adequately drained, this soil is well suited to corn, soybeans, and other crops. Wooded areas support fair stands of hardwoods. Capability unit IIw-2; woodland suitability subclass 3w.

Sloan Series

The Sloan series consists of deep, nearly level, very poorly drained soils on bottom land along the White River and the larger creeks. These soils formed in loamy alluvium. The native vegetation is water tolerant grasses and hardwoods.

In a representative profile, the surface layer is 14 inches thick. The upper 8 inches is very dark gray, heavy silt loam, and the lower 6 inches is very dark grayish brown silty clay loam. The subsoil is about 19 inches thick. The upper 7 inches is mottled very dark gray, firm silty loam, and the lower 12 inches is mottled gray, firm clay loam. The underlying material to a depth of about 45 inches is mottled gray heavy silt loam. Below this to a depth of 60 inches is gray, stratified gravelly loamy sand, loamy sand, and sand.

Permeability is moderate. Available water capacity is high. Organic-matter content of the surface layer is high. The seasonal high water table is at the surface or ½ foot below the surface during some part of the year.

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

Representative profile of Sloan silt loam in a cultivated field 2,640 feet east and 500 feet south of the northwest corner of sec. 9, T. 14 N., R. 3 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) heavy silt loam; moderate medium granular structure; friable; few fine roots; neutral; abrupt smooth boundary.

A12—8 to 14 inches; very dark grayish brown (2.5Y 3/2) silty clay loam; common medium distinct brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; firm; few fine roots; neutral; gradual wavy boundary.

B21g—14 to 21 inches; very dark gray (10YR 3/1) silty clay loam; few fine prominent brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; neutral; gradual wavy boundary.

B22t—21 to 28 inches; gray (10YR 5/1) clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; fine very dark grayish brown (10YR 3/2) iron and manganese oxide concretions; neutral; clear smooth boundary.

B3g—28 to 33 inches; gray (10YR 5/1) clay loam; many coarse prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; neutral; clear smooth boundary.

C1g—33 to 45 inches; gray (10YR 5/1) heavy silt loam; few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; moderately alkaline; gradual wavy boundary.

IIC2g—45 to 60 inches; gray (10YR 6/1) stratified gravelly loamy sand, loamy sand, and sand; single grained; loose; strong effervescence; moderately alkaline.

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

The Ap horizon, A1 horizon, or A12 horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark gray (10YR 3/1) silt loam, heavy silt loam, silty clay loam, or clay loam.

The B horizon is very dark gray (10YR 3/1), dark gray (10YR 4/1), or gray (10YR 5/1) clay loam, silty clay loam, or loam. It has weak or moderate fine to coarse subangular or angular blocky structure. Mottles are few to many, fine to coarse, and faint to prominent.

The upper part of the C horizon has weak or moderate medium or coarse subangular blocky structure or prismatic structure. Mottles are few to many, fine to coarse, and faint to prominent.

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. They have a darker surface layer than Genesee, Eel, and Shoals soils. They are mottled within 8 inches of the surface, whereas mottles are at a greater depth in Eel and Shoals soils.

Sn—Sloan silt loam. This nearly level soil is on the broad bottom land along the White River; on the narrower bottom land along some creeks; in low swales of both the broad bottom land along the river and the narrower bottom land along the creeks; and in oxbows of the river and creeks. Areas range from 2 to 500 acres in size; the largest are on the broad bottom land along the White River. Most areas are irregularly shaped, but those in low swales are long or irregularly shaped, and those in old oxbows are half moon shaped. 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 muck, which occur where the Sloan soil is lowest lying. The muck, which dries out more slowly than Sloan soils, is indicated by spot symbols on the soil map.

Runoff is very slow. Wetness and flooding are the main limitations. This soil is subject to flooding during winter and early in spring and to flooding during parts of the growing season. Because of wetness and flooding, limitations for most nonfarm uses are severe. If adequately drained, this soil is well suited to corn, soybeans, and other crops, but crops are subject to damage during periods of flooding. Wooded areas support poor stands of hardwoods. Capability unit IIIw-9; woodland suitability subclass 2w.

Urban Land

Urban land is so altered and obscured by public works and structures that identification of the soils is not feasible.

Ub—Urban land-Brookston complex. This nearly level mapping unit is on smooth upland flats and in depressions and drainageways. Slopes are 0 to 2 percent. Areas range from 2 to 110 acres in size and are irregularly shaped.

This mapping unit is about 50 percent Urban land and 30 percent very poorly drained Brookston soils. Brookston soils are identifiable in lawns, gardens, parks, and other open areas. They have a profile similar to the one described as representative of the series, but alteration is evident where small drainageways have been filled or leveled and other small areas have been cut, built up, or smoothed.

Included with this unit in mapping are small areas of well drained Miami soils and somewhat poorly drained Crosby soils. Also included are areas of Cut and fill land.

Runoff is generally rapid on the Urban land and slow on the Brookston soils. Most areas are drained by sewer systems and gutters, and some are drained by surface ditches. Some areas of Brookston soils in depressions and drainageways are ponded for brief periods by runoff from adjacent higher lying areas. Construction and engineering work should be based largely on the properties and qualities of the Brookston soils. Because of wetness, the Brookston soils have severe limitations for most nonfarm uses. If excess water is removed, they are well suited to lawns, vegetable and flower gardens, and water-tolerant shrubs and trees. Not assigned to a capability unit or woodland suitability subclass.

Uc—Urban land-Crosby complex. This nearly level mapping unit is on smooth upland flats. Slopes are 0 to 2 percent. Areas range from 10 to 1,000 acres and are irregularly shaped.

This mapping unit is about 50 percent Urban land and 30 percent somewhat poorly drained Crosby soils. Crosby soils are identifiable in lawns, gardens, parks, and other open areas. They have a profile similar to the one described as representative of the series, but alteration is evident where small, low lying ridges have been cut or smoothed.

Included with this unit in mapping are small areas of well drained Miami soils, very poorly drained Brookston soils, and Cut and fill land.

Runoff is generally rapid on the Urban land and slow on the Crosby soils. Most areas are drained by sewer systems and gutters, and some are drained by surface ditches. Construction and engineering work should be based largely on the properties and qualities of the Crosby soils. Erosion is a problem if disturbed areas are left bare for a considerable period. Bare areas are subject to gullying, sheet erosion, and water erosion, all of which remove much of the surface soil and subsoil. Because of wetness and slow permeability, the Crosby soils have severe limitations for most nonfarm uses. If excess water is removed, they are well suited to lawns, vegetable and flower gardens, and water-tolerant shrubs and trees. Not assigned to a capability unit or woodland suitability subclass.

UfA—Urban land-Fox complex, 0 to 3 percent slopes. This is a dominantly nearly level mapping unit on smooth terrace flats. In a few areas it is gently sloping. Areas range from 5 to 1,700 acres and are irregularly shaped.

This mapping unit is about 50 percent Urban land and 35 percent well drained Fox soils. Fox soils are identifiable in lawns, gardens, parks, and other open areas. They have a profile similar to the one described as representative of the series, but alteration is evident where small low knolls and ridges have been cut and the soil has been used as fill in lower lying areas.

Included with this unit in mapping are small areas of well drained Ockley and Martinsville soils, very poorly drained Westland soils, somewhat poorly drained Sleeth soils, and Cut and fill land.

Runoff is generally rapid on the Urban land and slow on the Fox soils. Most areas are drained by sewer systems and gutters, and some are drained by surface ditches. Construction and engineering work should be based largely on the properties and qualities of the Fox soils. Erosion is a problem if disturbed areas where the slopes are 2 or 3 percent are left bare for a considerable period. Bare areas on slopes are subject to gullying, sheet erosion, and water erosion, all of which remove much of the surface soil and subsoil. The Fox soils have slight limitations for most nonfarm uses. If adequately watered, they are well suited to lawns, vegetable and flower gardens, and drought-tolerant shrubs and trees. Not assigned to a capability unit or woodland suitability subclass.

UfC—Urban land-Fox complex, 6 to 12 percent slopes. This moderately sloping mapping unit is on the short slopes between broad, level terraces or outwash plains and bottom land and on the short slope breaks on terraces or outwash plains. Areas range from 10 to 65 acres in size and are long.

This mapping unit is about 50 percent Urban land and 35 percent well drained Fox soils. Fox soils are identifiable in lawns, gardens, parks, and other open areas. They have a profile similar to the one described as representative of the series, but the surface layer is thinner, depth to the underlying gravelly sand and sand is 24 to 32 inches, and in places alteration is evident.

Included with this unit in mapping are small areas of gently sloping soils and strongly sloping, well drained soils. Also included are areas of Cut and fill land.

Runoff is generally very rapid on the Urban land and medium on the Fox soils. Most areas are drained by sewer systems and gutters, and some are drained by surface ditches. Construction and engineering work should be based largely on the properties and qualities of the Fox soils. Erosion is a problem if disturbed areas are left bare for a considerable period. Bare areas are subject to gullying, sheet erosion, and water erosion, all of which remove much of the surface soil and subsoil. Because of slope, the Fox soils have moderate limitations for most nonfarm uses. If adequately watered, they are well suited to lawns, vegetable and flower gardens, and drought tolerant shrubs and trees. Not assigned to a capability unit or woodland suitability subclass.

Ug—Urban land-Genesee complex. This nearly level mapping unit is on bottom land. Areas range from 40 to 1,300 acres. Most are irregularly shaped, but some are long. Slopes are 0 to 2 percent. Large areas are protected by levees.

This mapping unit is about 40 percent Urban land and 40 percent well drained Genesee soils. Genesee soils are identifiable in lawns, gardens, parks, and other open areas. They have a profile similar to the one described as representative of the series, but alteration is evident in many areas where topsoil has been stripped.

Included with this unit in mapping are small areas of very poorly drained Sloan soils, somewhat poorly drained Shoals soils, and moderately well drained Eel soils. Also included are areas of fill.

Runoff is generally rapid on the Urban land and slow on the Genesee soils. Most areas are drained by sewer systems and gutters, and some are drained by surface ditches. Construction and engineering work should be based largely on the properties and qualities of the Genesee soils. Erosion is not a problem. Because of flooding, the Genesee soils have severe limitations for most nonfarm uses. They are well suited to lawns, vegetable and flower gardens, and shrubs and trees. Not assigned to a capability unit or woodland suitability subclass.

UmB—Urban land-Miami complex, 0 to 6 percent slopes. This nearly level and gently sloping mapping unit is on gently undulating uplands. Areas range from 5 to 1,260 acres and are irregularly shaped or long.

This mapping unit is about 50 percent Urban land and 30 percent well drained Miami soils. Miami soils are identifiable in lawns, gardens, parks, and other open areas. They have a profile similar to the one described as representative of the series, but alteration is evident in small areas where short, complex slopes have been cut and the soil has been used as fill in leveling or smoothing out lower lying areas.

Included with this unit in mapping are small areas of somewhat poorly drained Crosby soils, very poorly drained Brookston soils, and Cut and fill land.

Runoff is generally rapid on the Urban land and slow or medium on the Miami soils. Most areas are drained by sewer systems and gutters, and some are drained by surface ditches. Construction and engineering work should be based largely on the properties and qualities of the Miami soils. Erosion is a problem if disturbed areas where the slope is 2 to 6 percent are left bare for a considerable period. Bare areas on slopes are subject to gullying, sheet erosion, and water erosion, all of which remove much of the surface soil and subsoil. The Miami soils have slight or moderate limitations for most nonfarm uses. They are well suited to lawns, vegetable and flower gardens, and shrubs and trees. Not assigned to a capability unit or woodland suitability subclass.

UmC—Urban land-Miami complex, 6 to 12 percent slopes. This moderately sloping mapping unit is along drainageways and on knolls and ridges. Areas range from 10 to 80 acres and are long or irregularly shaped.

This mapping unit is about 50 percent Urban land and 30 percent well drained Miami soils. Miami soils are identifiable in lawns, gardens, parks, and other open areas. They have a profile similar to the one described as representative of the series, but the surface layer is thinner, depth to the underlying material averages about 30 inches, and alteration is evident in small areas where short, complex slopes have been cut and the soil has been used to fill or smooth out lower lying areas.

Included with this unit in mapping are small areas of gently sloping and strongly sloping Miami soils. Also included are small areas of Cut and fill land.

Runoff is generally very rapid on the Urban land and medium on the Miami soils. Most areas are drained by sewer systems and gutters, and some are drained by surface ditches. Construction and engineering work should be based largely on the properties and qualities of the Miami soils. Erosion is a major problem if disturbed areas are left bare for a considerable period. Bare areas are subject to gullying, sheet erosion, and water erosion, all of which remove much of the surface soil and subsoil. Because of slope, the Miami soils have moderate limitations for most nonfarm uses. They are suited to lawns, vegetable and flower gardens, and shrubs and trees. Not assigned to a capability unit or woodland suitability subclass.

Uw—Urban land-Westland complex. This nearly level mapping unit is in smooth, narrow to broad drainageways on outwash plains and terraces. Slopes are 0 to 2 percent. Areas range from 10 to 200 acres in size and are irregularly shaped or long.

This mapping unit is about 50 percent Urban land and 30 percent very poorly drained Westland soils. Westland soils are identifiable in lawns, gardens, parks, and other open areas. They have a profile similar to the one described as representative of the series, but alteration is evident where small drainageways have been filled or leveled and where small areas have been cut, built up, or smoothed.

Included with this unit in mapping are small areas of somewhat poorly drained Sleeth soils, well drained Ockley soils, and fill.

Runoff is generally rapid on the Urban land and very slow on the Westland soils. Most areas are drained by sewer systems and gutters, and some are drained by surface ditches. Some areas of the Westland soils in depressions and drainageways are ponded for brief periods by runoff from adjacent higher lying areas. Construction and engineering work should be based largely on the properties and qualities of the Westland soils. Because of wetness, the Westland soils have severe limitations for most nonfarm uses. If excess water is removed, they are well suited to lawns, vegetable and flower gardens, and water tolerant shrubs and trees. Not assigned to a capability unit or woodland suitability subclass.

Westland Series

The Westland series consists of deep, nearly level, very poorly drained soils on broad outwash plains and terraces and in old glacial drainageways. These soils formed in loamy outwash over gravelly sand and sand. The native vegetation is water-tolerant grasses and hardwoods.

In a representative profile, the surface layer is clay loam 12 inches thick. The upper 8 inches is very dark brown, and the lower 4 inches is black. The subsoil is about 30 inches thick. The upper 14 inches is mottled dark gray, firm clay loam, and the lower 16 inches is mottled grayish brown, friable sandy clay loam. The underlying material to a depth of about 60 inches is stratified, grayish brown gravelly sandy loam and dark grayish brown gravelly sand and sand.

Permeability is slow. Available water capacity is high. Organic-matter content of the surface layer is high. The seasonal high water table is at the surface or 1 foot below the surface during some part of the year.

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

Representative profile of Westland clay loam in a cultivated field 1,320 feet north and 1,320 feet east of the southwest corner of sec. 2, T. 14 N., R. 3 E.

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

A12—8 to 12 inches; black (10YR 2/1) clay loam; moderate medium granular structure; friable; few fine roots; neutral; clear smooth boundary.

B2tg—12 to 26 inches; dark gray (10YR 4/1) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; discontinuous faint thin very dark brown (10YR 2/2) clay films on faces of peds; 10 percent fine gravel; neutral; clear wavy boundary.

B3tg—26 to 42 inches; grayish brown (10YR 5/2) sandy clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; discontinuous distinct thin dark gray (10YR 4/1) clay films on faces of peds; 15 percent fine and coarse gravel; neutral; clear wavy boundary.

IIC1—42 to 44 inches; grayish brown (10YR 5/2) gravelly sandy loam; single grained; loose; slight effervescence; moderately alkaline; abrupt wavy boundary.

IIC2—44 to 60 inches; dark grayish brown (10YR 4/2) gravelly sand and sand; single grained; loose; slight effervescence; moderately alkaline.

The solum is 40 to 60 inches thick. Reaction throughout the solum is neutral to mildly alkaline.

The A 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) loam, clay loam, or silty clay loam. It has weak or moderate medium or coarse granular structure or weak fine or medium subangular blocky structure.

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, or gravelly clay loam. Mottles are few to many, fine to coarse, and faint to prominent. The B2 horizon has weak or moderate fine or medium subangular blocky structure or prismatic structure.

The C horizon is dark gray (N 4/0), gray (N 5/0 or 10YR 5/1), grayish brown (10YR 5/2), or dark grayish brown (10YR 4/2), stratified gravelly sandy loam, loamy sand, gravelly sand, and sand.

Westland soils are similiar in drainage to Brookston, Rensselaer, and Sloan soils. The soils have more gravel in the solum than Brookston or Rensselaer soils. In contrast to Sloan soils, Westland soils have an argillic horizon.

We—Westland clay loam. This nearly level soil is on broad outwash plains and terraces and in old glacial drainageways. Areas range from 2 to 160 acres in size. Most areas are irregularly shaped, but some are long. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of very poorly drained Rensselaer and Sloan soils and somewhat poorly drained Sleeth soils; small areas of soils that have sandy material on the surface; small areas of very poorly drained soils that are shallow to gravelly sand and sand; and small areas that are wet for prolonged periods. The wet areas are indicated by spot symbols on the soil map.

Runoff is very slow. Some areas are ponded or flooded for brief periods during winter and spring. Wetness is the main limitation of this soil. Because of wetness and slow permeability, limitations for most nonfarm uses are severe. If adequately drained, this soil is well suited to corn, soybeans, and other crops. A few areas are wooded. Wooded areas support poor to fair stands of hardwoods. Capability unit IIw-1; woodland suitability subclass 2w.

Whitaker Series

The Whitaker series consists of deep, nearly level, somewhat poorly drained soils on broad outwash plains and terraces and in old glacial drainageways. These soils formed in stratified silty and sandy glacial outwash. The native vegetation is hardwoods.

In a representative profile, the surface layer is dark grayish brown silt loam 9 inches thick. The subsoil is about 49 inches thick. The upper 15 inches is mottled light brownish gray, friable silt loam; the next 13 inches is mottled grayish brown, firm heavy silt loam; the next 12 inches is mottled light brownish gray, firm clay loam; and the lower 9 inches is mottled yellowish brown, friable loam. The underlying material to a depth of about 80 inches is mottled grayish brown, stratified fine sandy loam and loamy sand.

Permeability is moderate. Available water capacity is high. Organic-matter content of the surface layer is moderate. The seasonal high water table is 1 foot to 3 feet below the surface during some part of the year.

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

Representative profile of Whitaker silt loam in a cultivated field 125 feet west and 350 feet north of the southeast corner of sec. 15, T. 14 N., R. 3 E.

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

B1—9 to 24 inches; light brownish gray (10YR 6/2) silt loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

B21—24 to 37 inches; grayish brown (2.5Y 5/2) heavy silt loam; many medium distinct light gray (10YR 7/1) mottles; moderate medium subangular blocky structure; firm; neutral; clear smooth boundary.

B22t—37 to 49 inches; light brownish gray (10YR 6/2) clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; patchy distinct thin grayish brown (10YR 5/2) clay films on faces of peds; neutral; clear wavy boundary.

B23t—49 to 58 inches; yellowish brown (10YR 5/6) loam; many fine distinct light gray (10YR 7/1) mottles; weak medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

C—58 to 80 inches; grayish brown (10YR 5/2) stratified fine sandy loam and loamy sand; many medium distinct yellowish brown (10YR 5/8) mottles; massive or single grained; loose; strong effervescence; moderately alkaline.

The solum is 36 to 60 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2) silt loam or loam. It has weak to moderate fine or medium granular structure. The A2 horizon, if present, is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2) silt loam or loam. It has weak or moderate thin to thick platy structure or weak or moderate fine and medium granular structure.

The B2 horizon is pale brown (10YR 6/3), light brownish gray (10YR 6/2), brown (10YR 5/3), dark brown (10YR 4/3), yellowish brown (10YR 5/4, 5/6), or grayish brown (2.5Y 5/2) clay loam, silty clay loam, or silt loam. It has moderate medium subangular blocky structure or weak medium prismatic structure parting to moderate medium subangular blocky structure. In some profiles the B2 horizon has scattered pebbles. Mottles are few to many, fine to coarse, and faint to prominent.

The C horizon is mottled grayish brown (10YR 5/2), yellowish brown (10YR 5/4–5/8), strong brown (7.5YR 5/8), dark yellowish brown (10YR 4/4), or light gray (10YR 6/1–7/1), stratified loamy sand, sandy loam, fine sandy loam, and silt loam. In some profiles the C horizon has very thin layers of silty clay loam.

The upper part of the B horizon is grayer than is defined as the range for the series, but this difference does not alter the use or behavior of the soil.

Whitaker soils are similar in drainage to Crosby and Sleeth soils. Unlike Crosby soils, they are stratified in the solum and underlying material. They have less gravel in the lower part of the solum than Sleeth soils.

Wh—Whitaker silt loam. This nearly level soil is surrounded by very poorly drained Rensselaer or Westland soils or is surrounded by or at toe slopes of well drained Martinsville soils on outwash plains and terraces and in old glacial drainageways. Areas range from 5 to 80 acres in size. Most are irregularly shaped or long, but some are islandlike. Slopes are 0 to 2 percent.

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

Runoff is slow. Wetness is the main limitation of this soil. Because of wetness, limitations for most nonfarm uses are generally severe. If adequately drained, this soil is well suited to corn, soybeans, and other crops. Most areas are cultivated. The wooded areas support fair stands of hardwoods. 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 Marion County for cultivated crops and forage, wildlife, trees, engineering structures and practices, town and country planning, and recreation. Predicted yields of important crops are listed in table 2.

No specific management for individual soils is suggested. Detailed information on use and management can be provided by the local district conservationist of the Soil Conservation Service or by the Marion County Cooperative Extension Service.

Crops

About 25 percent of the acreage of Marion County is actively farmed. Most of the farm land is used for crops and pasture. The main crops are corn, soybeans, and wheat. A small acreage is used for truck farms and orchards.

The major management concerns in this county are wetness, water erosion, maintenance of fertility and organic-matter content, and maintenance of good tilth or improvement of tilth.

The major management needs are water management systems; grassed waterways; contour farming; diversion terraces; grade stabilization; minimum tillage; use of crop residue, green manure crops, and winter cover crops; and, for most soils, application of 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 explained, the soils in each capability unit are described, and the management suited to the soils in each unit is suggested. Predicted yields of the principal crops are given for all the soils in the county in table 2.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to 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 wildlife, for forest trees, 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 levels are described in the following paragraphs.

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

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode, but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat. (None in the county.)

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

Class VII soils have very severe limitations that make them unsuitable for 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 crop production and restrict their use to recreation, wildlife, water supply, or to esthetic purposes. (None in the 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, hay, 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, IIw-1 or IIw-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation as defined in the foregoing paragraphs; and the Arabic numeral specifically identifies the capability unit within each subclass.

Capability unit numbers are generally assigned locally, but are part of a statewide system. All of the units of the system are not represented in Marion County; therefore, the capability unit numbers in this soil survey are not consecutive.

Management by capability units

The soils in Marion County have been assigned to 15 capability units. The soils in each unit have about the same limitations, are subject to similar risks of damage, need about the same kind of management, and respond to management in about the same way.

On the following pages each capability unit is described and management is suggested. To find the capability unit for a specific soil, refer to the section "Descriptions of the Soils."

CAPABILITY UNIT I-1

This unit consists of deep, nearly level, well drained Martinsville, Miami, and Ockley soils. These soils are on outwash plains and terraces and on uplands. These soils have a medium textured surface layer and a moderately fine textured subsoil.

The surface layer has a moderate supply of organic matter. Available water capacity is high. Runoff is slow. Permeability is moderate to moderately slow. The erosion hazard is none to slight. These soils have moderate natural fertility and few limitations for crops. The major management needs are maintaining organic-matter content and fertility and improving and maintaining tilth.

These soils are well suited to corn, soybeans, small grain, and other crops commonly grown in the county. Minimum tillage, winter cover crops, and crop residue help to 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 IIe-1

The only soil in this unit, Miami silt loam, 2 to 6 percent slopes, eroded, is a deep, well drained soil on uplands. It has a medium textured surface layer and a moderately fine textured subsoil.

The surface layer has a moderate amount of organic matter. Available water capacity is high. Runoff is medium. Permeability is moderate in the solum and moderate to moderately slow in the underlying material. Erosion and runoff are the major hazards. This soil has moderate natural fertility and is generally medium acid to strongly acid. It is easy to cultivate. The major management needs are controlling erosion, maintaining organic-matter content and fertility, and improving and maintaining tilth.

This soil is well suited to corn, soybeans, small grain, grasses, legumes, and other crops. Minimum tillage, contour farming, winter cover crops, grassed waterways, and crop rotations that include grasses and legumes help control erosion and runoff. Crop residue and green manure crops help to maintain organic-matter content and fertility and improve and maintain tilth. Crops respond well to fertilization. Periodic applications of lime help maintain favorable soil reaction for commonly grown crops.

CAPABILITY UNIT IIe-3

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

The surface layer has a moderate amount of organic matter. Available water capacity is high. Runoff is medium. Permeability is moderate. Erosion and runoff are the major hazards. The soils are medium acid to strongly acid and have moderate natural fertility. The major management needs are controlling erosion, maintaining organic-matter content and fertility, and improving and maintaining tilth.

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

CAPABILITY UNIT IIe-9

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

The surface layer has a moderate amount of organic matter. Available water capacity is moderate. Runoff is medium. Permeability is moderate in the subsoil and rapid in the underlying material. Erosion and runoff are the major hazards. Droughtiness during long dry periods is also a problem. This soil is strongly acid to medium acid and has moderate natural fertility. It is easy to cultivate. The major management needs are controlling erosion and runoff, maintaining organic-matter content and fertility, and improving and maintaining tilth.

This soil is well suited to small grain, grasses, and legumes and moderately well suited to corn and soybeans. Minimum tillage, contour farming, winter cover crops, grassed waterways, and crop rotations that include grasses and legumes help control erosion and runoff. Crop residue and green manure crops help maintain organic-matter content and fertility and improve and maintain tilth. Crops respond well to fertilization, 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

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

The somewhat poorly drained soils of this unit have a low amount of organic matter in the surface layer and have slow permeability. The well drained soils have a moderate amount of organic matter in the surface layer and have moderate permeability in the solum and moderate to moderately slow permeability in the underlying material. Available water capacity is high. Runoff is medium. Erosion is the major hazard. Wetness in the somewhat poorly drained soils is also a limitation for farming. Natural fertility is moderate. The major management needs are controlling erosion, maintaining organic-matter content and fertility, and improving and maintaining tilth. Other needs are removing excess surface and subsurface water.

These soils are well suited to corn, soybeans, small grain, grasses, and legumes. Minimum tillage, contour farming, winter cover crops, grassed waterways, and crop rotations that include grasses and legumes help control erosion. Crop residue and green manure crops help 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 help maintain favorable soil reaction for commonly grown crops.

CAPABILITY UNIT IIw-1

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

The surface layer has a high amount of organic matter. Available water capacity is high. Runoff is very slow, and the soils are subject to ponding. Permeability is slow or moderate. Wetness is the major hazard. The high clay content of the surface layer restricts workability. It these soils are cultivated when wet, they are hard and cloddy when dry. The soils have high natural fertility. The major management needs are removing surface and subsurface water, maintaining organic-matter content and fertility, and improving and maintaining tilth.

If adequately drained, these soils are well suited to corn, soybeans, and other crops. Surface and subsurface drains and outlets help remove excess surface and subsurface water. Minimum tillage, crop residue, and winter cover crops help to maintain organic-matter content and fertility and improve and maintain tilth. Application of lime is seldom necessary because the soils have a naturally favorable soil reaction for crops.

CAPABILITY UNIT IIw-2

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

The Crosby soil has a low amount of organic matter in the surface layer; the Sleeth and Whitaker soils have a moderate amount in the surface layer. Available water capacity is high. Runoff is slow. Permeability is slow or moderate. Wetness is the major hazard. These soils have moderate natural fertility. The major management needs are removing excess surface and subsurface water, maintaining organic-matter content and fertility, and improving and maintaining tilth.

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

CAPABILITY UNIT IIw-7

This unit consists of deep, nearly level, well drained, moderately well drained, and somewhat poorly drained Eel, Genesee, and Shoals soils on bottom land. These soils have a medium textured surface layer and a medium textured and moderately coarse textured subsoil.

The surface layer has a moderate amount of organic matter. Available water capacity is high. Runoff is slow, and flooding is likely. Permeability is moderate. The erosion hazard is none to slight. These soils are generally neutral or mildly alkaline and have moderate or high natural fertility. The major management needs for Genesee and Eel soils are maintaining organic-matter content and fertility and improving and maintaining tilth. The major management needs for the Shoals soil are removing excess impounded and subsurface water, maintaining organic matter content and fertility, and improving and maintaining tilth.

Genesee and Eel soils are well suited to corn, soybeans, and other crops. They are also suited to grasses, such as tall fescue, that can tolerate periods of flooding. Small grain and most legumes are subject to some damage from flooding. If drainage is adequate, the Shoals soil is well suited to corn, soybeans, and other crops. This soil is also suited to pasture and hay, which can be grown in the narrow, dissected areas where row crops are not practical. In the Shoals soil, subsurface drains help remove excess subsurface water. Interspersed shallow surface drains help remove impounded water and control wetness by supplementing the subsurface drains. For all the soils, minimum tillage and crop residue help maintain organic-matter content and fertility and improve and maintain tilth. Application of lime is seldom necessary because these soils have a naturally favorable soil reaction for crops.

CAPABILITY UNIT IIs-1

The only soil in this unit, Fox loam, 0 to 2 percent slopes, is moderately deep over sand and gravel and is well drained. It is on outwash plains and terraces. It has a medium textured surface layer, a moderately fine textured subsoil, and coarse textured underlying material at a depth of 24 to 40 inches.

The surface layer has a moderate amount of organic matter. Available water capacity is moderate. Runoff is slow. Permeability is moderate in the subsoil and rapid in the underlying material. Droughtiness during long dry periods is the major hazard. This soil is easy to cultivate. The major management needs are maintaining organic-matter content and fertility and improving and maintaining tilth.

This soil is suited to all crops commonly grown in the area. Corn, soybeans, small grain, grasses, and legumes are the main crops. Minimum tillage, winter cover crops, crop residue, and green manure crops help maintain organic-matter content and fertility and improve and maintain tilth. Crops respond well to fertilization, 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 IIIe-1

The only soil in this unit, Miami silt loam, 6 to 12 percent slopes, eroded, is a deep, well drained soil on uplands. It has a medium textured surface layer and a moderately fine textured subsoil.

The surface layer has a moderate amount of organic matter. Available water capacity is high. Runoff is medium. Permeability is moderate in the solum and moderate or moderately slow in the underlying material. Erosion and runoff are the major hazards. This soil has moderate natural fertility and good tilth. The major management needs are controlling erosion and runoff, maintaining organic-matter content and fertility, and improving and maintaining tilth.

If erosion is adequately controlled, this soil is suited to corn, soybeans, small grain, and legume-grass hay. Minimum tillage, winter cover crops, spring plowing, crop rotations, and grassed waterways help control erosion and runoff. Crop residue and green manure crops help 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 IIIe-9

Only the Fox complex, 6 to 15 percent slopes, eroded, is in this unit. These soils are moderately deep over sand and gravel and are well drained. They are on outwash plains and terraces. They have a medium textured surface layer, a moderately fine textured subsoil, and coarse textured underlying material at a depth of 24 to 40 inches.

The surface layer has a moderate amount of organic matter. Available water capacity is moderate. Runoff is medium. Permeability is moderate in the subsoil and rapid in the underlying material. Erosion, runoff, and droughtiness are the major hazards. These soils have moderate natural fertility. The major management needs are controlling erosion and runoff, maintaining organic-matter content and fertility, and improving and maintaining tilth.

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

CAPABILITY UNIT IIIw-9

The only soil in this unit, Sloan silt loam, is a deep, nearly level, very poorly drained soil on bottom land. This soil has a medium textured surface layer and a moderately fine textured subsoil.

The surface layer has a high amount of organic matter. Available water capacity is high. Runoff is very slow or is ponded. Permeability is moderate in the solum and moderate or moderately slow in the underlying material. Flooding and wetness are the major hazards. This soil has high natural fertility. The major management needs are removing excess impounded and subsurface water, maintaining organic-matter content and fertility, and maintaining and improving tilth.

If drainage is adequate, this soil is well suited to corn, soybeans, and other crops. It is also suited to water tolerant grasses and legumes seeded for pasture or hay. Fall-seeded small grain is subject to damage from flooding. Subsurface drains help remove excess subsurface water, interspersed shallow surface drains help remove impounded water and control wetness by supplementing the subsurface drains, and diversion ditches help divert or dispose of excess water received from adjacent slopes. In places, suitable outlets for drainage systems are difficult to establish. Minimum tillage, crop residue, and spring plowing help maintain good tilth and allow for a better air-water relationship. Application of lime is seldom necessary because this soil has a naturally favorable soil reaction for crops.

CAPABILITY UNIT IVe-1

This unit consists of deep, well drained soils of the Miami complex, 12 to 18 percent slopes, eroded. These soils are on uplands. They have a medium textured surface layer and a moderately fine textured subsoil.

The surface layer has a moderate amount of organic matter. Available water capacity is high. Runoff is rapid. Permeability is moderate in the solum and moderate or moderately slow in the underlying material. Erosion and runoff are the major hazards. These soils have good tilth and moderate natural fertility. The major management needs are controlling erosion and runoff, maintaining organic-matter content and fertility, and maintaining and improving tilth.

These soils are suited to small grain, grasses, legumes, and trees. An occasional row crop can be grown in the cropping system. Erosion control is needed. Minimum tillage, contour farming, winter cover crops, crop rotations, and grassed waterways help control erosion and runoff. Crop residue during years when small grain and row crops are grown helps maintain organic-matter content and fertility and maintains and improves tilth. Periodic applications of lime help maintain favorable soil reaction for commonly grown crops.

CAPABILITY UNIT VIe-1

This unit consists of deep, well drained soils of the Miami complex, 18 to 24 percent slopes, eroded. These soils are on uplands. They have a medium textured surface layer and a moderately fine textured subsoil.

The surface layer has a moderate amount of organic matter. Available water capacity is high. Runoff is very rapid. Permeability is moderate in the solum and moderate or moderately slow in the underlying material. Erosion and runoff are the major hazards. These soils are subject to severe soil loss if vegetative cover is not maintained at all times. Steepness of slope may hinder workability and harvesting. The soils have moderate natural fertility. The major management needs are controlling erosion and runoff and maintaining good vegetative cover.

Because of steepness and erodibility, these soils are generally not suited to cultivation. They are best suited to woodland or wildlife habitat. Cleared areas are best suited to permanent pasture or hay. Renewing pasture, preparing land and seeding on the contour, and seeding mulch help protect these soils against erosion.

CAPABILITY UNIT VIIe-2

The only soil in this unit, Hennepin loam, 25 to 50 percent slopes, is a deep, well drained soil on uplands. This soil has a medium textured surface layer and subsoil.

The surface layer has a moderate amount of organic matter. Available water capacity is high. Runoff is very rapid. Permeability is moderate. Erosion and runoff are the major hazards. This soil has low natural fertility. The major management needs are controlling erosion and runoff and maintaining good vegetative cover.

This soil is best suited to woodland, wildlife habitat, or recreational uses. If protected against erosion, it is also suited to pasture. Renewing pasture, preparing land and seeding on the contour, seeding mulch, and limiting grazing help protect this soil against erosion.

Yields per acre

The per acre average yields 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 table 2 because of seasonal variations in rainfall and other climatic factors. Absence of a yield estimate indicates that the crop is not suited to or not commonly grown on the soil or that irrigation of a given crop is not commonly practiced on the soil.

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

The latest soil and crop management practices used by many farmers in the county are assumed in predicting the yields. Hay and pasture yields are predicted for varieties of grasses and legumes suited to the soil. A few farmers may be using more advanced practices and are 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; proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage, including timely 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; harvest with the smallest possible loss; and timely fieldwork.

The predicted 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 because their acreage is small, predicted yields for these crops are not included. The local offices of the Soil Conservation Service and the

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

[All yields were estimated for a high level of management in 1974. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Corn	Soybeans	Wheat winter	Grass-legume hay	Tall fescue
	Bu	*Bu*	*Bu*	*Tons*	*AUM*[1]
Brookston:					
Br	145	51	65	4.8	9.6
Crosby:					
CrA	105	37	47	3.4	6.8
[2] CsB2	102	35	46	3.3	6.6
Eel:					
Ee	100	36	—	3.0	8.0
Fox:					
FoA	90	32	45	3.0	—
FoB2	85	30	42	3.0	—
[2] FxC2	80	28	38	2.5	—
Genesee:					
Ge	100	36	—	3.0	8.0
Hennepin:					
HeF	—	—	—	1.9	—
Martinsville:					
MgA	120	42	48	4.0	8.0
MgB2	115	40	46	3.8	7.6
Miami:					
MmA	110	38	50	3.6	7.2
MmB2	105	37	47	3.4	6.8
MmC2	95	33	43	3.1	6.2
[2] MxD2	80	28	36	2.6	5.2
[2] MxE2	—	—	—	—	4.6
Ockley:					
OcA	110	38	44	3.6	7.2
OcB2	105	37	42	3.4	6.8
Rensselaer:					
Re	150	53	—	5.0	10.0
Shoals:					
Sh	90	32	—	3.0	6.0
Sleeth:					
Sk	120	42	48	4.0	8.0
Sloan:					
Sn	80	30	—	2.5	5.0
Urban land:					
[2] Ub	—	—	—	—	—
[2] Uc	—	—	—	—	—
[2] UfA	—	—	—	—	—
[2] UfC	—	—	—	—	—
[2] Ug	—	—	—	—	—
[2] UmB	—	—	—	—	—
[2] UmC	—	—	—	—	—
[2] Uw	—	—	—	—	—
Westland:					
We	140	49	56	4.6	9.2
Whitaker:					
Wh	130	46	52	4.3	8.6

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

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

Cooperative Extension Service can provide information about the productivity and management concerns of the soils for these crops.

Woodland [2]

Only about 5 percent of the land area in Marion County is woodland. The larger areas are in the northwestern part of the county around Eagle Creek Reservoir and in the northeastern part around Geist Reservoir. Other areas are smaller and widely scattered. Most of the small wooded areas are on steep banks along major streams or in wet areas that were not practical to drain.

Table 3 contains information useful to woodland owners or forest managers planning use of soils for wood crops. Mapping unit symbols for those soils suitable for wood crops are listed alphabetically by soil name, and the ordination 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.

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

TABLE 3.—*Woodland management and productivity*

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

Soil name and map symbol	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.
[1] CsB2: 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.
Fox: FoA, FoB2, [1] FxC2	2o	Slight	Slight	Slight	Slight	Northern red oak White oak Sugar maple	86 — —	Red pine, eastern white pine, white spruce, Norway spruce, black locust, yellow-poplar, white ash.
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.

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

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Important trees	Site index	
Martinsville: MgA, MgB2	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.
Miami: MmA, MmB2, MmC2, [1]MxD2.	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.
[1]MxE2	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.
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.
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.
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.
Sloan: Sn	2w	Slight	Severe	Severe	Severe	Pin oak Yellow-poplar Sweetgum White oak	85 85 80 75	Eastern white pine, baldcypress, white ash, red maple, yellow-poplar, American sycamore.
Urban land: [1]Ub: Brookston part.	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.
[1]Uc: 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.
[1]UfA, [1]UfC: Fox part	2o	Slight	Slight	Slight	Slight	Northern red oak White oak Sugar maple	86 — —	Red pine, eastern white pine, white spruce, Norway spruce, black locust, yellow-poplar, white ash.

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

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Important trees	Site index	
[1] Ug: Genesee part	1o	Slight	Slight	Slight	Slight	Yellow-poplar	100	Eastern white pine, black walnut, yellow-poplar, black locust.
[1] UmB, [1] UmC: 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.
[1] Uw: Westland part.	2w	Slight	Severe	Severe	Severe	Pin oak Sweetgum White oak	85 90 75	Eastern white pine, baldcypress, Norway spruce, red maple, white ash, sweetgum.
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.

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

The first part of the 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 *w* indicates excessive water in or on the soil and *r*, steep slopes. The letter *o* indicates no significant limitations or restrictions. If a soil has more than one limitation, priority in placing the soil into a limitation class is in the order in which the letters are listed.

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

Ratings of the hazard of erosion 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. The ratings are for seedlings from good planting stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality of the planted seedlings is less than 25 percent; *moderate,* 25 to 50 percent; and *severe,* more than 50 percent.

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 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.

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

Engineering [3]

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

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

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

Based on the information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, risk of corrosion, 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 may 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 (fig. 8) 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 alternate routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternate sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan

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

Figure 8.—**Graded and stabilized drainage ditch in very poorly drained Brookston silty clay loam.**

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-county movement of vehicles and construction equipment.

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

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

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 name and map symbol	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.
[1] CsB2:					
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.
Fox:					
FoA	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: shrink-swell.
FoB2	Severe: cutbanks cave.	Slight	Slight	Moderate: slope	Moderate: shrink-swell.
[1] FxC2	Severe: cutbanks cave.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope, shrink-swell.
Genesee:					
Ge	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods.
Hennepin:					
HeF	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Martinsville:					
MgA	Slight	Slight	Slight	Slight	Moderate: frost action.
MgB2	Slight	Slight	Slight	Moderate: slope	Moderate: frost action.
Miami:					
MmA	Slight	Moderate: shrink-swell, low strength.	Slight	Moderate: shrink-swell, low strength.	Severe: low strength.
MmB2	Slight	Moderate: shrink-swell, low strength.	Slight	Moderate: slope, shrink-swell, low strength.	Severe: low strength.

TABLE 4.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
MmC2	Moderate: slope	Moderate: slope, shrink-swell, low strength.	Moderate: slope	Severe: slope	Severe: low strength.
[1] MxD2, [1] MxE2	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
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.
Rensselaer:					
Re	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness, frost action.
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.
Urban land:					
[1] Ub: Brookston part	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness, frost action.
[1] Uc: Crosby part	Severe: wetness	Moderate: wetness, shrink-swell, low strength.	Severe: wetness	Moderate: wetness, shrink-swell, low strength.	Severe: frost action.
Urban land:					
[1] UfA: Fox part	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: shrink-swell.
[1] UfC: Fox part	Severe: cutbanks cave.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope, shrink-swell.
[1] Ug: Genesee part	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods.
[1] UmB: Miami part	Slight	Moderate: shrink-swell, low strength.	Slight	Moderate: shrink-swell, low strength.	Severe: low strength.
[1] UmC: Miami part	Moderate: slope	Moderate: slope, shrink-swell, low strength.	Moderate: slope	Severe: slope	Severe: low strength.
[1] Uw: Westland part	Severe: wetness	Severe: wetness, floods.	Severe: wetness	Severe: wetness, floods.	Severe: frost action, wetness, floods.
Westland:					
We	Severe: wetness	Severe: wetness, floods.	Severe: wetness	Severe: wetness, floods.	Severe: frost action, wetness, floods.
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 kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 5.—*Sanitary facilities*

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

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for 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.
[1] CsB2:					
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.
Fox:					
FoA, FoB2	Slight	Severe: seepage	Severe: seepage	Slight	Fair: thin layer.
[1] FxC2	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.
Martinsville:					
MgA, MgB2	Slight	Severe: seepage	Severe: seepage	Slight	Good.
Miami:					
MmA	Moderate: percs slowly.	Moderate: seepage	Slight	Slight	Good.
MmB2	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
MmC2	Moderate: percs slowly, slope.	Severe: slope	Slight	Moderate: slope	Fair: slope.
[1] MxD2, [1] MxE2	Severe: slope	Severe: slope	Moderate: slope	Severe: slope	Poor: slope.
Ockley:					
OcA, OcB2	Slight	Severe: seepage	Severe: seepage	Slight	Good.
Rensselaer:					
Re	Severe: wetness, percs slowly.	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness.
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.
Sloan:					
Sn	Severe: wetness, floods, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
Urban land:					
[1] Ub:					
Brookston part	Severe: wetness, percs slowly.	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness.
[1] Uc:					
Crosby part	Severe: percs slowly, wetness.	Slight	Severe: wetness	Moderate: wetness	Fair: too clayey.
[1] UfA:					
Fox part	Slight	Severe: seepage	Severe: seepage	Slight	Fair: thin layer.

TABLE 5.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
[1] UfC: Fox part	Moderate: slope	Severe: seepage, slope.	Severe: seepage	Moderate: slope	Fair: thin layer, slope.
[1] Ug: Genesee part	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Good.
[1] UmB: Miami part	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
[1] UmC: Miami part	Moderate: percs slowly, slope.	Severe: slope	Slight	Moderate: slope	Fair: slope.
[1] Uw: Westland part	Severe: wetness	Severe: seepage, wetness, floods.	Severe: seepage, wetness, floods.	Severe: wetness	Poor: wetness.
Westland: We	Severe: wetness	Severe: seepage, wetness, floods.	Severe: seepage, wetness, floods.	Severe: wetness	Poor: wetness.
Whitaker: Wh	Severe: wetness	Severe: seepage, wetness.	Severe: seepage, wetness.	Moderate: wetness	Good.

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

TABLE 6.—*Water management*

["Seepage" and some of the other terms that describe restrictive soil features are defined in the Glossary]

Soil name and map symbol	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.
[1] CsB2: 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.
Eel: Ee	Seepage	Piping, low strength.	Deep to water	Not needed	Not needed	Not needed.
Fox: FoA, FoB2	Seepage	Low strength, piping.	No water	Not needed	Piping, rooting depth.	Rooting depth.
[1] FxC2	Seepage	Low strength, piping.	No water	Not needed	Piping, rooting depth.	Rooting depth, slope.
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.
Martinsville: MgA	Seepage	Erodes easily	No water	Not needed	Not needed	Favorable.

TABLE 6.—*Water management*—Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
MgB2	Seepage	Erodes easily	No water	Not needed	Slope, erodes easily.	Slope, erodes easily.
Miami:						
MmA	Seepage	Compressible, low strength.	No water	Not needed	Complex slope	Favorable.
MmB2, MmC2, [1] MxD2, [1] MxE2	Seepage	Compressible, low strength.	No water	Not needed	Complex slope	Erodes easily, slope.
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.
Rensselaer:						
Re	Seepage	Compressible, shrink-swell, low strength.	Favorable	Percs slowly, wetness.	Not needed	Not needed.
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.
Urban land:						
[1] Ub: Brookston part.	Favorable	Low strength, piping.	Favorable	Favorable	Not needed	Wetness.
[1] Uc: Crosby part	Favorable	Compressible, low strength, piping.	Slow refill	Percs slowly, wetness.	Wetness	Wetness.
[1] UfA: Fox part	Seepage	Low strength, piping.	No water	Not needed	Piping, rooting depth.	Rooting depth.
[1] UfC: Fox part	Seepage	Low strength, piping.	No water	Not needed	Piping, rooting depth.	Rooting depth, slope.
[1] Ug: Genesee part.	Seepage	Piping, low strength, erodes easily.	Deep to water	Not needed	Not needed	Not needed.
[1] UmB: Miami part	Seepage	Compressible, low strength.	No water	Not needed	Complex slope	Erodes easily, slope.
[1] UmC: Miami part	Seepage	Compressible, low strength.	No water	Not needed	Complex slope	Erodes easily, slope.
Urban land:						
[1] Uw: Westland part.	Seepage	Favorable	Favorable	Cutbanks cave	Not needed	Not needed.
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 kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 7.—*Construction materials*

["Shrink-swell" 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 name and map symbol	Roadfill	Sand	Gravel	Topsoil
Brookston: Br	Poor: wetness, frost action	Unsuited	Unsuited	Poor: wetness.
Crosby: CrA	Poor: frost action	Unsuited	Unsuited	Fair: thin layer.
[1] CsB2: 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.
Fox: FoA, FoB2, [1] FxC2	Fair: low strength, frost action.	Good	Fair: excess fines	Fair: thin layer.
Genesee: Ge	Fair: frost action, low strength.	Unsuited	Unsuited	Good.
Hennepin: HeF	Poor: slope	Unsuited	Unsuited	Poor: slope, area reclaim.
Martinsville: MgA, MgB2	Fair: frost action, shrink-swell, low strength.	Unsuited	Unsuited	Fair: thin layer.
Miami: MmA, MmB2	Fair: frost action, low strength.	Unsuited	Unsuited	Fair: thin layer.
MmC2	Fair: frost action, low strength.	Unsuited	Unsuited	Fair: thin layer, slope.
[1] MxD2, [1] MxE2	Fair: frost action, low strength, slope.	Unsuited	Unsuited	Poor: slope.
Ockley: OcA, OcB2	Fair: frost action, low strength.	Good	Good	Fair: thin layer.
Rensselaer: Re	Poor: wetness, frost action.	Unsuited	Unsuited	Poor: wetness.
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.
Urban land: [1] Ub: Brookston part	Poor: wetness, frost action.	Unsuited	Unsuited	Poor: wetness.
[1] Uc: Crosby part	Poor: frost action	Unsuited	Unsuited	Fair: thin layer.
[1] UfA: Fox part	Fair: low strength, frost action.	Good	Fair: excess fines	Fair: thin layer.
[1] UfC: Fox part	Fair: low strength, frost action.	Good	Fair: excess fines	Fair: thin layer.

TABLE 7.—*Construction materials*—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
[1] Ug: Genesee part	Fair: frost action, low strength.	Unsuited	Unsuited	Good.
[1] UmB: Miami part	Fair: frost action, low strength.	Unsuited	Unsuited	Fair: thin layer.
[1] UmC: Miami part	Fair: frost action, low strength.	Unsuited	Unsuited	Fair: thin layer, slope.
[1] Uw: Westland part	Poor: frost action, wetness	Good	Good	Poor: wetness.
Westland: We	Poor: frost action, wetness	Good	Good	Poor: wetness.
Whitaker: Wh	Poor: frost action	Unsuited	Unsuited	Good.

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

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 different meanings in soil science and in engineering. The Glossary defines many of these terms.

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 specified use; any limitation is minor and is 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 so unfavorable or so 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, and open ditches. Such digging or trenching is influenced by soil wetness caused by a seasonal high 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 of large stones. In addition, excavations are affected by slope of the soil and by 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 more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence from settling or shear failure of the foundation 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, the slope, and the large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious limitation.

Local roads and streets referred to in table 4 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The AASHTO and Unified classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action indicate 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 deal with the 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 these uses and for use of the soil as daily cover for landfills.

If the degree of soil limitation is indicated by the rating *slight*, soils are favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are 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 so difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required.

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 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 the absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and a shallow depth to bedrock interfere with installation. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas. Also, soil erosion and soil slippage are hazards where absorption fields are installed in sloping soils.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and as a result ground water supplies in the area may be contaminated.

Percolation tests are performed to determine the absorptive capacity of the soil and its suitability for septic tank absorption fields. These tests should be performed during the season when the water table is highest and the soil is at minimum absorptive capacity.

In many of the soils that have moderate or severe limitations for septic tank absorption fields, it may be possible to install special systems that lower the seasonal water table or it may be possible to increase the size of the absorption field so that satisfactory performance is achieved.

Sewage lagoons are shallow ponds constructed to hold sewage while bacteria decompose the solid and liquid wastes. Lagoons have a nearly level flow area surrounded by cut slopes or embankments of compacted, nearly impervious soil material. They generally are designed so that depth of the sewage is 2 to 5 feet. Impervious soil at least 4 feet thick for the lagoon floor and sides is required to minimize seepage and contamination of local ground water. Soils that are very high in organic matter and those that have stones and boulders are undesirable. Unless the soil has very slow permeability, contamination of local ground water is a hazard in areas 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 its capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the location of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soils affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste, either in excavated trenches or on the surface of the soil. The waste is spread, compacted in layers, and covered with thin layers of soil. Landfill areas are subject to heavy vehicular traffic. Ease of excavation, risk of polluting ground water, and trafficability affect the suitability of a soil for this purpose. The best soils have a loamy or silty texture, have moderate or slow permeability, are deep to bedrock and a seasonal water table, are free of large stones and boulders, and are not subject to flooding. In areas where the seasonal water table is high, water seeps into the trenches and causes problems in excavating and filling the trenches. Also, seepage into the refuse increases the risk of pollution of ground water. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability that might allow noxious liquids to contaminate local ground water.

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

In the area type of sanitary landfill, refuse is placed on the surface of the soil in successive layers. The limitations caused by soil texture, depth to bedrock, and stone content do not apply to this type of landfill. Soil wetness, however, may be a limitation because of difficulty in operating equipment.

Daily cover for sanitary landfill should be soil that is easy to excavate and spread over the compacted fill during both wet and dry weather. 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.

In addition to these features, the soils selected for final cover of landfill should be suitable for growing plants. In comparison with other horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

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

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 6 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 suitable for this use have low seepage potential, which is determined by the permeability and the depth over fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and is of favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

An *aquifer-fed excavated pond* is a body of water created 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 6 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, structure, depth to claypan or other layers that influence 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.

Terraces and diversions are embankments, or a combination of channels and ridges, constructed across a slope to intercept runoff and allow the water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity of slope and steepness, depth to bedrock or other unfavorable material, permeability, ease of establishing vegetation, and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff at nonerosive velocities to outlets. Features that affect the use of soils for waterways are slope, permeability, erodibility, and suitability for permanent vegetation.

Construction material

The suitability for each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 7 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 material. Each soil is evaluated to the depth observed, generally about 6 feet, and is described as the survey is made.

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

The ratings apply to the soil profile between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within the profile. The estimated engineering properties in table 10 provide more specific information about the nature of each horizon that can help determine its suitability for roadfill.

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

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 7 provide guidance in 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 the 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 table 10.

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 sustain the growth of plants. Also considered is the damage that would result in the area from which the topsoil is taken.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones, are low in content of gravel and other coarse fragments, and have gentle slopes. They are low in soluble salts, which can limit plant growth. They are naturally fertile or respond well to fertilization. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy 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 salts.

Soils rated *poor* are very sandy soils and very firm clayey soils, soils with suitable layers less than 8 inches thick, soils having large amounts of gravel, stones or soluble salts, 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 much 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. Consequently, careful preservation and use of material from these horizons are desirable.

Recreation

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but im-

TABLE 8.—*Recreational development*

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

Soil name and map symbol	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.
[1] CsB2:				
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.
Fox:				
FoA	Slight	Slight	Slight	Slight.
FoB2	Slight	Slight	Moderate: slope	Slight.
[1] FxC2:				
Fox loam part	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Fox clay loam part.	Moderate: too clayey, slope.	Moderate: slope	Severe: slope	Moderate: too clayey.
Genesee:				
Ge	Severe: floods	Moderate: floods	Severe: floods	Moderate: floods.
Hennepin:				
HeF	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Martinsville:				
MgA	Slight	Slight	Slight	Slight.
MgB2	Slight	Slight	Moderate: slope	Slight.
Miami:				
MmA	Slight	Slight	Slight	Slight.
MmB2	Slight	Slight	Moderate: slope	Slight.
MmC2	Moderate: slope	Moderate: slope	Severe: slope	Slight.
[1] MxD2, [1] MxE2:				
Miami silt loam part.	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
Miami clay loam part.	Severe: slope	Severe: slope	Severe: slope	Moderate: too clayey, slope.
Ockley:				
OcA	Slight	Slight	Slight	Slight.
OcB2	Slight	Slight	Moderate: slope	Slight.
Rensselaer:				
Re	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.

TABLE 8.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
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.
Urban land:				
[1] Ub: Brookston part	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
[1] Uc: Crosby part	Moderate: wetness, percs slowly.	Moderate: wetness	Moderate: wetness, percs slowly.	Moderate: wetness.
[1] UfA: Fox part	Slight	Slight	Slight	Slight.
[1] UfC: Fox part	Moderate: slope	Moderate: slope	Severe: slope	Slight.
[1] Ug: Genesee part	Severe: floods	Moderate: floods	Severe: floods	Moderate: floods.
[1] UmB: Miami part	Slight	Slight	Moderate: slope	Slight.
[1] UmC: Miami part	Moderate: slope	Moderate: slope	Severe: slope	Slight.
[1] Uw: Westland part	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Westland: We	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Whitaker: Wh	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness.

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

portant in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreational use by the duration of flooding and the season when it occurs. Onsite assessment of the height, duration, and frequency of flooding is essential in planning recreational facilities.

In table 8 the limitations of soils are rated as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, or limited use, or by a combination of these measures.

The information in table 8 can be supplemented by additional 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 tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet 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 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 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 rock should be sufficient to allow necessary grading.

The design and layout of paths and trails for walking, horseback riding, and bicycling 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 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 development of water impoundments. 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, inadequate, or inaccessible, wildlife will either be scarce or will not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by properly managing the existing plant cover, and by fostering 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—

1. Planning the use of parks, wildlife refuges, nature study areas, and other developments for wildlife.
2. Selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat.

[4] JAMES D. MCCALL, wildlife biologist, Soil Conservation Service, helped prepare this section.

TABLE 9.—*Wildlife habitat potentials*

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

Soil name and map symbol	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.
[1] CsB2:										
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.
Fox:										
FoA, FoB2	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
[1] FxC2	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.
Martinsville:										
MgA, MgB2	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Miami:										
MmA, MmB2	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MmC2	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
[1] MxD2, [1] MxE2	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

TABLE 9.—*Wildlife habitat potentials*—Continued

Soil name and map symbol	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
Ockley: OcA, OcB2	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Rensselaer: Re	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
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.
Urban land:										
[1] Ub: Brookston part	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
[1] Uc: Crosby part	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
[1] UfA: Fox part	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
[1] UfC: Fox part	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
[1] Ug: Genesee part	Poor	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
[1] UmB: Miami part	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
[1] UmC: Miami part	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
[1] Uw: Westland part	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
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 kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

3. Determining the intensity of management needed for each element of the habitat.
4. Determining areas that are suitable for acquisition to manage for wildlife.

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

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

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

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

Wild herbaceous plants are native or naturally established herbaceous grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are ragweed, bristlegrass, goldenrod, beggarweed, pokeweed, lambsquarter, partridgepea, panicgrass, knotweed lespedeza, and bluegrass. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Examples of native plants are oak, hickory, beech, maple, poplar, wild cherry, sweetgum, black gum, basswood, hawthorn, dogwood, sumac, hazelnut, black walnut, blackberry, grape, blackhaw, viburnum, and briers. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated good are dogwood, autumn-olive, viburnum, and crabapple. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness.

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

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

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

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

Openland habitat consists of croplands, pastures, 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 are bobwhite quail, pheasant, meadowlark, field sparrow, killdeer, cottontail rabbit, red fox, and woodchuck.

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

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

Information, assistance, and guidance in the planning of wildlife and nature areas can be obtained from the local county office of the Soil Conservation Service.

Soil Properties

Extensive data about soil properties collected during the soil survey 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 samples selected from representative soil profiles in the field.

When he makes soil borings during field mapping, the soil scientist can identify several important soil properties. He notes the seasonal soil moisture condition, or the presence of free water and its depth in the profile. For each horizon, he notes the thickness of the soil and its color; the texture, or the amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or natural pattern of cracks and pores in the undisturbed soil; and the consistence of soil in-place under the existing soil moisture conditions. He records the root depth of plants, determines soil pH, or reaction, and identifies any free carbonates.

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

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

Engineering properties

Table 10 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area. These estimates are presented as ranges in values most likely to exist in areas where the soil is mapped.

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

Texture is described in table 10 in standard terms

TABLE 10.—*Engineering properties and classifications*

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				*Pct*					*Pct*	
Brookston: Br	0–14	Silty clay loam	CL	A-6, A-7	0	100	98–100	95–100	75–95	36–48	15–20
	14–54	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0	98–100	96–100	85–95	75–85	36–52	18–30
	54–60	Loam	CL	A-4, A-6	0–3	90–100	85–95	78–90	55–70	22–30	7–15
Crosby: CrA	0–9	Silt loam	CL, CL–ML	A-4, A-6	0	100	95–100	80–100	50–90	22–34	6–15
	9–27	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0–3	92–99	89–97	78–93	64–76	37–55	17–31
	27–60	Loam	CL, ML, CL–ML	A-4, A-6	0–3	88–94	83–89	74–87	50–64	17–30	2–14
[1] CsB2: Crosby part.	0–9	Silt loam	CL, CL–ML	A-4, A-6	0	100	95–100	80–100	50–90	22–34	6–15
	9–27	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0–3	92–99	89–97	78–93	64–76	37–55	17–31
	27–60	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	0–8	Silt loam	CL, CL–ML	A-4, A-6	0	100	95–100	80–100	50–90	22–34	6–15
	8–32	Clay loam, silty clay loam.	CL	A-6, A-7	0	92–99	89–97	78–95	64–95	37–50	17–31
	32–60	Loam	CL, CL–ML	A-4, A-6	0–3	85–95	80–90	75–90	40–60	15–30	2–14
Eel: Ee	0–9	Silt loam	ML, CL	A-4, A-6	0	100	100	90–100	75–85	26–40	5–15
	9–25	Silt loam, loam	ML, CL	A-4, A-6	0	100	100	90–100	75–85	26–40	5–15
	25–60	Stratified sandy loam to silty clay loam.	ML, CL	A-4, A-6	0	100	90–100	70–80	55–70	26–40	5–15
Fox: FoA, FoB2	0–8	Loam	ML	A-4	0	95–100	85–100	75–95	55–90	20–30	2–4
	8–24	Silty clay loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	85–100	75–100	70–95	55–90	25–45	10–25
	24–38	Gravelly clay loam, clay loam, sandy clay loam.	CL, SC	A-6, A-2-6, A-7	0	85–100	75–95	50–95	20–65	25–45	10–25
	38–60	Gravelly sand, sand.	SP, SM, GP, GM	A-1, A-2, A-3	0–5	40–100	35–100	15–95	2–15	—	NP
Fox: [1] FxC2: Fox loam part.	0–8	Loam	ML	A-4	0	95–100	85–100	75–95	55–90	20–30	2–4
	8–24	Silty clay loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	85–100	75–100	70–95	55–90	25–45	10–25
	24–38	Gravelly clay loam, clay loam, sandy clay loam.	CL, SC	A-6, A-2-6, A-7	0	85–100	75–95	50–95	20–65	25–45	10–25
	38–60	Gravelly sand, sand.	SP, SM, GP, GM	A-1, A-2, A-3	0–5	40–100	35–100	15–95	2–15	—	NP

TABLE 10.—*Engineering properties and classifications*—Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				*Pct*					*Pct*	
Fox clay loam part.	0–8	Clay loam	CL	A–6	0	90–100	75–100	75–95	60–80	20–40	10–20
	8–16	Silty clay loam, clay loam, sandy clay loam.	CL	A–6, A–7	0	85–100	75–100	70–95	55–90	25–45	10–25
	16–30	Gravelly clay loam, clay loam, sandy clay loam.	CL, SC	A–6, A–2–6, A–7	0	85–100	75–95	50–95	20–65	25–45	10–25
	30–60	Gravelly sand, sand.	SP, SM, GP, GM	A–1, A–2, A–3	0–5	40–100	35–100	15–95	2–15	—	NP
Genessee: Ge	0–6	Silt loam	ML, CL	A–4, A–6	0	100	100	90–100	75–85	26–40	5–15
	6–34	Silt loam, loam	ML, CL	A–4, A–6	0	100	100	90–100	75–85	26–40	5–15
	34–60	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	0–3	Loam	CL, CL–ML	A–4, A–6	0–5	90–100	85–100	70–100	60–95	25–40	5–20
	3–14	Loam	CL, CL–ML	A–4, A–6, A–7	0–5	85–100	80–100	65–100	50–95	20–50	5–25
	14–60	Loam	CL, CL–ML	A–4, A–6, A–7	0–5	85–100	80–100	65–100	50–95	20–50	5–25
Martinsville: MgA, MgB2	0–10	Silt loam	CL, CL–ML	A–4, A 6	0	100	95–100	80–100	60–90	22–33	4–12
	10–37	Clay loam, silty clay loam.	CL	A–4, A 6	0	100	95–100	65–90	50–90	20–35	8–17
	37–50	Sandy loam, sandy clay loam.	ML, SM	A–4, A 6	0	100	95–100	60–70	30–40	40–55	2–12
	50–60	Stratified sand to sandy clay loam.	CL, SC, CL–ML	A–4	0	95–100	90–100	80–95	40–60	5–21	4–9
Miami: MmA, MmB2, MmC2.	0–8	Silt loam	CL, CL–ML	A–4, A–6	0	100	95–100	80–100	50–90	22–34	6–15
	8–32	Clay loam, silty clay loam.	CL	A–6, A–7	0	92–99	89–97	78–95	64–95	37–50	17–31
	32–60	Loam	CL, CL–ML, SC	A–4, A–6	0	85–95	80–90	75–90	40–60	15–30	2–12
[1] MxD2, [1] MxE2: Miami silt loam part.	0–8	Silt loam	CL, CL–ML	A–4, A–6	0	100	95–100	80–100	50–90	22–34	6–15
	8–32	Clay loam, silty clay loam.	CL	A–6, A–7	0	92–99	89–97	78–95	64–95	37–50	17–31
	32–60	Loam	CL, CL–ML, SC	A–4, A–6	0	85–95	80–90	75–90	40–60	15–30	2–12
Miami clay loam part.	0–8	Clay loam	CL	A–6, A–7	0	100	90–100	75–95	65–95	30–45	15–25
	8–24	Clay loam, silty clay loam.	CL	A–6, A–7	0	92–99	89–97	78–95	64–95	37–50	17–31
	24–60	Loam	CL, CL–ML	A–4, A–6	0–3	88–94	83–89	74–87	50–64	17–30	2–14
Ockley: OcA, OcB2	0–9	Silt loam	CL, ML	A–4, A–6	0	100	95–100	80–100	60–90	22–33	4–12
	9–27	Silty clay loam, clay loam.	CL	A–6, A–4	0	100	75–100	65–90	50–90	20–35	8–17
	27–56	Gravelly clay loam, gravelly sandy clay loam.	CL, SC	A–6, A–7	0–2	70–85	45–75	40–70	35–55	30–45	11–25
	56–60	Stratified sand to gravelly sand.	SP, SP–SM, GP, GP–GM	A–1	1–5	30–70	20–55	5–20	2–10	—	NP
Rensselaer: Re	0–15	Clay loam	CL	A–4, A–6	0	100	100	90–100	70–90	27–36	10–20
	15–36	Clay loam	CL	A–6, A–7	0	100	100	90–100	70–80	33–47	15–26
	36–60	Stratified fine sand to clay loam.	CL, SC, CL–ML	A–4	0	98–100	98–100	94–100	40–60	<30	4–9

TABLE 10.—*Engineering properties and classifications*—Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number— 4	10	40	200	Liquid limit	Plasticity index
	In				*Pct*					*Pct*	
Shoals:											
Sh	0–10	Silt loam	ML, CL	A-4, A-6	0	100	100	90–100	65–90	22–36	6–15
	10–60	Stratified silt loam to loamy sand.	ML	A-4	0–3	95–100	90–100	70–80	55–70	32–40	3–8
Sleeth:											
Sk	0–11	Loam	CL, ML	A-4, A-6	0	100	90–100	75–95	50–85	22–30	4–12
	11–20	Clay loam, silty clay loam.	CL	A-6	0	85–95	85–95	80–90	65–75	30–40	20–30
	20–54	Gravelly clay loam, gravelly sandy clay loam, gravelly loam.	CL	A-6	0–3	65–75	60–70	55–70	50–70	30–40	20–30
	54–60	Stratified sand to gravelly sand.	SP, GP, SP-SM	A-1	1–5	30–70	22–55	7–20	2–10	—	NP
Sloan:											
Sn	0–8	Silt loam	CL, ML	A-6, A-4, A-7	0	100	95–100	85–100	70–95	30–50	8–15
	8–45	Silty clay loam, clay loam, silt loam.	CL, ML	A-6, A-7, A-4	0	100	90–100	85–100	75–95	30–45	8–18
	45–60	Stratified sand to loamy sand.	SP-SM, SM	A-1, A-3	0	95–100	80–100	40–75	5–20	—	NP
Urban land:											
[1] Ub: Brookston part.	0–14	Silty clay loam	CL	A-6, A-7	0	100	98–100	95–100	75–95	36–48	15–20
	14–54	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0	98–100	96–100	85–95	75–85	36–52	18–30
	54–60	Loam	CL	A-4, A-6	0–3	90–100	85–95	78–90	55–70	22–30	7–15
[1] Uc: Crosby part	0–9	Silt loam	CL, CL-ML	A-4, A-6	0	100	95–100	80–100	50–90	22–34	6–15
	9–27	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0–3	92–99	89–97	78–93	64–76	37–55	17–31
	27–60	Loam	CL, ML, CL-ML	A-4, A-6	0–3	88–94	83–89	74–87	50–64	17–30	2–14
[1] UfA: Fox part	0–8	Loam	ML	A-4	0	95–100	85–100	75–95	55–90	20–30	2–4
	8–24	Silty clay loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	85–100	75–100	70–95	55–90	25–45	10–25
	24–38	Gravelly clay loam, clay loam, sandy clay loam.	CL, SC	A-6, A-2-6, A-7	0	85–100	75–95	50–95	20–65	25–45	10–25
	38–60	Gravelly sand, sand.	SP, SM, GP, GM	A-1, A-2, A-3	0–5	40–100	35–100	15–95	2–15	—	NP
[1] UfC: Fox part	0–8	Loam	ML	A-4	0	95–100	85–100	75–95	55–90	20–30	2–4
	8–24	Silty clay loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	85–100	75–100	70–95	55–90	25–45	10–25
	24–38	Clay loam, gravelly clay loam, sandy clay loam.	CL, SC	A-6, A-2-6, A-7	0	85–100	75–95	50–95	20–65	25–45	10–25
	38–60	Gravelly sand, sand.	SP, SM, GP, GM	A-1, A-2, A-3	0–5	40–100	35–100	15–95	2–15	—	NP
[1] Ug: Genesee part.	0–6	Silt loam	ML, CL	A-4, A-6	0	100	100	90–100	75–85	26–40	5–15
	6–34	Silt loam, loam	ML, CL	A-4, A-6	0	100	100	90–100	75–85	26–40	5–15
	34–60	Stratified sandy loam to silt loam.	ML, CL	A-4, A-6	0	100	90–100	70–80	50–70	26–40	5–15
[1] UmB: Miami part	0–8	Silt loam	CL, CL-ML	A-4, A-6	0	100	95–100	80–100	50–90	22–34	6–15
	8–32	Clay loam, silty clay loam.	CL	A-6, A-7	0	92–99	89–97	78–95	64–95	37–50	17–31
	32–60	Loam	CL, CL-ML, SC	A-4, A-6	0–3	85–95	80–90	75–90	40–65	15–30	2–14

TABLE 10.—*Engineering properties and classifications*—Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				*Pct*					*Pct*	
[1] UmC: Miami part	0–8	Silt loam	CL, CL–ML	A–4, A–6	0	100	95–100	80–100	50–90	22–34	6–15
	8–32	Clay loam, silty clay loam.	CL	A–6, A–7	0	92–99	89–97	78–95	64–95	37–50	17–31
	32–60	Loam	CL, CL–ML, SC	A–4, A–6	0–3	85–95	80–90	75–90	40–65	15–30	2–14
[1] Uw: Westland part.	0–12	Clay loam	CL	A–6	0	95–100	90–100	85–95	65–75	27–38	11–20
	12–42	Clay loam, sandy clay loam.	CL	A–6	0	95–100	90–100	80–90	65–75	30–40	20–30
	42–60	Stratified gravelly sandy loam to gravelly sand.	SP, GP, SP–SM	A–1	1–5	30–70	22–55	7–20	2–10	—	NP
Westland: We	0–12	Clay loam	CL	A–6	0	95–100	90–100	85–95	65–75	27–38	11–20
	12–42	Clay loam, sandy clay loam.	CL	A–6	0	95–100	90–100	80–90	65–75	30–40	20–30
	42–60	Stratified gravelly sandy loam to gravelly sand.	SP, GP, SP–SM	A–1	1–5	30–70	22–55	7–20	2–10	—	NP
Whitaker: Wh	0–9	Silt loam	CL, CL–ML	A–4, A–6	0	100	95–100	80–100	60–90	22–33	4–12
	9–58	Clay loam, loam, silt loam.	CL	A–6, A–7	0	100	95–100	90–100	70–80	30–47	12–26
	58–60	Stratified loamy sand to silty clay loam.	CL, SC, ML, SM	A–4	0	98–100	98–100	94–100	40–60	21	4–9

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

used by the United States 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 used by USDA are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (USCS) (*2*) and the American Association of State Highway and Transportation Officials Soil Classification System (AASHTO) (*1*). In table 10 soils in the survey area are classified according to both systems.

The USCS 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 as one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse-grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified as A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or more for the poorest. The estimated AASHTO classification, without group index numbers, is given in table 10. Also in table 10 the percentage, by weight, of cobbles or the rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined largely by observing volume percentage in the field and then converting it, by formula, to weight percentage.

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

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

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

Physical and chemical properties

Table 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 representative profile of each soil. The estimates are

TABLE 11.—*Physical and chemical properties of soils*

[Dashes indicate data were not available. The symbol < means less than; > means greater than. The erosion tolerance factor (T) is for the entire profile. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	*In/hr*	*In/in*	*pH*						
Brookston: Br	0–14	0.6–2.0	0.21–0.24	6.6–7.3	Moderate	High	Low			7
	14–54	0.6–2.0	0.15–0.19	6.6–7.3	Moderate	High	Low			
	54–60	0.2–0.6	0.05–0.19	7.4–8.4	Moderate	High	Low			
Crosby: CrA	0–9	0.6–2.0	0.20–0.24	5.1–6.5	Low	High	Moderate	0.37	3–2	5
	9–27	0.06–0.2	0.15–0.20	5.1–7.3	Moderate	High	Moderate	0.37		
	27–60	0.06–0.6	0.05–0.19	7.9–8.4	Low	High	Low	0.37		
[1] CsB2: Crosby part	0–9	0.6–2.0	0.20–0.24	5.1–6.5	Low	High	Moderate	0.37	3–2	5
	9–27	0.06–0.2	0.15–0.20	5.1–7.3	Moderate	High	Moderate	0.37		
	27–60	0.06–0.6	0.05–0.19	7.9–8.4	Low	High	Low	0.37		
Miami part	0–8	0.6–2.0	0.20–0.24	5.6–7.3	Low	Low	Moderate	0.37	5–4	5
	8–32	0.6–2.0	0.15–0.20	5.6–6.0	Moderate	Moderate	Moderate	0.37		
	32–60	0.2–2.0	0.05–0.19	6.6–8.4	Low	Low	Low	0.32		
Eel: Ee	0–9	0.6–2.0	0.20–0.24	6.6–7.3	Low	Moderate	Low			5
	9–25	0.6–2.0	0.17–0.22	6.6–7.8	Low	Moderate	Low			
	25–60	0.6–2.0	0.19–0.21	7.4–7.8	Low	Moderate	Low			
Fox: FoA, FoB2	0–8	0.6–2.0	0.20–0.22	5.1–6.5	Low	Low	Moderate	0.32	3–2	6
	8–24	0.6–2.0	0.18–0.20	5.1–6.0	Moderate	Low	Moderate	0.32		
	24–38	0.6–2.0	0.12–0.14	6.1–7.8	Moderate	Low	Moderate	0.32		
	38–60	>6.0	0.02–0.04	7.9–8.4	Low	Low	Low	0.10		
[1] FxC2: Fox loam part	0–8	0.6–2.0	0.20–0.22	5.1–6.5	Low	Low	Moderate	0.32	3–2	6
	8–24	0.6–2.0	0.18–0.20	5.1–6.0	Moderate	Low	Moderate	0.32		
	24–38	0.6–2.0	0.12–0.14	6.1–7.8	Moderate	Low	Moderate	0.32		
	38–60	>6.0	0.02–0.04	7.9–8.4	Low	Low	Low	0.10		
Fox clay loam part	0–8	0.6–2.0	0.17–0.19	5.1–6.5	Moderate	Low	Moderate	0.32	3–2	6
	8–16	0.6–2.0	0.18–0.20	5.1–6.0	Moderate	Low	Moderate	0.32		
	16–30	0.6–2.0	0.12–0.14	6.1–7.8	Moderate	Low	Moderate	0.32		
	30–60	>6.0	0.02–0.04	7.9–8.4	Low	Low	Low	0.10		
Genesee: Ge	0–8	0.6–2.0	0.20–0.24	6.1–7.8	Low	Low	Low			5
	8–34	0.6–2.0	0.17–0.22	6.1–8.4	Low	Low	Low			
	34–60	0.6–2.0	0.19–0.21	7.4–8.4	Low	Low	Low			
Hennepin: HeF	0–3	0.6–2.0	0.18–0.24	6.1–7.8	Low	Low	Low	0.32	5–4	5
	3–14	0.2–2.0	0.14–0.22	6.1–7.8	Low	Low	Low	0.32		
	14–60	0.2–2.0	0.07–0.11	6.1–8.4	Low	Low	Low	0.32		
Martinsville: MgA, MgB2	0–10	0.6–2.0	0.20–0.24	5.6–7.3	Low	Moderate	Moderate	0.37	4–3	5
	10–24	0.6–2.0	0.17–0.20	5.1–6.0	Moderate	Moderate	Moderate	0.37		
	24–50	0.6–2.0	0.12–0.14	5.6–6.5	Low	Low	Moderate	0.24		
	50–60	2.0–6.0	0.19–0.21	7.4–8.4	Low	Low	Low	0.24		
Miami: MmA, MmB2, MmC2	0–8	0.6–2.0	0.20–0.24	5.6–7.3	Low	Low	Moderate	0.37	5–4	5
	8–32	0.6–2.0	0.15–0.20	5.6–6.0	Moderate	Moderate	Moderate	0.37		
	32–60	0.2–2.0	0.05–0.19	6.6–8.4	Low	Low	Low	0.32		
[1] MxD2, [1] MxE2: Miami silt loam part	0–8	0.6–2.0	0.20–0.24	5.6–7.3	Low	Low	Moderate	0.37	5–4	5
	8–32	0.6–2.0	0.15–0.20	5.6–6.0	Moderate	Moderate	Moderate	0.37		
	32–60	0.2–2.0	0.05–0.19	6.6–8.4	Low	Low	Low	0.32		

TABLE 11.—*Physical and chemical properties of soils*—Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	*In/hr*	*In/in*	*pH*						
Miami clay loam part	0–8	0.6–2.0	0.18–0.20	5.6–7.3	Moderate	Moderate	Moderate	0.37	4	6
	8–24	0.6–2.0	0.15–0.20	5.6–6.0	Moderate	Moderate	Moderate	0.37		
	24–60	0.2–2.0	0.05–0.19	6.6–8.4	Low	Low	Low	0.37		
Ockley:										
OcA, OcB2	0–9	0.6–2.0	0.20–0.24	5.6–6.5	Low	Low	Moderate	0.37	4	5
	9–27	0.6–2.0	0.15–0.20	4.5–6.0	Moderate	Moderate	Moderate	0.37		
	27–56	0.6–2.0	0.12–0.14	5.6–6.5	Moderate	Moderate	Moderate	0.24		
	56–60	>20	0.02–0.04	7.4–8.4	Low	Low	Low	0.10		
Rensselaer:										
Re	0–15	0.2–0.6	0.20–0.24	6.6–7.3	Low	High	Low			5
	15–36	0.06–0.2	0.15–0.19	6.6–7.3	Moderate	High	Low			
	36–60	0.6–2.0	0.19–0.21	7.9–8.4	Low	High	Low			
Shoals:										
Sh	0–10	0.6–2.0	0.22–0.24	6.6–7.3	Low	High	Low			5
	10–35	0.6–2.0	0.20–0.22	6.6–7.3	Low	High	Low			
	35–60	0.6–2.0	0.19–0.21	6.6–7.3	Low	High	Low			
Sleeth:										
Sk	0–11	0.6–2.0	0.20–0.24	6.6–7.3	Low	High	Low			5
	11–20	0.6–2.0	0.15–0.19	5.6–6.5	Moderate	High	Low			
	20–54	0.6–2.0	0.14–0.16	6.6–8.4	Moderate	High	Low			
	54–60	>20	0.02–0.04	7.9–8.4	Low	Low	Low			
Sloan:										
Sn	0–8	0.6–2.0	0.20–0.24	6.1–7.8	Moderate	High	Low			
	8–45	0.2–2.0	0.15–0.19	6.1–7.8	Moderate	High	Low			
	45–60	0.2–2.0	0.16–0.20	6.6–7.8	Low	High	Low			
Urban land:										
[1] Ub:										
Brookston part	0–14	0.6–2.0	0.21–0.24	6.6–7.3	Moderate	High	Low			7
	14–54	0.6–2.0	0.15–0.19	6.6–7.3	Moderate	High	Low			
	54–60	0.2–0.6	0.05–0.19	7.4–8.4	Moderate	High	Low			
[1] Uc:										
Crosby part:	0–9	0.6–2.0	0.20–0.24	5.1–6.5	Low	High	Moderate	0.37	3–2	5
	9–27	0.06–0.2	0.15–0.20	5.1–7.3	Moderate	High	Moderate	0.37		
	27–60	0.06–0.6	0.05–0.19	7.9–8.4	Low	High	Low	0.37		
[1] UfA:										
Fox part	0–8	0.6–2.0	0.20–0.22	5.1–6.5	Low	Low	Moderate	0.32	3–2	6
	8–24	0.6–2.0	0.18–0.20	5.1–6.0	Moderate	Low	Moderate	0.32		
	24–38	0.6–2.0	0.12–0.14	6.1–7.8	Moderate	Low	Moderate	0.32		
	38–60	>6.0	0.02–0.04	7.9–8.4	Low	Low	Low	0.10		
[1] UfC:										
Fox part	0–8	0.6–2.0	0.20–0.22	5.1–6.5	Low	Low	Moderate	0.32	3–2	6
	8–24	0.6–2.0	0.18–0.20	5.1–6.0	Moderate	Low	Moderate	0.32		
	24–38	0.6–2.0	0.12–0.14	6.1–7.8	Moderate	Low	Moderate	0.32		
	38–60	>6.0	0.02–0.04	7.9–8.4	Low	Low	Low	0.10		
[1] Ug:										
Genesee part	0–6	0.6–2.0	0.20–0.24	6.1–7.8	Low	Low	Low			5
	6–34	0.6–2.0	0.17–0.22	6.1–8.4	Low	Low	Low			
	34–60	0.6–2.0	0.19–0.21	7.4–8.4	Low	Low	Low			
[1] UmB:										
Miami part	0–8	0.6–2.0	0.20–0.24	5.6–7.3	Low	Low	Moderate	0.37	5–4	5
	8–32	0.6–2.0	0.15–0.20	5.6–6.0	Moderate	Moderate	Moderate	0.37		
	32–60	0.2–2.0	0.05–0.19	6.6–8.4	Low	Low	Low	0.32		
[1] UmC:										
Miami part	0–8	0.6–2.0	0.20–0.24	5.6–7.3	Low	Low	Moderate	0.37	5–4	5
	8–32	0.6–2.0	0.15–0.20	5.6–6.0	Moderate	Moderate	Moderate	0.37		
	32–60	0.2–2.0	0.05–0.19	6.6–8.4	Low	Low	Low	0.32		
[1] Uw:										
Westland part	0–12	0.6–2.0	0.18–0.21	5.6–7.3	Moderate	High	Low			6
	12–42	0.06–0.2	0.15–0.19	5.6–7.3	Moderate	High	Low			
	42–60	>20	0.02–0.04	7.4–8.4	Low	High	Low			
Westland:										
We	0–12	0.6–2.0	0.18–0.21	5.6–7.3	Moderate	High	Low			6
	12–42	0.06–0.2	0.15–0.19	5.6–7.3	Moderate	High	Low			
	42–60	>20	0.02–0.04	7.4–8.4	Low	High	Low			
Whitaker:										
Wh	0–9	0.6–2.0	0.20–0.24	5.6–7.3	Low	Moderate	Moderate	0.37	5	5
	9–58	0.6–2.0	0.15–0.19	5.1–6.0	Moderate	High	Moderate	0.37		
	58–60	0.6–6.0	0.19–0.21	6.6–8.4	Low	High	Low	0.37		

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

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 water movement in a vertical direction 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 the planning and design of drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

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

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

Risk of corrosion, as used in table 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 rating of soils for corrosivity to concrete is based mainly on the sulfate content, soil texture, and acidity. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely within one kind of soil or within one soil horizon.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion. The soil erodibility factor (K) is a measure of the susceptibility of the soil to water erosion. Soils having the highest K values are the most erodible. In the estimates of annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management, and climate. The soil-loss tolerance factor (T) is the maximum rate, in tons per acre per year, of soil erosion, whether from rainfall or wind, that can occur without reducing crop production or environmental quality.

Wind erodibility groups are made up of soils having the same potential for soil blowing if cultivated. Soils are grouped according to the following distinctions:

1. Sand, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suited to 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 that control soil blowing are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly eridible, but crops can be grown if intensive measures that 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 that control soil blowing are used.

4a. 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 that 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 that control soil blowing are used.
6. Loamy soils, excluding silty clay loams, that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate. 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

Features that relate to runoff or infiltration of water, to flooding, to grading and excavation, and to frost action of each soil are indicated in table 12. This information is helpful in planning land uses and engineering projects that are likely to be affected by the amount of runoff from watersheds, by flooding and a seasonal high water table, or by frost action.

Hydrologic groups are used to estimate runoff after rainfall. Soil properties that influence the minimum rate of infiltration into the bare soil are depth to a water table after prolonged wetting, water intake rate

TABLE 12.—*Soil and water features*

[Absence of an entry indicates the feature is not a concern. The symbol < means less than; > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	
					Ft			
Brookston: Br	B/D	Frequent	Brief	Dec–May	0–1.0	Apparent	Dec–May	High.
Crosby: CrA	C	None			1.0–3.0	Apparent	Jan–Apr	High.
[1] CsB2: Crosby part	C	None			1.0–3.0	Apparent	Jan–Apr	High.
Miami part	B	None			>6.0			Moderate.
Eel: Ee	C	Frequent	Brief	Oct–Jun	3.0–6.0	Apparent	Jan–Apr	High.
Fox: FoA, FoB2, [1] FxC2	B	None			>6.0			Moderate.
Genesee: Ge	B	Frequent	Brief	Oct–Jun	>6.0			Moderate.
Hennepin: HeF	B	None			>6.0			Moderate.
Martinsville: MgA, MgB2	B	None			>6.0			Moderate.
Miami: MmA, MmB2, MmC2, [1] MxD2, MxE2.	B	None			>6.0			Moderate.
Ockley: OcA, OcB2	B	None			>6.0			Moderate.
Rensselaer: Re	B/D	None			0–1.0	Apparent	Dec–May	High.
Shoals: Sh	C	Frequent	Brief	Oct–Jun	1.0–3.0	Apparent	Jan–Apr	High.
Sleeth: Sk	C	None			1.0–3.0	Apparent	Jan–Apr	High.
Sloan: Sn	B/D	Frequent	Long	Oct–Jun	0–0.5	Apparent	Nov–Jun	High.
Urban land: [1] Ub: Brookston part	B/D	Frequent	Brief	Dec–May	0–1.0	Apparent	Dec–May	High.
[1] Uc: Crosby part	C	None			1.0–3.0	Apparent	Jan–Apr	High.
[1] UfA: Fox part	B	None			>6.0			Moderate.
[1] UfC: Fox part	B	None			>6.0			Moderate.
[1] Ug: Genesee part	B	Frequent	Brief	Oct–Jun	>6.0			Moderate.
[1] UmB: Miami part	B	None			>6.0			Moderate.
[1] UmC: Miami part	B	None			>6.0			Moderate.
[1] Uw: Westland part	B/D	Frequent	Brief	Dec–May	0–1.0	Apparent	Dec–May	High.
Westland: We	B/D	Frequent	Brief	Dec–May	0–1.0	Apparent	Dec–May	High.
Whitaker: Wh	C	None			1.0–3.0	Apparent	Jan–Apr	High.

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

and permeability after prolonged wetting, and depth to layers of slowly or very slowly permeable soil.

Flooding is rated in general terms that describe the frequency, duration, and period of the year when flooding is most likely. The ratings are based on evidences 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; absence of distinctive soil horizons that form in soils of the area that are not subject to flooding; local information about floodwater heights and the extent of flooding; and local knowledge that relates the unique landscape position of each soil to historic floods. Most soils in low positions on the landscape where flooding is likely to occur are classified as fluvents at the suborder level or as fluventic subgroups. See the section "Classification of the Soils."

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

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

Information about the 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 to construct basements and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

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 the formation of ice lenses. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Formation and Classification of the Soils

In this section the factors that have affected the formation of soils in Marion County are described. The current system of soil classification is explained, and the soils are placed in the higher categories of the system. The soil series in the county, including a profile representative of each series, are described in the section "Descriptions of the Soils." This section also provides laboratory data pertaining to the physical properties and reaction of selected Marion County soils.

Factors of Soil Formation

Soil forms through soil-forming processes acting on deposited or accumulated geologic material. The characteristics of the soil at any given point 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 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 forms 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. Usually, a long time is required for the formation 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 forms. The parent material of the soils of Marion County was deposited by glaciers or by melt water from the glaciers that covered the county from about 20,000 to 25,000 years ago (*4*). Some of this material was reworked and redeposited by the subsequent action of water and wind. Parent material determines the limits of the chemical and mineralogical composition of the soil. Although the parent material in this county is of common glacial origin, its properties vary greatly, even within small areas, depending on how the material was deposited. The dominant parent material in Marion County is glacial till, glacial outwash, and alluvium.

Glacial till is material laid down directly by glaciers with a minimum of water action. It consists of particles of different sizes that are mixed together. Some small pebbles and even some boulders in glacial till originated from bedrock hundreds of miles from Marion County. The glacial till in Marion County is calcareous and firm. Its texture is loam. Miami soils are examples of soils formed in glacial till. These soils typically are medium textured and have well developed structure.

Outwash material was 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 that carries them. When the water slows down, the coarser particles are deposited. The finer particles, such as very fine sand, silt, and clay, can be carried by slowly moving water. Outwash deposits generally are stratified; that is, they consist of layers of similar-size particles, such as fine sand, sand, and gravelly sand. Ockley soils, for example, formed in deposits of outwash material in Marion County.

Alluvial material was deposited by floodwater of present streams in recent time. This material varies in texture, depending on the speed of the water from which it was deposited. The alluvium deposited along a swift stream, such as the White River, is therefore coarser textured than that deposited along a slow, sluggish stream, such as Little Buck Creek. Examples of alluvial soils are Genesee and Shoals soils.

Plant and animal life

The higher plants have been the principal organisms influencing the soils in Marion County but bacteria, fungi, earthworms, and the activities of man have also been important. The chief contribution of plant and animal life is the addition of organic matter, which contributes nitrogen to the soil. The remains of these plants accumulate on and in the soil, 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 that can be used by growing plants.

The natural vegetation in Marion County was mainly a deciduous forest. Differences in natural soil drainage and minor changes in parent material have affected the composition of the forest species.

In general, the well drained upland soils, such as Miami, supported sugar maple, beech, oak, hickory, and other trees. The wet soils supported water-tolerant trees, such as elm, pin oak, red maple, and willow. A few wet soils were also under water-tolerant grasses and mosses, which contributed substantially to the accumulation of organic matter. Brookston and Rensselaer soils, for example, formed under wet conditions and contain considerable amounts of organic matter. The soils of Marion County that formed dominantly under forest vegetation generally have less accumulated organic matter than the soils that formed dominantly under grass.

Climate

Climate is important in the formation of soils. It determines the kind of plant and animal life on and in the soil. It determines the amount of water available for weathering of minerals and transporting of soil material. Climate, through its influence on temperature in the soil, also determines the rate of chemical reaction that occurs in the soil.

Marion County has a continental humid climate. This climate is presumably similar to that which existed when the soils formed. The soils in Marion County differ from the soils that formed in a dry, warm climate and from those that formed in a hot, moist climate. Climate is uniform throughout the county, but its effect is modified locally by runoff. Therefore, the differences in the soils of Marion County are only to a minor extent the result of differences 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 Marion County through its influence on natural drainage, erosion, plant cover, and soil temperature. In Marion County, slopes range from 0 to more than 50 percent. Natural soil drainage ranges from well drained on slopes and ridgetops to very poorly drained in depressions.

Relief influences the formation of soils by affecting runoff and natural drainage. Drainage, in turn, through its effect on aeration of the soil, determines the color of the soil. Runoff is most rapid on the steeper slopes; in low areas, water is temporarily ponded. Water and air move freely through soils that are well drained. In poorly drained soils, the water table is seasonally near the soil surface, restricting air movement. In soils that are well aerated, the iron compounds that give most soils their color are oxidized and brightly colored, and in poorly aerated soils the compounds are dull gray and mottled. Martinsville soils are examples of well drained, well aerated soils, and Rensselaer soils are examples of poorly aerated, very poorly drained soils. Intermediate between the very poorly drained and well drained soils are the poorly drained, somewhat poorly drained, and moderately well drained soils.

Time

Time, usually a long time, is required by the agents of soil formation to form distinct horizons from parent material. The length of time that the parent material has been in place is commonly reflected in the degree of development of the soil profile. Some soils form rapidly; others, slowly.

The soils in Marion County range from young to mature. The glacial deposits from which many of the soils in Marion County formed have been exposed to soil-forming factors for a long enough time to allow distinct horizons to form within the soil profile. Some soils forming in recent alluvium, however, have not been in place long enough for distinct horizons to form.

Genesee soils are examples of young soils formed in alluvium. Miami and Ockley soils, which formed in Wisconsin age material, are leached of lime to a depth of 40 to 60 inches and have distinct horizons.

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 removal 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, but that 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. Leaching probably precedes the translocation of silicate clay minerals. Almost all of the carbonates and some of the bases have been leached from the A and B horizons of well drained soils. Even in the wettest soils, some leaching is indicated by the absence of carbonates and by an acid reaction. Leaching of wet soils is slow because the water table is high or because water moves slowly through such soils.

Clay particles accumulate in pores and other voids and form films on the surfaces along which water moves. Leaching of bases and translocation of silicate clay are among the more important processes in horizon differentiation in the soils of this county. Miami soils are examples of soils in which translocated silicate clay has 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 redistribution 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.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (*8*). Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. The same property or subdivisions of this property may be used in several different categories. In table 13, the soil series of Marion County are placed in six categories of the current system. Classes of the system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. Three exceptions to this are the Entisols, Histosols, and Vertisols, which occur in many different climates. Each order is identified by a word of three or four syllables ending in *sol* (Moll-i-sol).

SUBORDER. Each order is divided into suborders according to those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders are more narrowly defined than are the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or

TABLE 13.—*Classification of the soils*

[An asterisk in the first column indicates a taxajunct to the series. See text for a description of those characteristics of the taxadjunct that are outside the range of the series]

Soil name	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
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
Martinsville	Fine-loamy, mixed, mesic Typic Hapludalfs
Miami	Fine-loamy, mixed, mesic Typic Hapludalfs
Ockley	Fine-loamy, mixed, mesic Typic Hapludalfs
Rensselaer	Fine-loamy, mixed, mesic Typic Argiaquolls
Shoals	Fine-loamy, mixed, nonacid, mesic Aeric Fluvaquents
Sleeth	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Sloan	Fine-loamy, mixed, mesic Fluvaquentic Haplaquolls
Westland	Fine-loamy, mixed, mesic Typic Argiaquolls
*Whitaker	Fine-loamy, mixed, mesic Aeric Ochraqualfs

absence of a water table near the surface; soil climate; the accumulation of clay, iron, or organic carbon in the upper part of the solum; cracking of soils caused by a decrease in soil moisture; and fine stratification. Each suborder is identified by a word of two syllables. The last syllable indicates the order. An example is *Aquoll* (*Aqu*, meaning water or wet, and *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of soil horizons and features. The horizons used to make separations are those in which clay, carbonates, and other constituents have accumulated or have been removed and those that have pans that interfere with growth of roots, movement of water, or both. The features considered are soil acidity, soil climate, soil composition, and soil color. Each great group is identified by a word of three or four syllables; a prefix is added to the name of the suborder. An example is Haplaquoll (*Hapl*, meaning simple horizons, *aqu*, for wetness or water, and *oll*, from Mollisols).

SUBGROUP. Each great group is divided into subgroups, one representing the central (typic) segment of the group, and others called intergrades, which have properties of the group and also one or more properties of another great group, suborder, or order. Other subgroups have soil properties unlike those of any other great group, suborder, or order. Each subgroup is identified by the name of the great group preceded by one or more adjectives. An example is Typic Argiaquolls (a typical Argiaquoll).

FAMILY. Soil families are established within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, soil depth, and consistence. A family name is the subgroup name preceded by a series of adjectives. The adjectives are the class names that are used as family differentiae (see table 13), for example, for texture and mineralogy. An example is the fine-loamy, mixed, mesic family of Typic Argiaquolls.

SERIES. The series is a group of soils that formed from a particular kind of parent material and have major horizons that, except for the texture of the surface layer, are similar in important characteristics and in arrangement in the profile. A series is given the name of a geographic location near the place where it was first observed and mapped.

Environmental Factors Affecting Soil Use

Marion County is a flat plain dissected by the White River and numerous creeks, streams, and drainageways. Low relief and few abrupt changes characterize the physiography of the area. The highest point, 900 feet above sea level, is near the junction of Southport, Shelbyville, and Five Points Road in Franklin Township, about 4 miles east of the town of Southport. The lowest point, 650 feet above sea level, is near Wicker Road and the White River in Perry Township.

The population is about 800,000. The population density is 2,000 per square mile. Population increased only 13.6 percent between 1960 and 1970, but is anticipated to be in excess of one million by the year 1985 (*3*).

During the period 1958 to 1967, urban land increased by 10 percent and all categories of farm land decreased by the same total amount. About 42 percent of the county remained in farm uses (*9*). By the year 2020, Marion County is expected to be completely urbanized (*3*).

There are 123 miles of interstate highways in Marion County. Four separate interstate systems join a 56-mile loop around the City of Indianapolis. From this loop, the interstate highways radiate in seven different directions, much like the hub and spokes of a wheel. Another 250 miles of other federal highways cross the county in all directions. In addition, there are 1,692 miles of thoroughfares, primary roads, and collector roads in the county (*3*). Virtually every road in the county is paved.

The municipal airport Weir Cook is served by six commercial airlines and three commuter lines. It has complete air freight services (*3*). Three airports in the county serve small private planes.

Four main railroad lines cross the county. Railroad passenger service is available in Indianapolis.

Several processing plants for farm products are in Marion County. Most farm machinery manufacturers have statewide headquarters in Indianapolis. There is a small but active livestock market. A farmer's market for fresh produce is in the downtown area.

Most State and federal government agencies concerned with farm activities have statewide headquarters in Indianapolis.

Water Supply

Surface water is the main source of water in Marion County. Geist Reservoir in the northeast corner of the county is the main water supply. Morse Reservoir in Hamilton County to the north augments the flow of the White River, from which water is drawn. Eagle Creek Reservoir in the northwest corner of the county is in limited use for water supply. It is expected that the present water supply will be adequate until about 1980. There are plans to enlarge the capacity of Geist Reservoir by 1980.

Ground water is of limited extent. The principal sources are (1) sand and gravel deposits overlying bedrock, (2) limestone of Middle Devonian age, and (3) limestone of Middle Silurian age (*3*). These bedrock formations are 150 to 300 feet or more beneath the surface.

Climate [5]

Marion County is on the fringe of the climatic influence associated with the Great Lakes. It has a continental humid climate. Cool Canadian air masses alternate with tropical air masses from the south to

[5] LAWRENCE A. SCHAAL, State climatologist, National Weather Service.

bring changes within days and to create a variability of seasons.

The frequent weather changes come from the passing of weather fronts and associated low and high centers of air pressure. In general, a high brings lower temperatures, lower humidity, and sunny days, whereas an approaching low brings higher temperatures, southerly winds, higher humidity, and rain or showers. Changes are most frequent in winter and spring and least frequent late in summer and early in fall.

Tables 14 and 15 contain selected weather data collected by the National Weather Service at Weir Cook Airport, Indianapolis. The data are representative of suburban Marion County climate (*5, 10*).

Temperatures in a 14-year period ranged from –20° F to 99°. Temperatures were 90° or higher on an average of 16 days per year and were continually below freezing on an average of 37 days per year.

Average annual precipitation is somewhat evenly distributed throughout the year. Spring and early summer rains usually exceed winter precipitation. The least precipitation usually occurs in February.

Growing season weather generally favors the farming in the area. The spring rains ensure near maximum soil moisture as summer approaches. Wet fields in spring sometimes delay planting. Rainfall during the growing season is usually adequate for a diversified farming. In midsummer, however, evaporation from soils exceeds rainfall for brief periods and affects lawns, pasture, and crops.

Average annual snowfall is 20 inches. In the last 30-year period, the greatest daily total was 13 inches, on February 26, 1965, and the greatest monthly total was 17 inches, in January 1968. Snowfall averages 5 inches during both January and February. Snow protects winter grain from subsequent cold air.

TABLE 14.—*Temperature and precipitation*

[Data are from Weir Cook Airport, 1941–72]

Month	Temperature				Precipitation				
						One year in 10 will have—			
	Average daily maximum	Average daily minimum	Average maximum	Average minimum	Average total	Less than—	More than—	Days with snow cover	Average depth of snow on days with snow cover
	F	*F*	*F*	*F*	*In*	*In*	*In*		*In*
January	36	20	60	−4	2.9	0.6	7.4	9	3.0
February	39	22	61	1	2.4	0.4	4.0	7	2.3
March	49	30	73	12	3.8	1.3	7.9	3	2.7
April	63	42	82	26	3.9	1.7	7.8	(1)	1.4
May	73	52	87	36	4.1	0.9	9.2	0	0
June	82	61	93	47	4.2	1.2	7.5	0	0
July	85	65	94	53	3.7	1.3	7.3	0	0
August	84	62	94	51	2.8	1.2	5.4	0	0
September	78	55	91	39	2.9	1.0	5.6	0	0
October	67	44	83	28	2.5	0.6	5.7	0	0
November	51	33	71	15	3.1	1.3	5.2	1	2.1
December	39	23	62	4	2.7	0.9	5.2	6	2.1
Year	62	42	96 [2]	−7 [3]	38.7	28.9	49.2	26	2.5

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

TABLE 15.—*Probabilities of last freezing temperatures in spring and first in fall*

[Weir Cook Airport, Marion County, Indiana (*6*)]

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	Mar. 25	Apr. 2	Apr. 9	Apr. 23	May 10
2 years in 10 later than	Mar. 21	Mar. 30	Apr. 1	Apr. 17	May 6
5 years in 10 later than	Mar. 7	Mar. 28	Mar. 26	Apr. 10	Apr. 21
Fall:					
1 year in 10 earlier than	Nov. 16	Nov. 2	Oct. 23	Oct. 10	Oct. 6
2 years in 10 earlier than	Nov. 21	Nov. 10	Nov. 2	Oct. 21	Oct. 11
5 years in 10 earlier than	Dec. 2	Nov. 21	Nov. 7	Oct. 28	Oct. 22

Observations at Weir Cook Airport show that 172 days per year are cloudy and 91 days are clear. Sunshine averages 59 percent of daylight hours, but ranges from 40 percent in December to 70 percent in August.

Relative humidity at noon ranges from an average of about 58 percent in summer to 68 percent in winter. Relative humidity during most nights increases to 90 percent or more. This increase is frequently accompanied by dew or frost.

Winds are most frequently from the southwest, but during a couple of the winter months are dominantly from the northwest. Wind velocity averages 7 miles per hour in September and 11 miles per hour in winter and early in spring. Damaging winds may originate from thunderstorms or tornadoes. Thunderstorms occur on about 44 days per year. In a 53-year period, 19 tornadoes passed through the county.

Data on temperature and precipitation are shown in table 14. The probabilities of the last freezing temperature in the spring and the first in fall are shown in table 15.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

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—

	Inches
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.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Compressible. Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition 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.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil 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."

Drift (geology). Material of any sort deposited by geologic processes in one place after having been removed from another; includes drift materials deposited by glaciers and by streams and lakes associated with them.

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.

Favorable. Favorable soil features for the specified use.

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.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

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 precedes 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 lacking clearly defined horizons because the soil-forming forces have acted on the parent material only a relatively short time since it was deposited or exposed.

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 20 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.

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 inches), 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 basis of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

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 streams is called ground-water 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.

Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

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."

Thin layer. Otherwise suitable soil material too thin for the specified use.

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 adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper 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: 1991-281-364/40029

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