SOIL SURVEY OF

Sussex County, New Jersey

United States Department of Agriculture
Soil Conservation Service

in cooperation with
New Jersey Agricultural Experiment Station
and Cook College
Rutgers University

Major fieldwork for this soil survey was done in the period 1950–1970. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1970. This survey was made cooperatively by the Soil Conservation Service and the New Jersey Agricultural Experiment Station and Cook College of Rutgers University. It is part of the technical assistance furnished to the Sussex County Soil Conservation District.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

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

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

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

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

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

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation areas in the section "Town and Country Planning."

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

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

Newcomers in Sussex County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of the publication and in the section "General Nature of the County."

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SOIL SURVEY OF SUSSEX COUNTY, NEW JERSEY

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION AND COOK COLLEGE OF RUTGERS UNIVERSITY

SUSSEX COUNTY is in the northwestern part of New Jersey. It borders New York on the north and Pennsylvania and the Delaware River on the west (fig. 1). The county encompasses 343,216 acres. About 5,680 acres is lakes, each of which is more than 40 acres in size. The rest is areas of land and water less than 40 acres in size. Population of Sussex County in 1969 was 77,528, and that of the county seat, Newton, was 7,297.

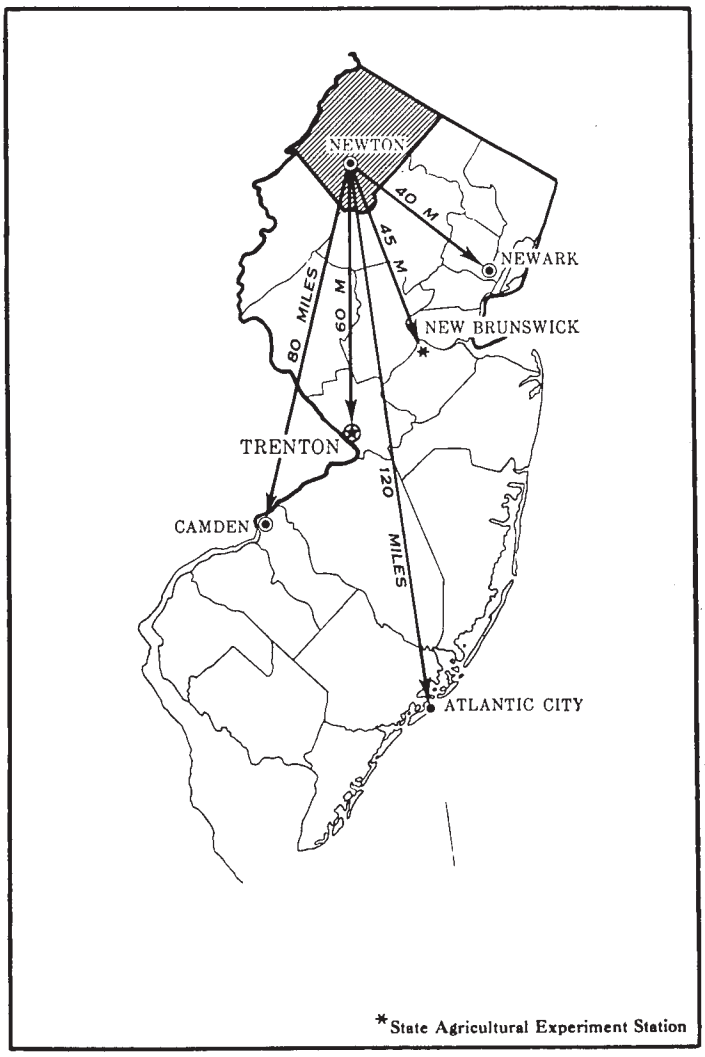

Figure 1.—Location of Sussex County in New Jersey.

Several valleys and mountain ridges roughly parallel the Delaware River. The valleys near the river are narrow and the nearest mountain ridges are the highest in the county. High Point, at an elevation of 1,804 feet, the highest elevation in New Jersey, is on Kittatinny Mountain near the New Jersey-New York border. The valleys are mostly 400 to 600 feet above sea level. Kittatinny Mountain is a narrow, even-crested sandstone ridge. The Highlands, mountains in the eastern part of the county, are broad or flat-topped ridges of granitic gneiss. They are generally steep and very stony. Some of the wide valley between the ridges formed over limestone, shale, or slate. Farmed areas dominantly are in this valley. About 30 percent of the county is farmed, predominantly dairy farms, and more than 60 percent is wooded. The number and size of farms are decreasing, but farm income has increased slightly during the last 5 years.

In 1965 the National Park Service was authorized to purchase land and develop the Delaware Water Gap National Recreation Area. About 7 percent of Sussex County is in this recreation area. About 25 percent of the county is in Federal, State, or municipal parks, forests, hunting and fishing areas, recreation areas, or municipal reservoir watersheds. In addition, the county has substantial private ski developments at Great Gorge and Vernon Valley.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Sussex County (*5*),[1] 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 speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent

[1] Italic numbers in parentheses refer to Literature Cited, p. 117.

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 the 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. Washington and Rockaway, 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, Washington loam, 3 to 8 percent slopes, is one of several phases within the Washington 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 in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning and 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 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. Three such kinds of mapping units are shown on the soil map of Sussex County: soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Washington-Wassaic complex, 3 to 15 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Rock outcrop-Oquaga association, steep, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Swartswood and Lackawanna very stony soils, 3 to 8 percent slopes, is an example.

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

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

Soil scientists observe how soils behave when used as a growing medium for native and cultivated plants, and as material for structures, foundations for 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 to slow permeability of the soil 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 a high shrink-swell potential. Thus, they use observation and knowledge of soil properties, together with available research data, to predict the limitation or suitability of a soil 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 Sussex County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who

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

The 11 soil associations in Sussex County are described on the following pages.

Soils Formed in Glacial Outwash

The soils in these associations are on the east side of the Delaware River and in valleys along major streams. They are deep, dominantly nearly level to strongly sloping cobbly sandy loams to loams. In some areas they are very steep.

1. Chenango-Atherton-Braceville association

Nearly level to very steep, deep, well-drained to very poorly drained loamy soils; on terraces

This association is dominantly in a lower position on the landscape than most of the other associations in the county. It makes up about 6 percent of the total acreage. It is about 50 percent Chenango soils, 10 percent Atherton soils, 10 percent Braceville soils, and 30 percent soils of minor extent.

Chenango soils are well drained and have a surface layer of gravelly fine sandy loam or cobbly sandy loam. They are mostly gently sloping, but in some areas they are very steep. They are on the high parts and sides of terraces. Atherton soils are nearly level, are poorly drained or very poorly drained, and have a loam surface layer. They are in low positions on the landscape. Braceville soils are moderately well drained, are nearly level to gently sloping, and have a surface layer of gravelly loam or gravelly sandy loam. They are on toe slopes.

Less extensive in this association are the well-drained Unadilla soils, the excessively drained Colonie soils, the moderately well drained to somewhat poorly drained Middlebury soils, the moderately well drained Wurtsboro soils, the very poorly drained Sloan soils, the poorly drained Wayland soils, and the well-drained Wassaic soils.

Most of this association was cleared for farming. Much of it is now idle. Some parts are public hunting and fishing grounds. The rest is within the Delaware Water Gap National Recreation Area. All but the wet areas are generally well suited to farming and to community development.

2. Hazen-Palmyra-Fredon association

Nearly level to very steep, deep, well-drained and poorly drained loamy soils; on terraces, kames, and outwash plains

This association is in areas above Carlisle muck and the flood plains of major tributaries. It makes up about 8 percent of the county. It is about 40 percent Hazen soils, 15 percent Palmyra soils, 10 percent Fredon soils, and 35 percent soils of minor extent.

Hazen soils are well drained, are nearly level to very steep, and have a gravelly loam surface layer. Palmyra soils are well drained, are nearly level to very steep, and have a gravelly fine sandy loam surface layer. Hazen and Palmyra soils are mostly on side slopes. Fredon soils are poorly drained, are nearly level to gently sloping, and have a loam surface layer. They are in low positions on the landscape.

Less extensive in this association are the moderately well drained Hero soils, the very poorly drained Halsey soils, and the well drained Valois and Bath soils.

This association has been extensively cleared for farming. The potential for community development is high. The steep areas are among the primary sources of sand and gravel.

Soils Formed in Organic Deposits, Glacial Lake Sediments, or Alluvium

The soils in these associations are on flood plains or in depressions in the valleys. They are nearly level and deep and range from muck to silty clay loam. Many are subject to frequent overflow or ponding.

3. Carlisle-Swamp association

Nearly level, deep, very poorly drained organic soils and mineral soils; in depressions

This association is in the lowest positions on the landscape. It is commonly in circular or elliptical depressions that have poor drainage outlets. It makes up about 6 percent of the county. It is about 60 percent Carlisle soils, 15 percent Swamp, and 25 percent soils of minor extent.

Carlisle soils formed in organic material. Swamp is dominantly mineral in composition and is almost continuously covered by water. Carlisle soils and Swamp are in low positions on the landscape.

Less extensive in this association are the poorly drained Chippewa soils and the very poorly drained Lyons, Norwich, and Wallkill soils.

Most areas of this association are woodland. Drained areas of Carlisle soils are used for vegetables. A few areas are used for specialty crops, such as sod. Growing vegetables and sod and developing ponds, reservoir sites, and wetland wildlife habitat are potential uses of this association.

4. Livingston-Sloan-Wayland association

Nearly level, deep, very poorly drained and poorly drained loamy soils; in depressions and on flood plains

This association is in very low positions on the flood plain, adjacent to main tributaries in the interior of the county, and is subject to stream flooding. It makes up about 3 percent of the county. It is about 35 percent Livingston soils, 20 percent Sloan soils, 15 percent Wayland soils, and 30 percent soils of minor extent.

Livingston soils are very poorly drained and have a silty clay loam surface layer and a slowly permeable clay subsoil. Sloan soils are very poorly drained and have a silt loam surface layer over a silty clay loam subsoil.

Wayland soils are poorly drained and have a silt loam surface layer over a silt loam subsoil.

Less extensive soils in this association are the poorly drained to somewhat poorly drained Raynham soils, the poorly drained Fredon soils, the very poorly drained Halsey soils, and Alluvial land, wet.

This association mainly is in hay, pasture (fig. 2), and woodland. Part of it is idle. Some artificially drained areas are used for row crops. If drainage outlets are available, many areas can be drained and used for crops. This association is well suited to development for wetland wildlife.

Soils Formed in Glacial Till or in Material Weathered from Bedrock

The soils in these associations are in the Valley and Ridge province between Kittatinny Mountain and the Highlands. They are mainly deep to shallow, nearly level to very steep loamy soils. Stony soils and Rock outcrop are common in most of these associations.

5. *Washington-Wassaic-Rock outcrop association*

Gently sloping to steep, deep and moderately deep, well-drained loamy soils and limestone outcrops; on uplands

This association is on hillsides and lower valley slopes between the mountains. It makes up about 9 percent of the county. It is about 40 percent Washington soils, 30 percent Wassiac soils, 20 percent Rock outcrop, and 10 percent soils of minor extent.

Washington soils are deep, well drained, and gently sloping to steep and have a surface layer of loam or very stony loam. Wassaic soils are moderately deep, well drained, and gently sloping to steep and have a surface layer of silt loam. Rock outcrop is dominantly limestone.

Less extensive in this association are the poorly drained and very poorly drained Lyons soils and the moderately well drained Hero soils.

This association is well suited to farming. The deep and moderately deep soils are dominant and are used for corn and alfalfa. The rocky areas are used for pasture, farm woodlots, and the development of residential and recreation communities surrounding lakes (fig. 3). The sinkholes that form in some low areas of this association definitely limit more intensive use of these areas.

6. *Swartswood-Nassau association*

Gently sloping to steep, deep and shallow, well-drained and somewhat excessively drained loamy soils; on uplands

This association is on hilltops and hillsides directly east of Kittatinny Mountain. It makes up about 5 percent of the county. It is about 40 percent Swartswood soils, 35 percent Nassau soils, and 25 percent soils of minor extent.

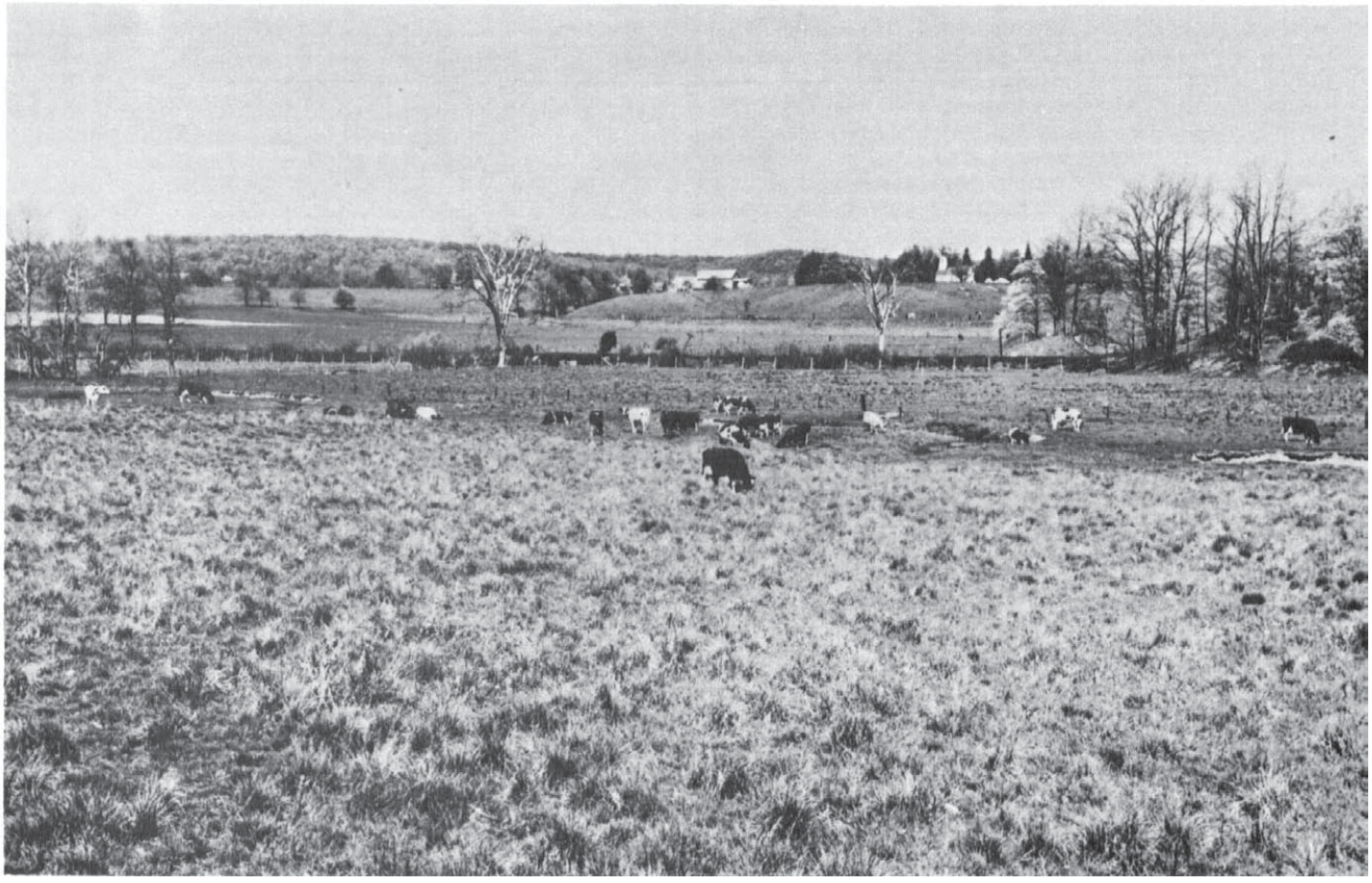

***Figure 2.*—Highly productive pasture on the flood plain, on Wayland and Sloan soils.**

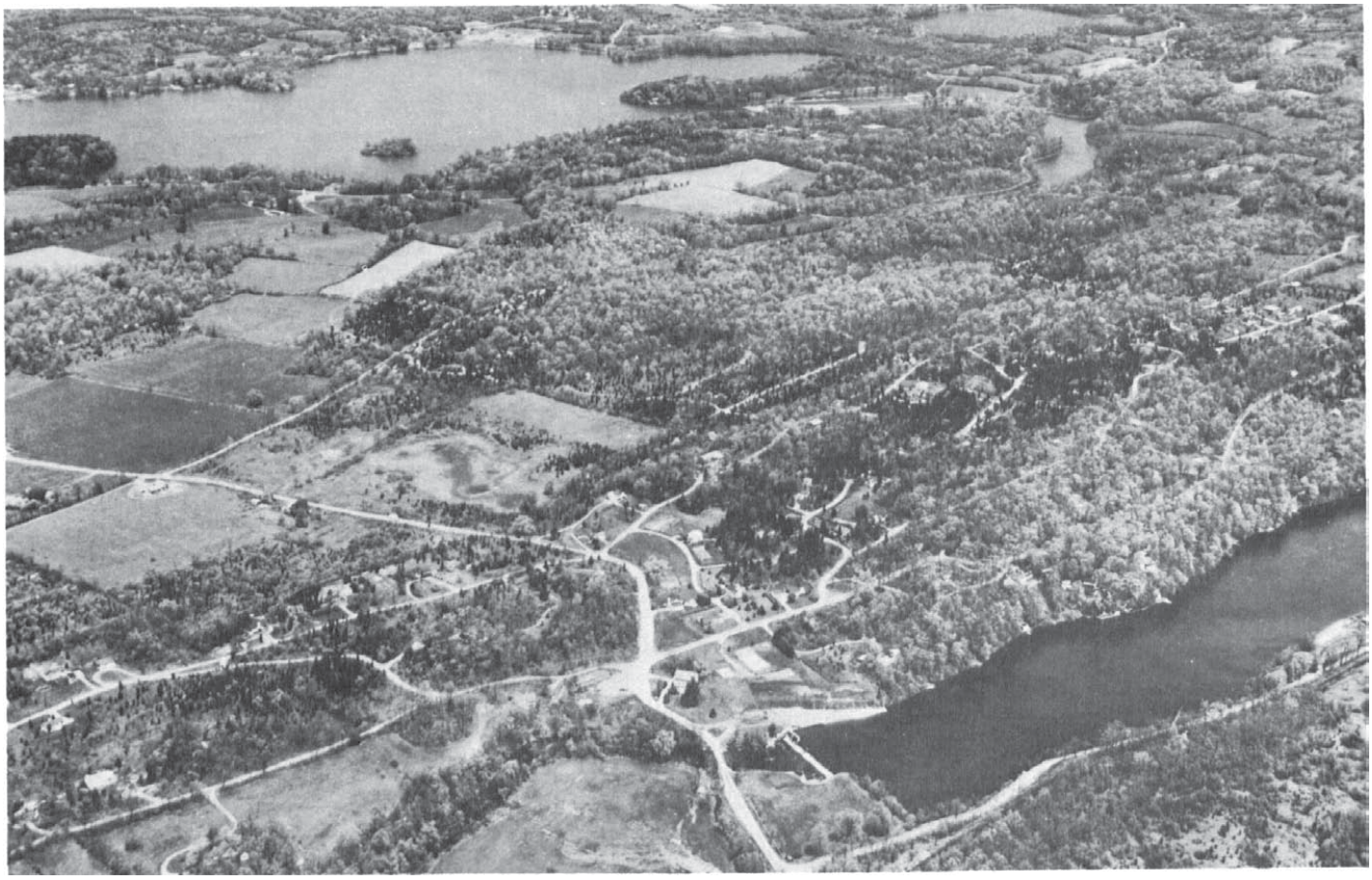

Figure 3.—**Residential and recreation communities surround most lakes in the county.**

Swartswood soils are deep, gently sloping to steep, and well drained and have a surface layer of gravelly loam or very stony loam. Nassau soils are shallow, gently sloping to very steep, and somewhat excessively drained and have a surface layer of silt loam. They are in areas containing rock ledges.

Less extensive in this association are the somewhat poorly drained Albia soils, the well drained Bath soils, the poorly drained Norwich soils, and the moderately well drained Wurtsboro soils.

Most of this association was cleared for farming. The dominant present uses are woodland and lake developments. A few dairy farms are in the area.

The shallowness of Nassau soils is severely limiting for many uses. Steep slopes and stoniness are the most limiting properties of Swartswood soils.

7. *Nassau-Bath-Norwich association*

Gently sloping to very steep, shallow and deep, somewhat excessively drained and well-drained loamy soils and nearly level, deep, very poorly drained very stony loamy soils, on uplands

This association is on hilltops and hillsides in the interior valleys. It makes up about 20 percent of the county. It is about 25 percent Nassau soils, 20 percent Bath soils, 20 percent Norwich soils, and 35 percent soils of minor extent.

Nassau soils are shallow over shale or slate, gently sloping to very steep, and somewhat excessively drained and have a surface layer of shaly silt loam. Rock outcrops are few to numerous. Bath soils are deep, well drained, and gently sloping to very steep and have a surface layer of loam, gravelly loam, or very stony loam. Norwich soils are deep, nearly level, and very poorly drained and have a surface layer of silt loam or very stony loam.

Less extensive in this association are the well-drained Valois soils, the somewhat poorly drained Albia soils, and Rock outcrop.

Most of this association has been cleared for farming. It is used for both row crops and pasture. Unless irrigated, Nassau soils are poorly suited to farming. Many ponds have been constructed in the very poorly drained areas. Some areas are used for community development. Shallowness over bedrock severely limits the Nassau soils for many uses.

8. *Wassaic-Wooster-Rock outcrop association*

Gently sloping to very steep, moderately deep and deep, well-drained loamy soils and limestone outcrops; on uplands

This association is on hilltops and hillsides near the Delaware River. It makes up about 3 percent of the county. It is about 40 percent Wassaic soils, 25 percent

Wooster soils, 20 percent Rock outcrop, and 15 percent soils of minor extent.

Wassaic soils are moderately deep, well drained, and gently sloping to steep and have a surface layer of silt loam. Wooster soils are deep, well drained, and gently sloping to very steep and have a surface layer of loam. The outcrops are limestone ledges.

Less extensive in this association are the somewhat excessively drained Nassau soils, the very poorly drained Lyons soils, and small areas of the well-drained Bath soils.

This association is dominantly woodland or idle areas that were formerly farmed. It is now part of the Delaware Water Gap National Recreation Area.

9. Rockaway-Hibernia-Whitman association

Gently sloping to very steep, deep, well-drained and somewhat poorly drained gravelly to very stony loamy soils and nearly level, deep, very poorly drained extremely stony loamy soils; on uplands

This association is on hillsides and hillsides in valleys west of the Highlands. It makes up about 7 percent of the county. It is about 65 percent Rockaway soils, 15 percent Hibernia soils, 10 percent Whitman soils, and 10 percent soils of minor extent.

Rockaway soils are well drained, are gently sloping to very steep, and have a surface layer of gravelly loam or very stony loam. They are on hilltops and hillsides. Hibernia soils are somewhat poorly drained, are gently sloping to moderately steep, and have a surface layer of gravelly loam or very stony loam. They are on the mid or lower slopes. Whitman soils are very poorly drained, are nearly level, and have a surface layer of extremely stony sandy loam. They are in low positions on the landscape.

Less extensive in this association are the excessively drained Otisville soils, the well-drained Riverhead soils, and Rock outcrop.

This association has been extensively cleared for farming, but the acreage in farms is declining. Idle acreages are reverting to woodland or are used for community development.

10. Rockaway-Rock outcrop-Whitman association

Steep and very steep, deep, well-drained gravelly to very stony loamy soils; rock outcrops; and nearly level. deep, very poorly drained extremely stony loamy soils; on uplands

This association is on ridgetops and side slopes of the Highlands. It makes up about 20 percent of the county. It is about 45 percent Rockaway soils, 35 percent Rock outcrop, 10 percent Whitman soils, and 10 percent soils of minor extent.

Rockaway soils are deep, well drained, and dominantly steep to very steep and have a surface layer of gravelly loam or very stony loam. They are on hilltops and hillsides. They are generally associated with Rock outcrop and shallow soils. Rock outcrop consists of areas where 25 to 90 percent of the surface is covered by mostly granitic rock. These areas are mainly on hilltops. Whitman soils are very poorly drained and have an extremely stony sandy loam surface layer. They are in low positions on the landscape.

Less extensive in this association are the somewhat poorly drained Hibernia soils and the well-drained Riverhead soils.

This association is dominantly woodland. Some areas are cleared and used for pasture. Other areas are used for private recreational development, such as ski slopes. Still other areas are State-owned parks and greenbelts.

11. Rock outcrop-Oquaga-Swartswood association

Rock outcrops and sloping to very steep, moderately deep and deep, well-drained very stony and extremely stony loamy soils; on uplands

This association is on sharp ridgetops, escarpments, and side slopes of Kittatinny Mountain. It makes up about 13 percent of the county. It is about 30 percent Rock outcrop, 30 percent Oquaga soils, 15 percent Swartswood soils, and 25 percent soils of minor extent.

Rock outcrop consists of areas, commonly on ridgetops, where 40 to 60 percent of the surface is covered by dominantly sandstone rocks. Oquaga soils have an extremely stony loam surface layer and are moderately deep. They are dominantly on side slopes. Swartswood soils have a surface layer of gravelly loam or very stony loam. They are either on the tops or the sides of ridges.

Less extensive in this association are the very stony, well drained Lackawanna soils, the moderately well drained Wurtsboro soils, and the very poorly drained Norwich soils.

This association is dominantly State forests or parks. Some of it has been used for residential development but now is part of the Delaware Water Gap National Recreation Area.

Descriptions of the Soils

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

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

As mentioned in the section "How This Survey Was Made," not all mapping units are of a soil series. Swamp, for example, does not belong to a soil series, but never-

theless is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and woodland group in which the mapping unit has been placed. The woodland group and the page for the description of each capability unit can be found by referring to the "Guide to Mapping Units" at the back of this survey.

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 (*9*).

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

Soil	Acres	Percent	Soil	Acres	Percent
Albia gravelly loam, 3 to 8 percent slopes	3,550	1.1	Norwich very stony silt loam, 0 to 3 percent slopes	3,450	1.0
Albia gravelly loam, 8 to 15 percent slopes	1,380	.4	Oquaga extremely stony loam, 3 to 8 percent slopes	360	.1
Albia extremely stony loam, 3 to 8 percent slopes	1,480	.4	Oquaga extremely stony loam, 8 to 25 percent slopes	2,550	.8
Alluvial land, wet	1,340	.4	Oquaga-Rock outcrop association, moderately steep	13,500	4.0
Atherton loam	2,550	.8	Otisville gravelly loamy sand, 3 to 15 percent slopes	770	.2
Bath loam, 3 to 8 percent slopes	3,750	1.1	Otisville gravelly loamy sand, 15 to 35 percent slopes	560	.2
Bath loam, 8 to 15 percent slopes	5,200	1.5	Palmyra gravelly fine sandy loam, 0 to 3 percent slopes	380	.1
Bath gravelly loam, 15 to 25 percent slopes	2,100	.6	Palmyra gravelly fine sandy loam, 3 to 8 percent slopes	1,850	.5
Bath gravelly loam, 25 to 40 percent slopes	310	.1	Palmyra gravelly fine sandy loam, 8 to 25 percent slopes	2,100	.6
Bath very stony loam, 3 to 8 percent slopes	790	.2	Pits, sand and gravel	470	.1
Bath very stony loam, 8 to 25 percent slopes	2,350	.7	Pompton fine sandy loam, 0 to 3 percent slopes	790	.2
Bath very stony loam, 25 to 40 percent slopes	520	.2	Preakness sandy loam	670	.2
Braceville gravelly sandy loam, 0 to 3 percent slopes	1,200	.4	Raynham silt loam, 0 to 5 percent slopes	1,150	.3
Braceville gravelly sandy loam, 3 to 8 percent slopes	570	.2	Riverhead sandy loam, 3 to 8 percent slopes	1,480	.4
Carlisle muck	12,100	3.6	Riverhead sandy loam, 8 to 25 percent slopes	1,190	.4
Chenango gravelly fine sandy loam, 3 to 8 percent slopes	4,650	1.4	Rockaway gravelly loam, 3 to 8 percent slopes	2,500	.7
Chenango gravelly fine sandy loam, 8 to 25 percent slopes	2,750	.8	Rockaway gravelly loam, 8 to 15 percent slopes	3,400	1.0
Chenango cobbly sandy loam, 3 to 15 percent slopes	1,970	.6	Rockaway gravelly loam, 15 to 25 percent slopes	1,650	.5
Chenango cobbly sandy loam, 15 to 35 percent slopes	1,700	.5	Rockaway very stony loam, 5 to 25 percent slopes	13,900	4.1
Chippewa extremely stony loam, 0 to 8 percent slopes	3,100	.9	Rockaway very stony loam, 25 to 40 percent slopes	1,040	.3
Chippewa silt loam, 3 to 8 percent slopes	3,000	.9	Rockaway-Rock outcrop association, sloping and moderately steep	26,500	7.9
Colonie loamy fine sand, 3 to 8 percent slopes	460	.1	Rock outcrop-Nassau association, very steep	2,250	.7
Colonie loamy fine sand, 8 to 15 percent slopes	270	.1	Rock outcrop-Oquaga association, steep	12,700	3.8
Fredon loam, 0 to 3 percent slopes	2,050	.6	Rock outcrop-Rockaway association, steep	23,000	6.8
Fredon loam, 3 to 8 percent slopes	870	.3	Sloan and Wayland silt loams	4,100	1.2
Halsey loam	2,000	.6	Swamp	3,800	1.1
Hazen gravelly loam, 0 to 3 percent slopes	660	.2	Swartswood gravelly loam, 3 to 8 percent slopes	1,270	.4
Hazen gravelly loam, 3 to 8 percent slopes	5,700	1.7	Swartswood gravelly loam, 8 to 15 percent slopes	1,440	.4
Hazen gravelly loam, 8 to 25 percent slopes	3,750	1.1	Swartswood gravelly loam, 15 to 25 percent slopes	680	.2
Hazen and Palmyra gravelly sandy loams, 25 to 45 percent slopes	2,750	.8	Swartswood and Lackawanna very stony soils, 3 to 8 percent slopes	3,000	.9
Hero loam, 0 to 3 percent slopes	1,220	.4	Swartswood and Lackawanna very stony soils, 8 to 25 percent slopes	8,700	2.6
Hero loam, 3 to 8 percent slopes	1,080	.3	Swartswood and Lackawanna very stony soils, 25 to 35 percent slopes	1,000	.3
Hibernia gravelly loam, 3 to 8 percent slopes	660	.2	Unadilla very fine sandy loam, 0 to 3 percent slopes	410	.1
Hibernia very stony loam, 3 to 8 percent slopes	4,550	1.3	Unadilla very fine sandy loam, 3 to 8 percent slopes	690	.2
Hibernia very stony loam, 8 to 25 percent slopes	1,200	.4	Valois shaly loam, 3 to 8 percent slopes	1,270	.4
Hoosic gravelly loam, 3 to 8 percent slopes	570	.2	Valois shaly loam, 8 to 15 percent slopes	1,900	.6
Hoosic gravelly loam, 8 to 25 percent slopes	720	.2	Valois shaly loam, 15 to 25 percent slopes	1,030	.3
Livingston silty clay loam	3,750	1.1	Wallkill silt loam	530	.2
Lyons silt loam	1,340	.4			
Lyons very stony silt loam	1,120	.3			
Made land, sanitary land fill	340	.1			
Middlebury loam	1,500	.4			
Nassau rocky silt loam, 3 to 8 percent slopes	1,480	.4			
Nassau rocky silt loam, 8 to 15 percent slopes	5,200	1.5			
Nassau-Rock outcrop complex, 15 to 25 percent slopes	9,900	2.9			
Nassau-Rock outcrop complex, 25 to 45 percent slopes	8,600	2.5			
Nassau-Rock outcrop complex, extremely stony	1,800	.5			
Norwich silt loam, 0 to 3 percent slopes	13,400	4.0			

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

Soil	Acres	Percent	Soil	Acres	Percent
Washington loam, 3 to 8 percent slopes	2,000	0.6	Whitman extremely stony sandy loam	9,400	2.8
Washington loam, 8 to 15 percent slopes	780	.2	Wooster loam, 3 to 8 percent slopes	910	.3
Washington loam, 15 to 25 percent slopes	410	.1	Wooster loam, 8 to 15 percent slopes	570	.2
Washington very stony loam, 3 to 15 percent slopes	2,000	.6	Wooster loam, 15 to 25 percent slopes	660	.2
Washington very stony loam, 15 to 25 percent slopes	890	.3	Wooster loam, 25 to 35 percent slopes	260	.1
Washington-Wassaic complex, 3 to 15 percent slopes	6,700	2.0	Wurtsboro gravelly loam, 3 to 8 percent slopes	910	.3
Washington-Wassaic complex, 15 to 25 percent slopes	3,700	1.1	Wurtsboro gravelly loam, 8 to 15 percent slopes	660	.2
Wassaic silt loam, 3 to 15 percent slopes	2,850	.8	Wurtsboro very stony loam, 0 to 8 percent slopes	6,200	1.8
Wassaic silt loam, 15 to 30 percent slopes	870	.2	Wurtsboro very stony loam, 8 to 20 percent slopes	210	.1
Wassaic-Rock outcrop association, moderately steep	13,500	4.0	Quarries	326	.1
			Water (bodies less than 40 acres in size)	2,400	.8
			Total	337,536	100.0

Albia Series

The Albia series consists of deep, gently sloping to sloping, somewhat poorly drained gravelly or extremely stony soils that have a firm, compact, brittle fragipan. These soils formed in glacial till material weathered from shale, sandstone, and slate. They are on uplands.

In a representative profile the plow layer is dark grayish-brown gravelly loam 9 inches thick. The upper 9 inches of the subsoil is dark yellowish-brown and yellowish-brown gravelly heavy loam. The lower part is a fragipan of very firm, dense, light brownish-gray and olive-gray gravelly loam that extends to a depth of 60 inches or more.

Available water capacity is moderate. Permeability is moderate in the upper part of the subsoil and slow in the fragipan. The fragipan restricts the downward movement of air, water, and roots. Natural fertility is moderate.

If drained, these soils are used for corn, alfalfa, other hay, and pasture. Some areas are residential developments.

Representative profile of Albia gravelly loam, 3 to 8 percent slopes, 3 miles north of Quarryville, on the back road to Unionville, New York, east side of road, 250 feet into field:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) gravelly loam; moderate, medium, granular structure; friable; many fine and medium roots; 20 percent fine gravel; strongly acid; clear, wavy boundary.

B2—9 to 18 inches, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) gravelly heavy loam; many, fine, distinct, light brownish-gray (2.5Y 6/2) and few, fine, faint, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; slightly firm; common medium roots; 20 percent fine and medium gravel; strongly acid; gradual, wavy boundary.

Bx1—18 to 24 inches, light brownish-gray (2.5Y 6/2) gravelly loam; strong, very coarse, prismatic structure; very firm; 25 percent fine and medium gravel; strongly acid; gradual, wavy boundary.

Bx2—24 to 36 inches, olive-gray (5Y 5/2) gravelly loam; many, medium, faint, light olive-brown (2.5Y 5/6) and olive-yellow (2.5Y 6/6) mottles; strong, very coarse, prismatic structure; very firm; 20 percent fine and medium gravel; moderately acid; gradual, wavy boundary.

Bx3g—36 to 60 inches, olive-gray (5Y 2/2) gravelly loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; very firm; 30 percent fine and coarse gravel; slightly acid.

The solum ranges from 40 to 72 inches in thickness. Depth to bedrock is 5 feet or more. Depth to the fragipan ranges from 12 to 20 inches. The content of coarse fragments ranges from 10 percent to 30 percent and generally increases with increasing depth. Cobblestones and stones are more numerous in the A horizon than in the horizons below. Unless limed, these soils are slightly to strongly acid.

The A horizon is gravelly loam or loam. The B horizon ranges from gravelly heavy loam to gravelly loam. The upper part of the B horizon generally has a higher percentage of clay than the lower part. The B horizon is firm or very firm. The C horizon is very firm and brittle.

Albia soils are associated with Bath, Chippewa, Valois, and Nassau soils. In contrast with Bath, Valois, and Nassau soils, they have low-chroma mottles. They are not so gray throughout the profile as Chippewa soils.

Albia gravelly loam, 3 to 8 percent slopes (AlB).—The profile of this soil is the one described as representative of the series. Included in mapping are areas of less gravelly Albia soils, inextensive areas of stony or extremely stony Albia soils, and small areas of sloping or moderately steep Albia soils. Small areas of Bath and Chippewa soils are also included.

If drained, this soil is suited to corn, soybeans, small grain, mixed hay, and pasture. Alfalfa and winter small grain are subject to winterkill. A moderately high water table is the major limitation. Runoff is medium. The hazard of erosion is moderate. Diversion terraces, random tile lines, and surface drains are used to reduce excess wetness. Capability unit IIIw–28; woodland group 4w1.

Albia gravelly loam, 8 to 15 percent slopes (AlC).—The profile of this soil is similar to the one described as representative of the series, but in places the fragipan is nearer the surface. Included in mapping are areas of moderately well drained and poorly drained soils and small areas of well-drained Bath soils and poorly drained Chippewa soils.

This soil is used for commonly grown field crops and for hay and pasture. In places gravel interferes with tillage and harvest. Runoff is medium. The hazard of erosion is moderate. Root penetration and the movement of water are limited by the fragipan. Erosion control is needed in cultivated areas. Capability unit IIIe–28; woodland group 4w1.

Albia extremely stony loam, 3 to 8 percent slopes (AmB).—The profile of this soil is similar to the one de-

scribed as representative of the series, but the stone content is 10 to 15 percent in the surface layer and 5 to 10 percent in the subsoil. Stones are 3 to 5 feet apart. Included in mapping are small areas of nonstony Albia soils and Chippewa very stony loam.

This soil is used for pasture and woodland. The stones make cultivation impractical. Capability unit VIIs–45; woodland group 5x1.

Alluvial Land, Wet

Alluvial land, wet (Ar) is very poorly drained and poorly drained. It is on flood plains. The surface layer is gray or mottled gray fine sandy loam to silty clay that varies widely within short distances. The content of gravel and cobblestones varies from place to place. In places debris deposited by floodwater is scattered on the surface.

These wet alluvial areas occupy very low positions along the major streams of the county. They have a water table at or near the surface most of the year. They are subject to stream overflow and in places are subject to surface ponding during long wet periods. Most areas are flooded annually. The rest is flooded once in 4 or 5 years. Floodwater stands for as long as a week or more.

Small pockets of muck, peat, and lacustrine sediments are included in the mapped areas of this unit. The muck and peat areas have low bearing strength. The lacustrine sediments are likely to be plastic and slowly permeable.

Alluvial land, wet, is used for hay and pasture. A few drained areas are used for corn. Capability unit VIw–46; woodland group 5w1.

Atherton Series

The Atherton series consists of deep, nearly level, poorly drained and very poorly drained soils that formed on glacial outwash terraces. These soils are in slight depressions and on terraces along streams in the county. They are seldom flooded.

In a representative profile the surface layer is very dark brown loam 6 inches thick. The subsoil extends to a depth of 30 inches. The upper 6 inches is dark-gray loam mottled with dark brown. The lower part is mottled, olive-brown loam. The substratum is dark-brown and gray, firm and slightly plastic sandy clay loam that extends to a depth of 60 inches or more.

Available water capacity is high. Permeability is moderate or moderately slow in the surface layer and subsoil. A high water table keeps these soils saturated for long periods. Natural fertility is high. Roots are restricted by the high water table.

Where drained, these soils are suited to corn, hay, and pasture. Undrained areas are woodland.

Representative profile of Atherton loam, west side of U.S. Highway No. 206, near Montague Township School:

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

B21g—6 to 12 inches, dark-gray (10YR 4/1) loam; many, medium, faint, dark-brown (10YR 3/3) mottles; weak, medium, granular structure; friable; slightly acid; gradual, wavy boundary.

B22g—12 to 30 inches, olive-brown (2.5Y 4/4) loam; many, fine and medium, dark-brown (7.5YR 4/4) mottles on dominantly grayish-brown (10YR 5/2) ped surfaces; weak, fine, subangular blocky structure; friable; slightly acid; gradual, wavy boundary.

IIC1g—30 to 40 inches, dark-brown (7.5YR 4/2) sandy clay loam; many, fine, distinct, strong-brown (7.5YR 5/6) and reddish-yellow (7.5YR 6/6) mottles; weak, medium, subangular blocky structure; firm, slightly plastic; slightly acid; clear, wavy boundary.

IIC2g—40 to 60 inches, gray (10YR 5/1) sandy clay loam; massive; firm, slightly plastic; slightly acid.

The solum ranges from 24 to 42 inches in thickness. Depth to limestone or sandstone bedrock is 6 feet or more. The content of coarse fragments, mostly gravel size, makes up as much as 15 percent of the solum and as much as 35 percent of the C horizon. Reaction ranges from strongly acid to mildly alkaline.

The Ap or the A1 horizon is very dark brown (10YR 2/2) or very dark gray (10YR 3/1). Ped faces in the B horizon range from grayish brown (10YR 5/2) to dark gray (5Y 4/1). The B horizon varies within short distances and ranges from loam to silty clay loam. The C horizon is stratified with sandy loam and sandy clay loam, or gravelly textures.

Atherton soils are associated with the moderately well drained Braceville soils, the well-drained Chenango soils, and the very poorly drained Carlisle soils. They have a B horizon that is dominantly gray, whereas that of Chenango and Braceville soils is brown. They are dominantly mineral material and contain less organic matter than Carlisle soils.

Atherton loam (At).—This soil is in long narrow or oval depressions adjacent to streams or low spots where surface and seepage water collect. In most places, slopes are less than 3 percent.

Included with this soil in mapping are somewhat poorly drained soils too small in extent to map separately. In some areas a small amount of gravel and cobblestones is scattered on the surface and throughout the profile. In many areas thin alluvial deposits have accumulated on the surface.

Wetness is the major limitation. Runoff is very slow, and there is little or no erosion hazard. If drained and under high-level management, this soil can be cultivated continuously. It is best suited to water-tolerant plants. It is not well suited to alfalfa.

This soil is suited to trees and unimproved pasture. Where drainage outlets are available and the soil is drained, it is suited to pasture, hay, and corn. Excessive wetness has been reduced by surface drains and in some places by tile drains. Capability unit IIIw–36; woodland group 4w1.

Bath Series

The Bath series consists of deep, gently sloping to very steep, well-drained soils that have a fragipan in the lower part of the subsoil. These soils formed in glacial till derived predominantly from gray sandstone, siltstone, and coarse shale. They are on uplands, on the crests and side slopes on long, distinctly convex landscapes.

In a representative profile the plow layer is very dark grayish-brown loam 10 inches thick. The upper 18 inches of the subsoil is yellowish-brown or dark yellowish-brown loam. The lower part is a fragipan of firm, dark yellowish-brown gravelly loam 20 inches thick. The substratum to a depth of 60 inches or more is light olive-brown gravelly sandy loam.

Available water capacity is moderate. Permeability is moderate above the fragipan but slow in the pan. Natural

fertility is moderate. Some Bath soils are very stony in the surface layer but somewhat less stony in the subsoil.

Gently sloping and sloping Bath soils dominantly are used for corn, alfalfa, and fruit. Steep and very stony Bath soils are better suited to pasture and woodland than to most other uses.

Representative profile of Bath loam, 3 to 8 percent slopes, on Dairy Research Farm, 2½ miles north of Beemerville, along County Route No. 519, ¼ mile west of road along farm lane, 400 feet south of lane, in alfalfa field:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) loam; weak, medium, granular structure; friable; many fine and medium roots; 10 percent gravel; medium acid; clear, wavy boundary.

B21—10 to 17 inches, yellowish-brown (10YR 5/4) loam; weak, medium and fine, subangular blocky structure; friable; common medium roots; 10 percent gravel; medium acid; gradual, wavy boundary.

B22—17 to 28 inches, dark yellowish-brown (10YR 4/4) loam; moderate, medium, subangular blocky structure; slightly firm; 15 percent gravel; medium acid; gradual, wavy boundary.

Bx—28 to 48 inches, dark yellowish-brown (10YR 4/4) gravelly loam; many, coarse, distinct, light yellowish-brown (2.5Y 6/4) and yellowish-brown (10YR 5/6) mottles; weak, coarse prisms; very firm; 25 percent gravel; medium acid.

C—48 to 60 inches, light olive-brown (2.5Y 5/6) gravelly sandy loam; massive; firm; 30 percent coarse fragments of pebbles, cobblestones, and angular rocks; medium acid.

The solum ranges from 40 to 60 inches in thickness. Depth to the fragipan ranges from 26 to 34 inches. In many places, the pan extends into the C horizon. Slate or sandstone bedrock is at a depth of at least 4 feet, but generally is much deeper. The content of coarse fragments ranges from 10 to 30 percent in the upper horizons and from 20 to 40 percent in the Bx and C horizons. Coarse fragments are cobblestones, gravel, or stones in differing proportions. In some Bx or C horizons, they are dominantly flat, angular fragments of slate, siltstone, or sandstone. Unless limed, these soils range from strongly acid in the A horizon to neutral in the C horizon.

The Ap horizon is very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2). It ranges from loam and gravelly loam to very stony loam. The B2 and Bx horizons range from dark yellowish brown (10YR 4/4) to yellowish brown (10YR 5/4). They are loam or silt loam and in places are gravelly. The C horizon is similar to the Bx in texture, but is less firm and paler in color.

Bath soils are closely associated with Albia, Chippewa, and Nassau soils. They do not have the low-chroma mottles that are common to Albia soils and the gray matrix colors of the Chippewa soils. They are deeper over bedrock and contain less shale and slate coarse fragments than Nassau soils.

Bath loam, 3 to 8 percent slopes (BoB).—The profile of this soil is the one described as representative of the series. Included in mapping are small areas of gravelly loam soils and areas of soils that have a gravelly clay loam subsoil.

This soil is used extensively for row crops and hay and silage crops. Many areas are in pasture. A few are wooded and a few are idle. Runoff is slow. The hazard of erosion is moderate in cultivated areas. Erosion control is needed in cultivated areas. Capability unit IIe–3; woodland group 3o1.

Bath loam, 8 to 15 percent slopes (BoC). Included with this soil in mapping are areas of gravelly loam soils, areas of soils that have a gravelly clay loam subsoil, and areas where slopes are more than 15 percent. A few seep spots occur in concave pockets and at the base of long slopes.

This soil is used extensively for row crops, small grain, hay, silage, and pasture. A few areas are wooded and a few are idle. Runoff is medium to rapid. The hazard of erosion is moderate. Erosion control is needed in cultivated areas. Capability unit IIIe–3; woodland group 3o1.

Bath gravelly loam, 15 to 25 percent slopes (BfD).—This soil has a profile similar to the one described as representative of the series, but it is more gravelly. Slopes generally are short. Included in mapping are areas of soils that have a gravelly clay loam subsoil. These areas are dominantly on the lower slopes. Seep spots commonly occur in spring and during other long wet periods, especially in areas where the slope changes.

This soil is used for hay and silage crops, occasional row crops, pasture, and woodland. Some areas are idle. Runoff is rapid. The hazard of erosion is severe. Erosion control is needed in cultivated areas. Capability unit IVe–3; woodland group 3r1.

Bath gravelly loam, 25 to 40 percent slopes (BfE).—This soil has a profile similar to the one described as representative of the series, but it is more gravelly. Included in mapping are small areas of sloping and moderately steep soils, some small areas of loamy soils, and some areas of soils that have a gravelly clay loam subsoil. Seep spots occur in areas where the slope changes.

This soil is used for pasture and woodland and occasionally for hay. Runoff is rapid. The hazard of erosion is severe in cleared areas. Erosion control is needed in cultivated areas. Capability unit VIe–3; woodland group 3r1.

Bath very stony loam, 3 to 8 percent slopes (BgB).—The profile of this soil is the one described as representative of the series, but the surface layer and subsoil are stony. Stones are 5 to 30 feet apart. Included in mapping are areas of cobbly loam, gravelly loam, and loam soils and some areas of soils that have a gravelly clay loam subsoil. Also included are small areas of moderately well drained and somewhat poorly drained soils that are in slightly concave pockets or near areas where the slope changes.

Most of the acreage is woodland. Some areas are pasture, and some are idle. Capability unit VIs–19; woodland group 3o1.

Bath very stony loam, 8 to 25 percent slopes (BgD).—This soil has a profile similar to the one described as representative of the series, but it has stones 5 to 30 feet apart in the surface layer and subsoil.

Included with this soil in mapping are small areas of stony loam soils and some areas of gravelly loam and loam soils. Some areas of moderately well drained and somewhat poorly drained soils are also included; these areas generally are in concave pockets or near areas where the slope changes.

Most of the acreage is woodland. Some areas are pasture, and some are idle. Runoff is moderate. The hazard of erosion is moderate to severe. Stone removal is needed if this soil is to be cultivated. Capability unit VIs–19; woodland group 3r1.

Bath very stony loam, 25 to 40 percent slopes (BgE).—This soil has a profile similar to the one described as representative of the series, but it is very stony. Stones on the surface are generally 5 to 30 feet apart. The con-

tent of stones in the surface layer and subsoil is about 3 percent. Included in mapping are small areas of loam soils.

This soil is used for pasture and woodland. Machinery is severely restricted by stones and very steep slopes. Runoff is moderate to rapid. The hazard of erosion is severe in cleared areas. Capability unit VIIs–21; woodland group 3r1.

Braceville Series

The Braceville series consists of deep, nearly level to gently sloping, moderately well drained soils that have a weakly formed to moderately formed fragipan in the lower part of the subsoil. The soils formed on glacial outwash terraces in material derived predominantly from gray sandstone and slate and smaller amounts of siltstone and limestone.

In a representative profile the plow layer is very dark grayish-brown gravelly sandy loam 8 inches thick. The upper 8 inches of the subsoil is brown gravelly sandy loam. The middle 8 inches is mottled yellowish-brown gravelly sandy loam. The lower 12 inches is a fragipan of firm, mottled brown gravelly loam. The substratum to a depth of 60 inches is grayish-brown stratified gravelly sand.

Available water capacity is moderate. Permeability is moderately slow in the fragipan. Rooting depth and available water capacity are restricted by the fragipan. Natural fertility is moderate.

These soils are well suited to corn, spring-sown small grain, hay, and pasture.

Representative profile of Braceville gravelly sandy loam, 0 to 3 percent slopes, in Sandyston Township, 50 feet east of County Route No. 521, ¾ mile south of intersection of Hainesville Road and County Route No. 521, in a hay field:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) gravelly sandy loam; moderate, medium, granular structure; friable; many roots; many, fine to coarse, tubular pores; 15 percent medium gravel; medium acid; abrupt, smooth boundary.

B21—8 to 16 inches, brown (10YR 5/3) gravelly sandy loam; weak, fine, subangular blocky structure; friable; many fine and medium roots; many, medium and coarse, tubular pores; 15 percent gravel; medium acid; gradual, wavy boundary.

B22—16 to 24 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; common, fine and medium, faint, yellowish-brown (10YR 5/8) and grayish-brown (10YR 5/2) mottles; weak, fine and medium, subangular blocky structure; friable; few medium and large roots; common coarse pores; 25 percent gravel; medium acid; gradual, wavy boundary.

Bx—24 to 36 inches, brown (10YR 5/3) gravelly loam; common, medium and fine, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; weak, very coarse, prismatic structure parting to weak, coarse, subangular blocky; firm, brittle; few fine pores; 25 percent gravel; medium acid; gradual, irregular boundary.

IIC—36 to 60 inches, grayish-brown (2.5Y 5/2) stratified gravelly sand; grayish and brownish variegations and mottles; single grain; loose; 40 to 50 percent gravel; medium acid.

The solum ranges from 30 to 40 inches in thickness. Depth to the fragipan ranges from 24 to 30 inches. Depth to bedrock is more than 60 inches. The content of coarse fragments of sandstone and slate in the solum ranges from 15 to 30 percent. The content of coarse fragments in the C horizon ranges from 20 to 50 percent. Unless limed, these soils range from strongly acid to slightly acid.

The B horizon ranges from light olive brown (2.5Y 5/6) to brown (10YR 4/3). Mottles range from brown or strong brown to grayish brown or olive yellow, but they are not distinct or prominent in the upper 15 inches. The B horizon is sandy loam, loam, or gravelly analogs. The C horizon is layers of sand and gravelly sand.

Braceville soils are associated with Chenango, Hoosic, and Atherton soils. In contrast with Chenango and Hoosic soils, they have a fragipan and contain mottles. They do not have the gray matrix colors in the upper part of the B horizon that are common in Atherton soils.

Braceville gravelly sandy loam, 0 to 3 percent slopes (BrA).—This soil has the profile described as representative of the series. It is on slight rises and broad flat terraces along major streams. Included in mapping are a few spots of somewhat poorly drained to very poorly drained soils.

This soil is used for row crops, hay, pasture, and woodland. Under high-level management, it is suited to intensive cultivation. Seasonal wetness and moderately slow permeability in the fragipan are the major limitations to crops. Runoff is slow. The hazard of erosion is slight. Tile and surface drains reduce wetness. Capability unit IIw–24; woodland group 3o1.

Braceville gravelly sandy loam, 3 to 8 percent slopes (BrB).—This soil is on rises and low-lying kame terraces. Included in mapping are small spots of poorly drained to very poorly drained Atherton soils, some areas of somewhat poorly drained soils, and some areas of moderately eroded soils.

This soil is used for row crops, hay, pasture, and woodland. Under high-level management, it is suited to intensive cultivation. Erosion control is needed in cultivated areas. Seasonal wetness and moderately slow permeability in the fragipan are the major limitations to crops. Runoff is medium. The hazard of erosion is moderate. Random tile drains and diversion terraces reduce wetness. Capability unit IIw–24; woodland group 3o1.

Carlisle Series

The Carlisle series consists of deep, nearly level, very poorly drained organic soils. These soils formed in depressions or low areas formerly occupied by lakes or ponds. Over a period of thousands of years these areas filled gradually with an accumulation of plant remains or mixed mineral sediment and plant remains.

In a representative profile the surface layer is black, highly decomposed muck 12 inches thick. The next 36 inches is black, decomposed fibrous muck that contains partially decayed woody fragments. The lower part to a depth of 60 inches is dark reddish-brown, fibrous and woody muck.

Available water capacity is high. Permeability is moderately rapid to rapid. Natural fertility is high. In undrained areas the water level is at or near the surface most of the time.

Representative profile of Carlisle muck, ½ mile north of Newton, 100 feet west of Hicks Avenue:

Oa1—0 to 6 inches, black (5YR 2/1 on broken face and rubbed) sapric material; about 10 percent fibers, about 5 percent when rubbed; moderate, coarse, granular structure; friable; neutral; clear, wavy boundary.

Oa2—6 to 12 inches, black (5YR 2/1 on broken face and rubbed) sapric material; about 10 percent mainly woody fibers, about 5 percent when rubbed; moderate, coarse, granular structure; friable; neutral; abrupt, wavy boundary.

Oa3—12 to 48 inches, black (5YR 2/1 on broken face and rubbed) sapric material; about 40 percent fibers, 5 percent when rubbed; massive; friable; many woody fragments ¼ inch to 6 inches in diameter within a matrix of herbaceous fibers; neutral; clear, wavy boundary.

Oa4—48 to 60 inches, dark reddish-brown (5YR 2/2 on broken face and rubbed) sapric material; 20 percent fibers, less than 10 percent when rubbed; massive; mostly woody fibers and woody fragments ¼ inch to 6 inches in diameter; neutral.

The organic deposit is more than 51 inches thick. The material extending from a depth of 12 inches to at least 51 inches is dominantly sapric material, but layers of hemic material 1 to 6 inches thick occur in many profiles. Woody fragments of twigs, branches, logs, or stumps occur in some horizon of all profiles, and they make up as much as 30 percent of some horizons. Unless limed, these soils range from slightly acid to neutral.

The surface tier, 0 to 12 inches, has weak or moderate, coarse through fine granular structure. The subsurface tier, 12 to 35 inches, ranges from black (5YR 2/1) to dark brown (10YR 3/3) broken face and rubbed. Value or chroma changes up to 1 unit if material is rubbed and typically becomes darker if exposed to air. The subsurface tier is massive or has weak granular or subangular blocky structure. The bottom tier, 35 to 51 inches, is similar to the subsurface tier in color, composition, structure, and consistence.

Carlisle soils are associated with Sloan, Wayland, Atherton, Halsey, Livingston, and Norwich soils. They are deep organic deposits, and those associated soils are not. In some of the associated soils the surface layer is mucky and is less than 15 inches thick.

Carlisle muck (Ca).—Included with this soil in mapping are narrow bands of organic soils less than 51 inches thick around the edges. Also included are areas of Sloan, Wallkill, and Wayland soils.

Most areas are wooded with stands of elm, red maple, and other water-tolerant species. Successful cultivation depends on improved drainage. Drained areas have been used for vegetables, such as lettuce and onions, and for sod. Capability unit IIIw–41; woodland group 5w1.

Chenango Series

The Chenango series consists of deep, well-drained, gently sloping to very steep, gravelly soils on glacial outwash terraces. These soils formed in material derived predominantly from gray sandstone, shale, and siltstone and smaller amounts of limestone and igneous rock.

In a representative profile the plow layer is dark-brown gravelly fine sandy loam 9 inches thick. The subsoil is dark yellowish-brown gravelly sandy loam and gravelly loamy sand 27 inches thick. The substratum to a depth of 70 inches is dark-brown and grayish-brown, loose very gravelly loamy sand.

Available water capacity is moderately low. Permeability is moderately rapid in the surface layer and subsoil and rapid in the substratum. Natural fertility is moderate.

The less sloping Chenango soils generally are well suited to corn, small grain, alfalfa, and other crops. High-value crops generally need irrigation. The steeper soils are better suited to pasture and woodland than to most other uses.

Representative profile of Chenango gravelly fine sandy loam, 3 to 8 percent slopes, near Wallpack Bend, in the vicinity of the Lower Wallpack Bend cemetery, in a field:

Ap—0 to 9 inches, dark-brown (10YR 3/3) gravelly fine sandy loam; weak, fine, granular structure; very friable; many fine roots; 20 percent gravel; slightly acid; gradual, wavy boundary.

B21—9 to 21 inches, dark yellowish-brown (10YR 4/4) gravelly sandy loam; very weak, medium, subangular blocky structure; very friable; few fine roots in upper part, some medium roots throughout; 30 percent gravel; medium acid; gradual, wavy boundary.

B22—21 to 30 inches, dark yellowish-brown (10YR 4/4) gravelly sandy loam; weak, medium, subangular blocky structure; friable; 35 percent gravel; medium acid; gradual, wavy boundary.

B3—30 to 36 inches, dark yellowish-brown (10YR 4/4) and dark-brown (7.5YR 4/4) gravelly loamy sand; single grain; loose; 45 percent fine and medium gravel; medium acid.

IIC—36 to 70 inches, dark-brown (10YR 4/3) and grayish-brown (10YR 5/2) very gravelly loamy sand; single grain, loose; 65 percent hard gravel, capped on upper side with brown (7.5YR 5/2) loamy material, lower surfaces clean; medium acid.

The solum ranges from 24 to 36 inches in thickness. In places depth to firm glacial till is more than 45 inches. The content of coarse fragments ranges from 20 to 60 percent in individual horizons, but it averages more than 35 percent in the upper 40 inches and is 60 percent or more in the C horizon. Coarse fragments are dominantly pebble size, but in many soils a high proportion of cobblestone-size fragments occur in some horizons. The coarse fragments contain much material from red and gray sandstone, shale, and siltstone and, in places, small amounts of material from limestone. Unless limed, these soils are slightly acid to medium acid.

The A horizon is gravelly fine sandy loam, gravelly sandy loam, or cobbly sandy loam. The B horizon is yellowish brown (10YR 5/6) or dark yellowish brown (10YR 4/4) in the upper part and ranges to dark brown (7.5YR 4/4) in the B3 horizon. The B2 horizon ranges from gravelly sandy loam to gravelly loam. The C horizon typically is stratified, water-sorted gravelly sand or very gravelly or cobbly material generally many feet thick.

Chenango soils are principally associated with Braceville, Colonie, and Unadilla soils. They do not have the mottles that are common in Braceville soils. They contain more clay and less fine sand than Colonie soils. They are not so fine textured as Unadilla soils.

Chenango gravelly fine sandy loam, 3 to 8 percent slopes (ChB).—This soil has the profile described as representative of the series. It is on undulating terraces or outwash plains.

Included with this soil in mapping are a few small areas of nearly level soils, small areas of sandy loams and gravelly sandy loams, and a few areas of moderately eroded soils where the yellowish-brown subsoil has been mixed into the surface layer in plowing. Also included are some areas of Braceville soils and somewhat poorly drained soils and areas of soils on Wallpack Ridge that have scattered cobblestones on the surface and a firm layer of varying thickness between depths of 36 and 45 inches. Small areas of limestone ledge are also included.

This soil is suited to corn, vegetables, fruit, and alfalfa. Most areas are cultivated. Runoff is medium. The hazard of erosion is moderate. Erosion control is needed in cultivated areas. Capability unit IIs–7; woodland group 2o1.

Chenango gravelly fine sandy loam, 8 to 25 percent slopes (ChD).—The profile of this soil is similar to the one described as representative for the series, but the depth to the substratum is about 24 inches. This soil is on kames and long sloping mounds.

Included with this soil in mapping are some areas of soils where the surface layer is sandy loam or gravelly sandy loam. These areas make up about 25 percent of the mapped areas. Also included are small areas of limestone ledge and areas of soils on Wallpack Ridge are included that have scattered cobblestones on the surface and a firm layer of varying thickness between depths of 36 and 45 inches.

Although this soil is used for commonly grown field crops and for hay and pasture, it is better suited to small grain. Much of the acreage is idle. The slope, the severe erosion hazard, and the moderately low available water capacity are concerns in cultivated areas. Runoff is medium to rapid. Erosion control is needed in cultivated areas. Capability unit IVe–15; woodland group 2r1.

Chenango cobbly sandy loam, 3 to 15 percent slopes (CIC).—The profile of this soil is similar to the one described as representative of the series, but the depth to the substratum is about 24 inches, the content of cobblestones in the surface layer ranges from 10 to 15 percent, the content of gravel is about 15 percent, and the percentage of fine sand is less. This soil has uneven kamelike slopes.

Included with this soil in mapping are some moderately eroded soils, areas where the gravel content is less than 15 percent, and some areas where slopes are more than 15 percent.

This soil typically is used for pasture or woodland and for commercial sand and gravel. In some areas cobblestones have been removed and hay crops are grown. The moderately low available water capacity is the major limitation to crops. Strong slopes and the hazard of erosion are other limitations. Capability unit VIe–13; woodland group 2o1.

Chenango cobbly sandy loam, 15 to 35 percent slopes (CID).—The profile of this soil is similar to the one described as representative of the series, but the depth to the substratum is 24 inches, the content of cobblestones in the surface layer ranges from 10 to 15 percent, and the content of gravel is about 15 percent. This soil is on hilly to very steep kames and ground moraines.

Included with this soil in mapping are moderately eroded soils, small areas of gravelly sandy loam, and small areas where slopes are less than 15 percent.

This soil typically is wooded or brushy areas used for pasture. Extensive areas were once cleared but now are idle or are commercial sand and gravel pits. Runoff is rapid. The hazard of erosion is severe in cultivated fields. The moderately low available water capacity and the steep to very steep slopes are limitations. This soil is suited to occasional cultivation if the cropping system is predominantly meadow or sod crops. Capability unit VIe–13; woodland group 2r1.

Chippewa Series

The Chippewa series consists of deep, nearly level to gently sloping, poorly drained soils that have a fragipan in the subsoil. These soils are in low positions on the landscape. They formed in glacial till material derived predominantly from acid gray slate, yellowish-brown shale, and calcareous sandstone.

In a representative profile the surface layer is dark-gray silt loam 8 inches thick. The upper part of the subsoil is 13 inches thick, is light brownish-gray silt loam, has common light olive-brown and yellowish-brown mottles, and is firm. The lower part of the subsoil is 19 inches thick, is light brownish-gray gravelly loam, has strong-brown mottles, and is very firm. The substratum to a depth of 60 inches is gray gravelly fine sandy loam.

Available water capacity is moderate. Natural fertility is high. Permeability is moderately slow above the fragipan and slow in the pan.

In undrained areas the nonstony Chippewa soils are suited mainly to pasture or woodland. In drained areas they are suited to commonly grown field crops, hay, and pasture. The extremely stony Chippewa soils are not suited to cultivation, and they are used mainly for pasture and woodland.

Representative profile of Chippewa silt loam, 3 to 8 percent slopes, 2 miles north and 1½ miles east of Ross's Corner on County Route No. 565, near intersection of two township roads, along a stream:

A1—0 to 8 inches, dark-gray (10YR 4/1) silt loam; moderate, medium, granular structure; friable; many fine and medium roots; medium acid; abrupt, wavy boundary.

B2g—8 to 21 inches, light brownish-gray (2.5Y 6/2) silt loam; common, medium, faint, light olive-brown (2.5Y 5/4) and common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure, some platy structure in lower part; firm; few fine roots, mainly in upper part; medium acid; gradual, wavy boundary.

Bxg—21 to 40 inches, light brownish-gray (2.5Y 6/2) gravelly loam; common, medium, distinct, strong-brown (7.5 YR 5/8) mottles; weak, very coarse, prismatic structure parting to weak, medium, subangular blocky; 20 percent gravel; very firm; slightly acid; gradual, wavy boundary.

Cxg—40 to 60 inches, gray (N 6/0) gravelly fine sandy loam; common, coarse, distinct, yellowish-brown (10YR 5/6) and brownish-yellow (10YR 6/8) mottles; massive; very firm; 20 percent gravel; slightly acid.

The solum ranges from 40 to 50 inches in thickness. Depth to the fragipan ranges from 15 to 24 inches. The content of coarse fragments ranges from 0 to 25 percent throughout the A and upper part of the B horizon and is 20 percent or more in the lower part of the B horizon and in the C horizon. Coarse fragments are typically cobblestones and stones, but some are gravelly. Reaction ranges from medium acid to slightly acid in the A, B, and upper part of the C horizons and to neutral in the lower part of the C horizon.

The A1, or Ap, horizon is dark gray (10YR 4/1) to dark grayish brown (2.5Y 4/2). It is silt loam or loam. The B horizon ranges from grayish brown (2.5Y 5/2) or light olive gray (5Y 6/2) to gray (N 5/0). Mottles in the B horizon range from dark brown (7.5YR 4/4) to olive yellow (2.5Y 6/8). The B2 horizon ranges from clay loam to silt loam. The Bx horizon is firm or very firm and brittle. The C horizon ranges from gray (N 6/0) to dark gray (5Y 4/1). It ranges from gravelly fine sandy loam to gravelly silt loam.

Chippewa soils are associated with Albia and Valois soils. They do not have the brown matrix colors that are common in Valois soils. They have grayer matrix colors than Albia soils.

Chippewa extremely stony loam, 0 to 8 percent slopes (CmB).—The profile of this soil is similar to the one described as representative of the series, but the content of stones is 10 to 15 percent in the surface layer and 5 to 10 percent in the subsoil. Stones are 2 to 5 feet apart.

This soil generally is better suited to woodland than to other uses, but some areas have been cleared and are used for pasture. Stone content and excess water are the major limitations for farming. Capability unit VIIs–45; woodland group 5x1.

Chippewa silt loam, 3 to 8 percent slopes (CnB).—The profile of this soil is the one described as representative of the series. About 20 percent of this mapping unit is included areas of Chippewa soils where slopes are 8 to 15 percent. About 15 percent is included areas of eroded soils where the surface layer is lighter colored than this Chippewa soil. In both of these included areas, the surface layer is thinner.

This soil is better suited to pasture and woodland than to most other uses. Runoff is medium. The hazard of erosion is moderate in cultivated areas. Excess water is the major limitation to crops. In areas where excess water is controlled, this soil is suited to row crops, hay, and small grain. Capability unit IVw–44; woodland group 5w1.

Colonie Series

The Colonie series consists of deep, gently sloping to sloping, well-drained to excessively drained soils underlain by water-deposited strata of medium to coarse sand. These soils formed on glacial outwash plains and long, dunelike terraces along the Delaware River.

In a representative profile the plow layer is dark grayish-brown loamy fine sand 8 inches thick. The subsoil is brown, dark-brown and reddish-brown loamy fine sand and fine sand 57 inches thick. The substratum to a depth of 80 inches is grayish-brown sand.

Available water capacity is low. Permeability is moderately rapid to rapid. Natural fertility is low.

These soils mostly are wooded or idle. In areas where water is available for irrigation, vegetables and other high-value crops can be grown with good results. The gently sloping Colonie soils are used for field crops, vegetables, hay, and pasture.

Representative profile of Colonie loamy fine sand, 3 to 8 percent slopes, in Sandyston Township, 200 feet west of County Road No. 521, ½ mile south of intersection of Hainesville Road and County Road No. 521, in hay field:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loamy fine sand; weak, fine, granular structure; very friable; few to many fine roots; porous; medium acid; abrupt, smooth boundary.

B21—8 to 14 inches, dark-brown (7.5YR 4/4) loamy fine sand; very weak, fine, granular structure; very friable; few to many fine and medium roots; porous; medium acid; gradual, wavy boundary.

B22—14 to 36 inches, reddish-brown (5YR 4/4) fine sand; discontinuous fine sandy loam lamella 1 to 3 inches thick in lower part; single grain; loose; few, medium to large crop roots; medium acid; gradual, wavy boundary.

B23—36 to 55 inches, reddish-brown (5YR 4/4) fine sand; single grain; loose; medium acid; gradual, wavy boundary.

B24—55 to 65 inches, brown (7.5YR 5/4) fine sand; few, dark-brown (7.5YR 4/4), discontinuous loamy fine sand lamella 1 to 3 inches thick; single grain; loose to very friable; medium acid; gradual, wavy boundary.

C—65 to 80 inches, grayish-brown (10YR 5/2) sand; single grain; loose; medium acid.

The solum ranges from 50 to 75 inches in thickness. Depth to a major nonconforming layer is more than 10 feet. The content of coarse fragments is less than 5 percent throughout the profile. Unless limed, these soils are dominantly medium acid, but range to strongly acid. Loamy fine sand or fine sand predominates throughout the solum, and thin discontinuous fine sandy loam or loamy fine sand lamellae occur in the lower horizons. The combined thickness of the lamellae, to a depth of 6 feet, is less than 6 inches.

The B horizon ranges from 10YR to 5 YR in hue, from 4 to 6 in value, and from 3 to 6 in chroma. It is very friable or loose, but the lamellae are friable. The C horizon is dominantly sandy, but in places thin gravelly layers occur below a depth of 80 inches.

Colonie soils are associated with Chenango and Unadilla soils. They contain less clay than those soils.

Colonie loamy fine sand, 3 to 8 percent slopes (CoB).—This soil has the profile described as representative of the series. It is on undulating uplands and outwash terraces. Included in mapping are small areas of Chenango soils and a few areas of Unadilla soils.

This soil is used most extensively for hay, pasture, and woodland. In some places it is used for vegetables. Runoff is slow to medium. The hazard of erosion is moderate. Erosion control is needed in cultivated areas. Irrigation is generally needed where high-value crops are grown. Capability unit IVs–12; woodland group 4s1.

Colonie loamy fine sand, 8 to 15 percent slopes (CoC).—Included with this soil in mapping are spots of Chenango soils.

This soil is better suited to wildlife habitat or to woodland and pasture than to most other uses. Runoff is medium. The strong slopes, the low available water capacity, and the moderate hazard of erosion are limitations for crops. Capability unit VIIs–12; woodland group 4s1.

Fredon Series

The Fredon series consists of deep, nearly level to gently sloping, poorly drained soils underlain by stratified sandy and gravelly water-deposited material. These soils formed in glacial outwash material derived predominantly from gray sandstone, shale, and siltstone. They are on glacial stream terraces slightly above stream flood plains, in the lowest depressions, and in a few seep spots in pockets of steeper slopes.

In a representative profile the plow layer is mottled, dark grayish-brown loam 7 inches thick. The subsoil is 23 inches thick. It is mainly grayish-brown very fine sandy loam that has distinct, yellowish-brown and light olive-brown mottles. The substratum to a depth of 60 inches is olive and olive-gray stratified very gravelly sand.

Available water capacity is moderate. A high water table keeps these soils saturated for long periods in winter, in spring, and early in summer. Permeability is moderate in the subsoil and moderate to moderately rapid in the substratum. Natural fertility is moderate.

These soils are wet, and only a small acreage has been cleared for farming. Most cleared areas have been drained and are used for corn, hay, or pasture. These soils are not well suited to alfalfa and other deep-rooted legumes.

Representative profile of Fredon loam, 3 to 8 percent slopes, 1¼ miles south of Branchville, on low plain south of Paulins Kill tributary, 250 feet east of road and 200 feet northeast of barn:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam; light brownish-gray (10YR 6/2) when dry; common, fine, pale-brown (10YR 6/3) and brownish-yellow (10YR 6/8) mottles; weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

B1g—7 to 10 inches, grayish-brown (2.5Y 5/2) very fine sandy loam; light olive-brown (2.5Y 5/6) mottles; weak, medium, subangular blocky structure; friable; medium acid; gradual, smooth boundary.

B21g—10 to 16 inches, grayish-brown (2.5Y 5/2) very fine sandy loam; many, fine, distinct, yellowish-brown (10YR 5/8) and light olive-brown (2.5Y 5/6) mottles; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; friable; many worm channels; medium acid; clear, wavy boundary.

B22g—16 to 26 inches, grayish-brown (2.5Y 5/2) fine sandy loam; many, medium, distinct, light olive-brown (2.5Y 5/6) and yellowish-brown (10YR 5/6) mottles; weak, coarse, prismatic structure parting to thick, platy and moderate, medium, subangular blocky; firm; fine roots; 10 percent gravel; medium acid; clear, wavy boundary.

IIB3—26 to 30 inches, strong-brown (7.5YR 5/8), yellowish-red (5YR 5/8), and 20 percent grayish-brown (2.5Y 5/2) very gravelly sandy loam; massive; friable; 60 percent sandstone, shale, and limestone gravel; medium acid; smooth, abrupt boundary.

IIC—30 to 60 inches, olive (5Y 5/4) and olive-gray (5Y 5/2) stratified very gravelly sand; single grain; loose; neutral in upper part and grades to calcareous below.

The solum ranges from 22 to 35 inches in thickness. Depth to bedrock is more than 6 feet. The solum is mainly fine sandy loam and loam but ranges to silt loam that is more than 30 percent fine or coarser textured sand. The upper part of the solum is 10 to 15 percent gravel by volume, and the lower part and the C horizon are 60 percent or more.

In uncultivated areas the A1 horizon ranges from 3 to 5 inches in thickness and is black when moist and gray when dry. The A2 horizon, if present, is 10YR or 2.5Y in hue, 5 or 6 in value, and 2 or 3 in chroma. It contains mottles that have chroma as high as 6. The B1 and B2 horizons range from 10YR through 5Y in hue and are 5 or 6 in value. They contain mottles that have a hue ranging from 2.5Y to 5YR and a value of 5 or 6; chroma mainly is 4 or 6, but in some places it is 8. The B3 horizon ranges from strong brown (7.5YR 5/8) to yellowish red (5YR 5/6). It contains grayish-brown to dark-brown mottles. The C horizon ranges from olive gray (5Y 5/2) through olive brown (2.5Y 4/4) and dark yellowish brown (10YR 4/4). Free lime is common between depths of 4 and 6 feet.

Fredon soils are associated with Hazen, Hero, and Halsey soils. They have grayer matrix colors in the B horizon than the Hazen and Hero soils. They have less gray matrix colors throughout than Halsey soils.

Fredon loam, 0 to 3 percent slopes (FrA).—The profile of this soil is similar to the one described as representative of the series, but the depth to the substratum is more than 30 inches. Included in mapping are small pockets of shallow muck and very poorly drained Halsey soils.

Adequately drained areas of this soil are used for corn and improved pasture. Undrained areas are used for woodland and unimproved pasture. Wetness is the major limitation. The high water table must be lowered before this soil can be used for most crops. Capability unit IIIw–36; woodland group 4w1.

Fredon loam, 3 to 8 percent slopes (FrB).—This soil has the profile described as representative for the series. It is on slight rises on stream terraces. Included in mapping are small areas of very poorly drained Halsey soil and shallow muck.

Adequately drained areas of this soil are suited to corn and pasture. Undrained areas are suited to woodland and unimproved pasture. Wetness is the major limitation to crops. The water table is at a depth of 6 to 12 inches, and it must be lowered before this soil is used for crops. Capability unit IIIw–36; woodland group 4w1.

Halsey Series

The Halsey series consists of nearly level, very poorly drained soils that are moderately deep over sand. These soils are in shallow depressions, broad areas near streams, and depressions in more sloping areas. They formed in glacial outwash material derived predominantly from gray sandstone, shale, and siltstone.

In a representative profile the plow layer is very dark gray loam 10 inches thick. The subsurface layer is mottled gray loam 8 inches thick. The subsoil is gray and light olive-gray loam and very fine sandy loam, is 12 inches thick, and has many, distinct, yellowish-brown and strong-brown mottles. The substratum to a depth of 60 inches is stratified gray and light olive-brown very gravelly sand.

Available water capacity is moderate. Permeability is moderate in the subsoil and rapid in the substratum. Natural fertility is moderate. A high water table keeps these soils saturated most of the year. Roots of many plants are restricted by the high water table.

Large acreages are woodland and pasture. Some areas have been drained and are used for corn, vegetables, and hay. Some drained areas are used for pasture.

Representative profile of Halsey loam, 1¼ miles south of Branchville, 250 feet south of small stream, 200 feet east of road, and 250 feet north of barn:

Ap—0 to 10 inches, very dark gray (10YR 3/1) light loam, gray (10YR 5/1) when dry and crushed; very weak, fine, granular structure; friable; medium acid; abrupt, smooth boundary.

A2g—10 to 18 inches, gray (10YR 6/1) loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles on ped surfaces and in ped interiors; moderate, medium, prismatic structure; friable, very hard when dry; few pebbles ¼ to ¾ inch in diameter; medium acid; clear, wavy boundary.

B2g—18 to 24 inches, gray (10YR 6/1) loam; many, medium, distinct, yellowish-brown (10YR 5/6) and strong-brown (7.5YR 5/8) mottles in ped surfaces and in ped interiors; moderate, medium, platy structure; friable, very hard when dry; few thin clay films line voids; 15 percent gravel in lower part; medium acid; gradual, wavy boundary.

B3g—24 to 30 inches, light olive-gray (5Y 6/2) very fine sandy loam; many, coarse, distinct, yellowish-brown (10YR 5/4) mottles that decrease in number and contrast with increasing depth; weak, medium, platy structure; friable; medium acid; clear boundary.

IIC—30 to 60 inches, gray (N 5/0) and light olive-brown (2.5Y 5/4), stratified very gravelly sand; single grain; loose; mainly quartz, sandstone, slate, and shale fragments; slightly acid in upper part, mildly alkaline below; calcareous at a depth of about 48 inches.

The solum ranges from 22 to 34 inches in thickness and varies widely within short distances. Depth to bedrock is 6 feet or more. The gravel content ranges from 0 to 15 percent in the solum and to as much as 60 percent in the C horizon. Reaction ranges from medium acid to neutral throughout most of the solum, and to mildly alkaline in the C horizon. Depth to free lime ranges from 36 to 60 inches.

The Ap, or A1, horizon is black, very dark gray, or very dark brown (moist) and has a hue of 10YR or 2.5Y, a value of 2 or 3, and a chroma of 0, 1, or 2. The A2 horizon is predominantly gray (10YR 6/1) and has yellowish-brown (10YR 5/4 or 5/6) mottles. The B horizon is commonly gray, but ranges from gray (10YR 6/1) through light brownish gray (2.5Y 6/2) to light olive gray (5Y 6/2) or olive gray (5Y 5/2). It contains common to many medium or coarse mottles of yellowish brown (10YR 5/4 or 5/6), strong brown (7.5YR

5/6 or 5/8), light olive brown (2.5Y 5/4), and brown (10YR 4/3); mottles generally decrease in number and contrast with increasing depth. The B horizon is commonly loam or very fine sandy loam. The C horizon is dominantly gray and is as coarsely mottled as the B horizon to a depth of at least 30 inches. Below this depth, mottling fades and gray (N 5/0), light olive brown (2.5Y 5/4), or brown (10YR 4/3) colors predominate. The C horizon is loose or firm, stratified gravelly sand.

Halsey soils are associated with Fredon, Hero, and Carlisle soils. They typically have a darker colored A horizon and have grayer matrix colors throughout the B horizon than Fredon and Hero soils. They differ from Carlisle soils in not having a deep organic profile.

Halsey loam (Ha).—This is a wet soil. It is in low areas, and it has a high water table. Slopes are commonly less than 3 percent. Included in mapping are small areas of poorly drained Fredon soils and shallow muck and small areas where slopes are more than 3 percent.

If adequately drained, this soil is suited to corn and improved pasture. Open ditches and tile drains are used where drainage outlets are available. Ponding is a risk during long wet periods. Capability unit IIIw–36; woodland group 5w1.

Hazen Series

The Hazen series consists of deep, nearly level to very steep, well-drained soils that are underlain by stratified sand and gravel at a depth of 20 to 40 inches. These soils formed in glacial outwash deposit derived predominantly from slate, shale, and sandstone. They are on terraces and mounds in the central valleys that extend throughout Sussex County.

In a representative profile the plow layer is very dark grayish-brown gravelly loam 8 inches thick. The subsoil is yellowish-brown and dark-brown gravelly sandy loam and gravelly loam 16 inches thick. The substratum to a depth of 70 inches is stratified layers of gravelly sand and sand.

Available water capacity is moderate. Permeability is moderate in the surface layer and subsoil and rapid in the substratum. Natural fertility is moderate.

The nearly level to sloping soils are well suited to corn, small grain, vegetables, hay, and pasture. The steeper soils are better suited to pasture and woodland than to most other uses.

Representative profile of Hazen gravelly loam, 3 to 8 percent slopes, at the edge of a sand and gravel pit, 150 feet east of County Road No. 565, 2.7 miles north of Ross Corner, in a cultivated area:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) gravelly loam; weak, fine, granular structure; friable; many fine and medium roots; many fine to large pores; 15 percent rounded gravel; medium acid; abrupt, smooth boundary.

B1—8 to 16 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; moderate, medium, subangular blocky structure; friable; many medium and fine roots; many fine and medium pores; 15 percent rounded gravel; medium acid; gradual, wavy boundary.

B2t—16 to 24 inches, dark-brown (7.5YR 4/4) gravelly loam; moderate and strong, coarse, subangular blocky structure; firm; thin, patchy clay films on ped faces; many fine pores; 20 percent rounded gravel; medium acid; clear, smooth boundary.

IIC—24 to 70 inches, dark-brown (7.5YR 4/4) stratified gravelly sand and sand; single grain; loose; 40 percent gravel; neutral.

The solum ranges from 20 to 40 inches in thickness. Gravel content ranges from 15 to 35 percent in the solum and from 10 to 65 percent in the IIC horizon. Reaction ranges from medium acid to slightly acid in the solum and from neutral to mildly alkaline in the C horizon.

The Ap, or A1, horizon ranges from 7.5YR 3/2 to 10YR 3/3. It is loam or sandy loam and is gravelly in places. The B1 horizon has a value of 4 or 5 and is gravelly sandy loam or gravelly loam. The B2t horizon ranges from dark brown (7.5YR 4/4) to yellowish brown (10YR 5/6) and typically is gravelly loam or gravelly sandy loam. The C horizon ranges from 2.5Y to 7.5YR in hue, is 4 or 5 in value, and ranges from 3 to 6 in chroma. It is sand or loamy sand and gravelly or very gravelly in places.

Hazen soils are associated with Fredon, Hero, and Palmyra soils. In contrast with Fredon soils, they do not have low chroma matrix colors in the B horizon. In contrast with Hero soils, they do not contain mottles in the B horizon. They contain less clay in the upper part of the B horizon than Palmyra soils.

Hazen gravelly loam, 0 to 3 percent slopes (HfA).—The profile of this soil is similar to the one described as representative of the series, but the depth to the substratum is about 30 inches. Included in mapping are small spots of Hero loam, mostly in closed depressions. Also included are some areas of Hazen soils where slopes are more than 3 percent.

This soil is well suited to corn, small grain, fruit, and pasture. Runoff is slow. The hazard of erosion is slight. Capability unit I–6; woodland group 3o1.

Hazen gravelly loam, 3 to 8 percent slopes (HfB).—The profile of this soil is the one described as representative of the series. Included in mapping are small areas where the content of gravel is less than 15 percent and areas of moderately eroded soils where the yellowish-brown subsoil has been mixed into the surface layer in plowing.

This soil is better suited to corn, small grain, fruit, hay, and pasture than to most other uses. Control of the medium runoff and the moderate hazard of erosion is needed. Capability unit IIe–6; woodland group 3o1.

Hazen gravelly loam, 8 to 25 percent slopes (HfD).—The profile of this soil is similar to the one described as representative of the series, but the depth to the substratum is about 20 inches. This soil is on terraces and side slopes of mounds.

Included with this soil in mapping are similar soils where the depth to the substratum ranges from 15 to 20 inches.

This soil is used for commonly grown field crops and for hay and pasture. It is better suited to drought-resistant grasses and legumes than to other plants. Runoff is medium to rapid, and the erosion is moderate to severe in cultivated areas. Control of runoff and erosion is needed. Crop yields are reduced during dry periods. Capability unit IVe–11; woodland group 3r1.

Hazen and Palmyra gravelly sandy loams, 25 to 45 percent slopes (HgE).—Areas of this mapping unit are dominantly the Hazen soil or the Palmyra soil or any combination of these soils.

Included with these soils in mapping are soils where the sandy loam surface layer is underlain by a gravelly and sandy substratum at a depth of less than 20 inches. Also included are soils that are very gravelly and sandy throughout.

These soils are mostly woodland or unimproved pasture because the very steep slopes limit use. Sand and

gravel pits are common. Capability unit VIIe–10; woodland group 3r1.

Hero Series

The Hero series consists of deep, nearly level to gently sloping, moderately well drained soils underlain by stratified sand and gravel at a depth of 20 to 32 inches. These soils formed in glacial outwash material, predominantly of slate, shale, sandstone, and small amounts of limestone. They occupy broad flats or slight rises along stream terraces in the central valleys.

In a representative profile the plow layer is very dark grayish-brown loam 10 inches thick. The subsoil is light olive-brown fine sandy loam and gravelly sandy loam, is 14 inches thick, and has mottles in the lower part. The substratum to a depth of 64 inches is dark grayish-brown stratified gravelly sand, sand, and very gravelly sand.

Available water capacity is moderate. Permeability is moderately rapid to rapid. A seasonal high water table is at a depth of 1½ to 3 feet. It restricts internal drainage in winter and spring, but it drops several feet in summer. Natural fertility is moderate.

These soils are suited to field and specialty crops that tolerate some wetness. They are well suited to hay and pasture of water-tolerant grasses and legumes. Excess water in the soil delays seedbed preparation in spring and causes frost heaving. Drainage improvement is needed if high-value crops are grown.

Representative profile of Hero loam, 3 to 8 percent slopes, in Green Township, adjacent to Trinka Airport, 1,760 feet north of runway along Lehigh and Hudson River Railroad, between railroad and County Road No. 517, in a field:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, granular structure; very friable; many fine and medium roots; 10 percent gravel; medium acid; abrupt, wavy boundary.

B21—10 to 17 inches, light olive-brown (2.5Y 5/4) fine sandy loam; weak, medium, subangular blocky structure; very friable; many fine roots; 10 percent gravel; medium acid; gradual, wavy boundary.

B22—17 to 24 inches, light olive-brown (2.5Y 5/4) gravelly sandy loam; common, fine, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/6) mottles; massive; friable; few large roots; 20 percent gravel; medium acid; clear, wavy boundary.

IIC—24 to 64 inches, dark grayish-brown (10YR 4/2) stratified gravelly sand, sand, and very gravelly sand; few, yellowish-brown (10YR 5/6), weathered limestone pebbles; single grain; loose; neutral.

The solum ranges from 20 to 32 inches in thickness. Depth to bedrock is more than 5 feet and generally is more than 10 feet. Gravel content ranges from 10 to 20 percent in the solum and generally increases with increasing depth. Gravel content in the IIC horizon ranges from 50 to 65 percent or more. Reaction ranges from medium acid to neutral in the A and B horizons and to mildly alkaline in the C horizon.

The Ap horizon has a hue of 10YR or 2.5Y, a value of 3 or 4, and a chroma of 2. The B horizon has a hue of 10YR or 2.5Y, a value of 4 or 5, and a chroma of 4 in the upper part and 3 or 4 in the lower part. It contains low-chroma mottles between depths of 12 to 20 inches. It ranges from fine sandy loam to gravelly sandy loam. The C horizon is stratified sand and gravel. It is dominantly loose, but some layers below 5 or 6 feet are weakly cemented.

Hero soils are associated with Hazen, Palmyra, Fredon, and Halsey soils. They contain mottles and Hazen and Palmyra soils do not. They do not have the low-chroma matrix colors in the B horizon that are common in Fredon and Halsey soils.

Hero loam, 0 to 3 percent slopes (HkA).—Included with this soil in mapping are areas where the surface layer is sandy loam or fine sandy loam. These areas make up about 10 to 15 percent of the unit. Also included are small areas of Hazen and Palmyra soils and scattered, small areas of Fredon and Halsey soils that are wetter than Hero soils.

If adequately drained, this soil is suited to corn, small grain, hay, and pasture. Wetness is the major limitation to cultivation. Runoff is slow. The hazard of erosion is slight. Roots are sometimes restricted by the seasonal high water table. Tile drains help to control wetness in depressions and seep areas. Capability unit IIw–25; woodland group 3o1.

Hero loam, 3 to 8 percent slopes (HkB).—The profile of this soil is the one described as representative of the series. Included in mapping are small areas of soils where the surface layer is sandy loam or fine sandy loam and some areas where the gravel content in the surface layer is more than 15 percent. Also included are scattered, small areas of Fredon and Halsey soils and small areas of Hazen and Palmyra soils especially where the latter two soils are adjacent.

This soil is used for most general field crops and for hay and pasture. If adequately drained, it is well suited to small grain and grasses and legumes. Wetness is the main limitation. Runoff is medium. The hazard of erosion is moderate. Roots are sometimes restricted by the seasonal high water table. Diversions, terraces, cover crops, and contour strips are used to control runoff and erosion. Tile drains are needed in depressions and seep areas. Capability unit IIw–25; woodland group 3o1.

Hibernia Series

The Hibernia series consists of deep, gently sloping to steep, somewhat poorly drained soils that have a fragipan in the lower part of the subsoil. These soils formed in glacial till primarily of granite gneiss and small amounts of quartzite, shale, and sandstone. They occupy undulating and hilly glacial moraine landscapes and slightly concave drainageways.

In a representative profile the surface layer is 5 inches of very dark grayish-brown cobbly loam that contains many stones. The subsoil is 31 inches thick and is mottled in the lower 26 inches. The upper 15 inches is yellowish-brown cobbly loam and gravelly loam. The lower part is a fragipan of firm, dark yellowish-brown gravelly loam. The substratum to a depth of 72 inches is very firm, brittle gravelly sandy loam.

Available water capacity is moderate. Permeability is moderate above the fragipan and slow in the pan. Natural fertility is moderate. A seasonal water table is at a depth of 1 foot late in winter and early in spring.

Very stony areas of these soils are better suited to woodland than to most other uses. Some areas have been cleared and farmed. These areas are suited to crops commonly grown in the county.

Representative profile of Hibernia cobbly loam in an area of Hibernia very stony loam, 3 to 8 percent slopes, in Vernon Township, 1 mile west of Lake Pochung, 100 feet into wooded area south of road:

A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) cobbly loam; weak, fine, granular structure; friable;

many fine and medium roots; porous; 30 percent cobblestones, stones, and gravel; strongly acid; gradual, wavy boundary.

B1—5 to 10 inches, yellowish-brown (10YR 5/4) cobbly loam; weak, fine, subangular blocky structure; friable; abundant fine and medium roots; porous; 30 percent coarse fragments of cobblestones, stones, and gravel; strongly acid; gradual, wavy boundary.

B2t—10 to 20 inches, yellowish-brown (10YR 5/6) gravelly loam; many, fine, light brownish-gray (10YR 6/2) and brownish-yellow (10YR 6/8) mottles; moderate, fine, subangular blocky structure; friable; thin, patchy, discontinuous silt and clay films on ped faces, bridging of fines; few medium and large roots; 25 percent gravel, cobblestones, and stones; strongly acid; gradual, wavy boundary.

Bx—20 to 36 inches, dark yellowish-brown (10YR 4/4) gravelly loam; many, coarse, distinct, yellowish-brown (10YR 5/8) and light brownish-gray (2.5Y 6/2) mottles; massive parting to weak, thick plates; firm, brittle; bridging of fines; common, patchy, thin to thick clay films on ped faces; 25 percent gravel, cobblestones, and stones; strongly acid; gradual, wavy boundary.

Cx—36 to 72 inches, grayish-brown (2.5Y 5/2) gravelly sandy loam; common, coarse, distinct, yellowish-brown (10YR 5/6) and light olive-gray (5Y 6/2) mottles; massive; very firm, brittle; 25 percent cobblestones and stones; strongly acid.

The solum ranges from 24 to 36 inches in thickness. Depth to the fragipan is 20 to 30 inches. Depth to gneissic bedrock generally is 5 feet but ranges to 10 feet or more in some places. The content of coarse fragments, mainly cobblestones, stones, and gravel, ranges from 15 to 35 percent throughout the solum. Most surface stones and cobblestones have been removed from cleared fields, but the subsoil is still 10 to 30 percent coarse fragments. Unless limed, these soils are strongly acid.

The B horizon is loam or sandy loam and is gravelly or cobbly in places. The B2t horizon has a hue of 7.5YR, 10YR, or 2.5Y, a value of 4 or 5, and a chroma of 4 to 6. It contains mottles that are 10YR or 2.5Y in hue, 5 or 6 in value, and 2 to 8 in chroma. The Bx horizon is firm to very firm and brittle. The Cx horizon is massive, firm, or very firm and brittle.

Hibernia soils are associated with Rockaway and Whitman soils. They contain grayish mottles in the upper part of the B horizon and Rockaway soils do not. They do not have gray matrix colors so near the surface as Whitman soils.

Hibernia gravelly loam, 3 to 8 percent slopes (HmB).—This soil has a profile similar to the one described as representative of the series, but it contains fewer stones. It is on undulating uplands along the terminal moraine.

Included with this soil in a few places are very stony areas or areas of Hibernia soils where slopes are 8 to 20 percent. Also included are areas of Rockaway soils where slopes are 3 to 8 percent slopes. The included areas of Rockaway soils make up as much as 20 percent of some mapping units.

This soil is suited to most crops grown in the county, but is poorly suited to alfalfa and other deep-rooted crops. Winterkill is a hazard. Wetness is the major limitation. Runoff is medium. The hazard of erosion is slight to moderate in cultivated areas. Diversion terraces have been installed to remove excess water and control erosion. Capability unit IIIw–28; woodland group 2w1.

Hibernia very stony loam, 3 to 8 percent slopes (HnB).—The profile of this soil is the one described as representative of the series. The surface layer and subsoil are 1 to 3 percent stones 5 to 30 feet apart. Included in the mapping are some areas where slopes are more than 8 percent and areas of Rockaway very stony loam.

This soil is better suited to pasture and woodland than to most other uses. Most areas are wooded. Runoff is medium. The hazard of erosion is moderate in areas cleared of trees and shrubs. Stoniness is the major limitation, but excess water is also a limitation. Stones make it impractical to use machinery for cultivation, pasture management, or tree planting. Capability unit VIs–19; woodland group 2w1.

Hibernia very stony loam, 8 to 25 percent slopes (HnD).—Stones in this soil are 5 to 30 feet apart. Included in mapping are areas where slopes are less than 8 percent and areas of Rockaway soils.

Stones limit the use of this soil to pasture and woodland. Water-tolerant grasses and legumes are desirable for pasture. Runoff is medium to rapid. The hazard of erosion is moderate to severe if trees are removed. Capability unit VIs–19; woodland group 2r1.

Hoosic Series

The Hoosic series consists of deep, gently sloping to steep, somewhat excessively drained soils underlain by stratified sand and gravel. These soils are on undulating glacial outwash plains and valley trains and steep side slopes of kames and eskers.

In a representative profile the surface layer is very dark grayish-brown gravelly loam 7 inches thick. The upper 16 inches of the subsoil is yellowish-brown and dark yellowish-brown gravelly sandy loam. The lower 7 inches is dark yellowish-brown gravelly loamy sand. The substratum to a depth of more than 60 inches is dark grayish-brown, stratified very gravelly sand.

Available water capacity is low. Permeability is moderately rapid in the subsoil and rapid in the substratum. Natural fertility is moderate.

These soils are suited to all crops commonly grown in the county, but they are best suited to small grain. Yields of summer crops are lower during dry periods. Irrigation is needed if high-value crops are grown.

Representative profile of Hoosic gravelly loam, 3 to 8 percent slopes, 2 miles north of borough of Sussex, 450 feet west of State Road No. 23 bridge over Clove Brook, 35 feet east of Wantage Township Road, in a pasture:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) gravelly loam; weak, medium, granular structure; friable; many fine roots; 20 percent gravel; strongly acid; abrupt, smooth boundary.

B21—7 to 14 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; weak, fine and medium, granular structure; friable; many fine and medium roots; 25 percent gravel; strongly acid; clear, wavy boundary.

B22—14 to 23 inches, dark yellowish-brown (10YR 4/4) gravelly sandy loam, moderate, medium and fine, granular structure; very friable; few fine roots; 30 percent gravel; strongly acid; gradual, wavy boundary.

B3—23 to 30 inches, dark yellowish-brown (10YR 4/4) gravelly loamy sand, very weak, fine, granular structure; very friable; 40 percent fine gravel; strongly acid; gradual, wavy boundary.

IIC—30 to 60 inches, dark grayish-brown (10YR 4/2) stratified very gravelly sand; single grain; loose; strongly acid; 60 percent gravel.

The solum ranges from 22 to 36 inches in thickness. Depth to bedrock is 6 feet or more and generally is more than 10 feet. The content of coarse fragments, dominantly gravel derived from slate and shale, ranges from 20 to 40 percent in the solum and from 35 to 60 percent in the C horizon. Unless limed, these soils are dominantly strongly acid to a depth of about 30 inches and range to medium acid in the lower part of the C horizon.

The Ap horizon is 10YR in hue, 3 or 4 in value, and 2 in chroma. The B horizon is dominantly 10YR in hue, but in some places ranges to 7.5YR; value is 4 or 5 and chroma is 4 or 6. The B horizon is gravelly sandy loam or sandy loam in the upper part and grades to gravelly loamy sand in the lower part. The IIC horizon is stratified loose sand or loamy sand, which in places is gravelly or very gravelly.

Hoosic soils are associated with Braceville and Raynham soils. In contrast with Braceville soils, they do not contain mottles and do not have a fragipan. They contain more medium-textured and coarse-textured sand and coarse-textured fragments than Raynham soils.

Hoosic gravelly loam, 3 to 8 percent slopes (HoB).—The profile of this soil is the one described as representative of the series. Included in mapping are areas of Hoosic gravelly sandy loam and Hoosic loam and some areas where the depth to sand and gravel is less than 22 inches. Also included are small, scattered wet spots of Braceville soils.

This soil is suited to most crops commonly grown in the county. Droughtiness is the major limitation to cultivation. Runoff is slow. The hazard of erosion is slight. Maintaining the content of organic matter, conserving moisture, and controlling erosion are essential. Irrigation of high-value crops generally is needed. Capability unit IIs–7; woodland group 3o1.

Hoosic gravelly loam, 8 to 25 percent slopes (HoD).—The profile of this soil is similar to the one described as representative of the series, but the depth to sand and gravel is less. Included in mapping are some areas of gravelly sandy loam and Hoosic loam and some areas where the depth to sand and gravel is less than 22 inches.

This soil is not well suited to cultivated crops because it is droughty and strongly sloping. Runoff is medium to rapid. Maintaining the content of organic matter, conserving moisture, and controlling erosion are the major needs in cultivated areas. Lower slopes are suitable for row crops if erosion can be controlled. Steep slopes are better suited to small grain, hay, pasture, woodland, and wildlife habitat than to most other uses. Capability unit IVe–15; woodland group 3r1.

Lackawanna Series

The Lackawanna series consists of deep, gently sloping to very steep, well-drained soils that have a fragipan in the lower part of the subsoil. These soils formed in glacial till derived from a mixture of the red, gray, or brown siltstone, shale, sandstone, and quartzite near the Kittatinny Mountain.

In a representative profile the plow layer is brown gravelly fine sandy loam 8 inches thick. The subsurface layer is reddish-brown gravelly fine sandy loam 7 inches thick. The subsoil is 40 inches thick. The upper 11 inches is reddish-brown gravelly loam, and the lower part is a fragipan of reddish-gray gravelly loam. The substratum to a depth of 60 inches is weak-red gravelly fine sandy loam.

Available water capacity is moderately low. Permeability is moderate in the upper part of the subsoil and slow in the fragipan. Natural fertility is moderately low.

These soils have been used for hay, corn, and other row crops and for woodland. Most areas formerly farmed are idle and are reverting to woodland.

The Lackawanna soils in this county are mapped only with Swartswood soils.

Representative profile of Lackawanna gravelly fine sandy loam, in an area of Swartswood and Lackawanna very stony soils, 8 to 25 percent slopes, 1½ miles west of Stokes State Forest Office, opposite Deer Lake:

Ap—0 to 8 inches, brown (7.5YR 4/2) gravelly fine sandy loam; moderate, fine, granular structure; very friable; stones common; 20 percent gravel and cobblestones; strongly acid; abrupt, wavy boundary.

A2—8 to 15 inches, reddish-brown (5YR 4/4) gravelly fine sandy loam; weak, thin platy structure parting to weak, fine granules; friable; stones common, 20 percent gravel and cobblestones; strongly acid; clear, wavy boundary.

B2—15 to 26 inches, reddish-brown (5YR 4/4) gravelly loam; weak, medium, subangular blocky structure; friable; few, thin, patchy clay films; stones common, 20 percent gravel and cobblestones; strongly acid; clear, wavy boundary.

Bx—26 to 55 inches, reddish-gray (5YR 5/2) gravelly loam; reddish-brown (5YR 4/4) lenses; weak, very coarse, prismatic structure parting to weak, coarse, subangular blocky; very firm, brittle; few, thin, patchy clay films; 30 percent gravel, cobblestones, and stones; strongly acid; diffuse, wavy boundary.

Cx—55 to 60 inches, weak-red (2.5YR 5/2) gravelly light fine sandy loam; massive; very firm, brittle; 30 percent gravel and cobblestones; strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is 42 inches or more. Depth to the Bx horizon ranges from 16 to 26 inches. The content of coarse fragments, dominantly stones and gravel, ranges from 10 to 30 percent. Most surface stones have been removed in cleared fields. Unless limed, these soils range from strongly acid in the surface layer to strongly acid or slightly acid in the C horizon. These soils range from fine sandy loam to silt loam and in places are gravelly.

The Ap horizon ranges from 7.5YR to 5YR in hue and has a value of 4 and a chroma of 2 or 3. The B horizon ranges from 5YR to 2.5YR in hue and is 4 or 5 in value and 2, 3, or 4 in chroma. In some places the Bx horizon rests on red sandstone or red siltstone bedrock.

Lackawanna soils are associated with Swartswood, Wurtsboro, and Oquaga soils. They are redder and finer textured than Swartswood and Wurtsboro soils. They are deeper over bedrock than Oquaga soils.

Livingston Series

The Livingston series consists of deep, nearly level, very poorly drained soils that have a fine-textured subsoil. These soils formed in clay deposits in low positions on the landscape. Some areas are subject to occasional overflow.

In a representative profile the surface layer is black silty clay loam 10 inches thick. The subsoil is dark-gray clay, is 20 inches thick, and has distinct or prominent mottles. The substratum to a depth of 60 inches is mottled gray clay.

Available water capacity is high. A perched water table is near the surface for long periods during the year because these soils are fine textured and are in low positions. These soils are ponded late in winter and early in spring. Permeability is slow. Natural fertility is high.

These soils generally are used for pasture if adequate drainage outlets are available.

Representative profile of Livingston silty clay loam, ½ mile south of borough of Sussex, north of Air Port Diner, 100 feet east of Route 565:

A1—0 to 10 inches, black (10YR 2/1) silty clay loam; moderate, coarse, granular structure; friable; very sticky wet; many fine roots; slightly acid; gradual, irregular boundary.

B21g—10 to 14 inches, dark-gray (N 4/0) clay; few, fine, distinct, light olive-brown (2.5Y 5/6) mottles; strong, medium, subangular blocky structure; firm, very plastic when wet; few fine and medium roots; neutral; clear, wavy boundary.

B22g—14 to 30 inches, dark-gray (N 4/0) clay; many, coarse, prominent, light olive-brown (2.5Y 5/6) and strong-brown (7.5YR 5/8) mottles; weak, medium, angular blocky structure; firm, very plastic; neutral; gradual, wavy boundary.

C—30 to 60 inches, gray (N 5/0) clay; many, coarse, prominent olive-yellow (2.5Y 6/8) and yellowish-brown (10YR 5/8) mottles; massive; very firm, plastic; mildly alkaline.

The solum is 30 to 40 inches thick over a clay substratum. Depth to bedrock is more than 5 feet and generally is more than 10 feet. Reaction ranges from slightly acid to neutral in the A and B horizons and to mildly alkaline in the C horizon.

The A horizon is black or very dark gray. The B horizon ranges from dark gray (N 4/0) through dark grayish brown (2.5Y 4/2) to gray (5Y 5/1). It is firm or very firm and plastic or very plastic. The C horizon ranges from gray (5Y 5/1) to dark gray (N 4/0) and has a value of 4 or 5 and a chroma of 0 or 1. It is very firm and plastic.

Livingston soils are associated with Raynham, Sloan, and Wayland soils and Swamp. They have a fine-textured B horizon and the associated soils do not. They contain fewer coarse fragments than those soils.

Livingston silty clay loam (Lv).—This soil commonly has slopes of less than 3 percent. In some areas it is subject to occasional stream overflow. Included in mapping are some soils where slopes are as much as 6 percent and small areas of shallow muck and Raynham silt loam.

Most areas are woodland and pasture or are idle. Drainage is difficult because this soil is fine textured and is in very low positions on the landscape. Capability unit IVw–44; woodland group unassigned.

Lyons Series

The Lyons series consists of deep, very poorly and poorly drained, nearly level soils. These soils formed in calcareous glacial till derived from limestone and varying amounts of shale, sandstone, gneiss, and granite.

In a representative profile the surface layer is very dark gray silt loam 10 inches thick. The subsoil is mottled light brownish-gray and dark-gray silt loam 20 inches thick. The substratum is firm, gray and greenish-gray gravelly loam.

Available water capacity is high. Permeability is slow. Natural fertility is high.

Poor drainage and stones limit the use of these soils to pasture and woodland. These soils are saturated for 6 months or more during the year. In places, they are ponded late in winter and in spring. Adequately drained areas are suited to crops commonly grown in the county. Sinkholes are likely to form because solution caverns occur in the underlying limestone.

Representative profile of Lyons silt loam, ½ mile north of the village of Greendell, on Wolf's Corner Road, 800 feet from east side of the road:

A1—0 to 10 inches, very dark gray (10YR 3/1) silt loam; weak, medium, granular structure; very friable, sticky when wet; many fine and medium roots; slightly acid; abrupt, smooth boundary.

B21g—10 to 13 inches, light brownish-gray (2.5Y 6/2) silt loam; many, medium, strong-brown (7.5YR 5/6) and dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; friable, sticky when wet; few medium and fine roots; slightly acid; clear, wavy boundary.

B22g—13 to 30 inches, dark-gray (5Y 4/1) silt loam; many, faint, coarse greenish-gray (5BG 5/1) and many, fine and medium, distinct, yellow (2.5Y 7/6) and light olive-brown (2.5Y 5/6) mottles; weak, coarse, prismatic structure parting to strong, medium, subangular blocky; slightly firm, sticky when wet; few patchy clay films on ped faces; neutral; gradual, wavy boundary.

Cg—30 to 60 inches, gray (5Y 5/1) and greenish-gray (5BG 5/1) gravelly loam; many, medium and coarse, distinct, yellow (2.5Y 7/6) and light olive-brown (2.5Y 5/6) mottles; massive; firm; mildly alkaline; calcareous.

The solum ranges from 27 to 40 inches in thickness. Depth to limestone bedrock is more than 4 feet. Coarse fragments range from a few to as much as 20 percent of the soil mass, but in many places they are concentrated on the surface. Reaction ranges from slightly acid to neutral in the solum and to mildly alkaline in the C horizon.

The A horizon has a hue of 10YR, a value of 2 or 3, and a chroma of 1 or 2. The B horizon ranges in hue from 5Y to 10YR. The B horizon ranges from fine sandy loam and silt loam to light clay loam. The C horizon is similar to the B horizon in color. It ranges from gravelly loam to gravelly silt loam.

Lyons soils are associated with Washington and Wassaic soils. In contrast with Washington and Wassaic soils, they have a low-chroma B horizon. They have a darker colored A horizon than Wassaic soils.

Lyons silt loam (Ly).—This soil has the profile described as representative of the series. Much of the acreage is in slight depressions. Slopes are commonly less than 3 percent. Included in mapping are small areas of somewhat poorly drained soils, areas of shallow muck, and small areas of gently sloping Lyons soils.

Adequately drained areas can be used for commonly grown crops and for hay and pasture. Undrained areas are suited mainly to woodland or wildlife. Wetness is the major limitation to cultivation. Runoff is slow. The hazard of erosion is slight. Surface drains, tile underdrains, and diversions terraces have been used to reduce wetness. Capability unit IVw–44; woodland group 5w1.

Lyons very stony silt loam (Lz).—This soil has a profile similar to the one described as representative of the series, but the surface layer is about 3 percent stones that are 5 to 30 feet apart. Slopes are commonly less than 3 percent. Included in mapping are some areas where the surface layer is thinner and less dark, areas of similar gently sloping Lyons soils, and small areas of shallow muck.

Most of the acreage is woodland of red maple and other water-tolerant species. Stone removal and drainage are needed if this soil is cultivated. Capability unit VIIs–45; woodland group 5w1.

Made Land, Sanitary Land Fill

Made land, sanitary land fill (Ma) generally consists of all types of refuse, including garbage, glass, metal, and building materials. Some areas are predominantly stones. Many areas have been covered with soil and then smoothed.

Use of these areas is limited by uneven settling and formation of gases through decomposition. Some areas are wet. Capability unit unassigned; woodland group unassigned.

Middlebury Series

The Middlebury series consists of deep, nearly level, moderately well drained to somewhat poorly drained soils on flood plains subject to occasional stream overflow. These soils are underlain by fine sandy loam or silt loam alluvial material.

In a representative profile the plow layer is very dark grayish-brown loam 11 inches thick. The subsoil is brown fine sandy loam, is 14 inches thick, and has mottles. The substratum to a depth of 65 inches is mottled, brown fine sandy loam.

Available water capacity is high, and permeability is moderate. Natural fertility is high.

Excess water delays seedbed preparation in spring and also when stream flow is excessive. These soils are subject to occasional flooding.

Representative profile of Middlebury loam, ¾ mile southeast of the village of Bevans, 200 feet south of Flatbrook, 100 feet into a field owned by the New Jersey Division of Fish and Game:

Ap—0 to 11 inches, very dark grayish-brown (10YR 3/2) loam, light brownish gray (10YR 6/2) when dry; moderate, fine, granular structure; very friable; many roots; medium acid; clear, smooth boundary.

B—11 to 25 inches, brown (7.5YR 5/4) fine sandy loam; few, fine, faint, strong-brown (7.5YR 5/6) and common, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky structure; very friable; many roots in upper part; medium acid; clear, smooth boundary.

C1—25 to 45 inches, brown (7.5YR 5/4) fine sandy loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; massive; very friable; medium acid; gradual, diffuse boundary.

C2—45 to 65 inches, brown (7.5YR 5/2) fine sandy loam; many to common, fine, faint, strong-brown (7.5YR 5/6) and few, fine, distinct, light brownish-gray (10YR 6/2) mottles; massive; very friable; medium acid.

The solum ranges from 15 to 25 inches in thickness. Natural reaction ranges from strongly acid in the A horizon to medium acid in the C horizon. Few or no coarse fragments occur in the upper 40 inches.

The A horizon ranges from 10YR 3/2 to 2.5Y 4/2. It is fine sandy loam, loam, or silt loam. The B horizon ranges from 7.5YR to 2.5Y in hue and is 4 or 5 in value and 3 or 4 in chroma. It contains mottles throughout that are 7.5YR or 10YR in hue, are 5 or 6 in value, and range from 2 to 8 in chroma. It is friable or very friable. The C horizon has the same matrix color as the B horizon. The organic-matter content varies in successive thin strata within the C horizon.

Middlebury soils are associated with Chenango soils and Alluvial land, wet. They contain mottles in the B horizon, and Chenango soils do not. They do not have the dominant gray colors that are common in Alluvial land, wet.

Middlebury loam (Md).—Slopes commonly are less than 3 percent. Included in mapping are small areas of Chenango soils, Alluvial land, wet, and gravel bars along streams. This soil is subject to occasional stream overflow.

This soil is used for hay, corn, pasture, wildlife habitat, and woodland. Drainage is needed for optimum crop production. Capability unit IIw–32; woodland group 1o1.

Nassau Series

The Nassau series consists of somewhat excessively drained, gently sloping to very steep soils that are shallow over slate or shale bedrock. These soils are on uplands. Most areas are rocky. Rock outcrop is extensive.

In a representative profile the plow layer is very dark grayish-brown shaly silt loam 6 inches thick. The subsoil is yellowish-brown very shaly silt loam 12 inches thick. Unconsolidated, partly weathered shale and slate underlain by beds of hard slate and shale are at a depth of 18 inches.

Available water capacity is low because the soils are shaly and shallow over bedrock. Permeability is moderate. Natural fertility is low.

Very stony areas of these soils are better suited to woodland or unrenovated pasture than to most other uses.

Representative profile of Nassau shaly silt loam in an area of Nassau rocky silt loam, 8 to 15 percent slopes, in Fredon Township, on township road 3½ miles southwest of Newton, ¼ mile northeast of road intersection near old Fredon Firehouse, 50 feet east of road:

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) shaly silt loam; weak, fine, granular structure; very friable; many fine and medium roots; 30 percent shale fragments; strongly acid; clear, wavy boundary.

B2—6 to 18 inches, yellowish-brown (10YR 5/4) very shaly silt loam; very weak, fine, subangular blocky structure; friable; common, fine and few, medium roots; 55 percent shale fragments; strongly acid; abrupt, wavy boundary.

R—18 inches, bedded shale and slate.

The solum is 12 to 20 inches thick over bedrock. The content of coarse fragments ranges from 10 to 50 percent in the Ap horizon and from 35 to 60 percent in the B horizon. Unless limed, these soils are strongly acid.

The Ap horizon is 10YR in hue, 3 or 4 in value, and 2 in chroma. The B horizon ranges from 10YR to 2.5Y in hue and is 4 or 5 in value and 3 or 4 in chroma. The B horizon is shaly or very shaly silt loam or loam. In some places a C horizon 2 to 6 inches thick and 80 to 90 percent shale occurs above the bedrock.

Nassau soils are associated with Valois, Bath, and Albia soils. They are shallower over bedrock than Valois, Bath, and Albia soils.

Nassau rocky silt loam, 3 to 8 percent slopes (NaB).—Included with this soil in mapping are small areas of deep, well-drained Valois soils. Also included are areas of Rock outcrop that make up about 5 percent of the mapped areas. Also included in the area of Mt. Salem and Rockport is a soil similar to Bath soils, but only 24 to 30 inches deep over shale.

Areas of this soil are used for pasture, woodland, and some commonly grown crops. Capability unit IIIe–15; woodland group 5d1.

Nassau rocky silt loam, 8 to 15 percent slopes (NaC).—The profile of this soil is the one described as representative of the series. Included in mapping are small areas of deep, well-drained Valois soils. Also included are areas of Rock outcrop that make up about 5 percent of the mapped areas (fig. 4). Also included in the area of Mt. Salem and Rockport is a soil similar to Bath soils, but only 24 to 30 inches deep over shale.

This soil is used for pasture, commonly grown crops, and woodland. Runoff is medium. The hazard of erosion is moderate. Erosion control is needed in cultivated areas. Capability unit IVe–15; woodland group 5d1.

Nassau-Rock outcrop complex, 15 to 25 percent slopes (NfD).—This complex is about 85 percent Nassau soils and 15 percent shale Rock outcrop. The Nassau soil is generally about 13 inches thick near the top of the slopes. Included in mapping in gently sloping areas between moderately steep slopes are areas of Norwich soils that are more than 24 inches thick.

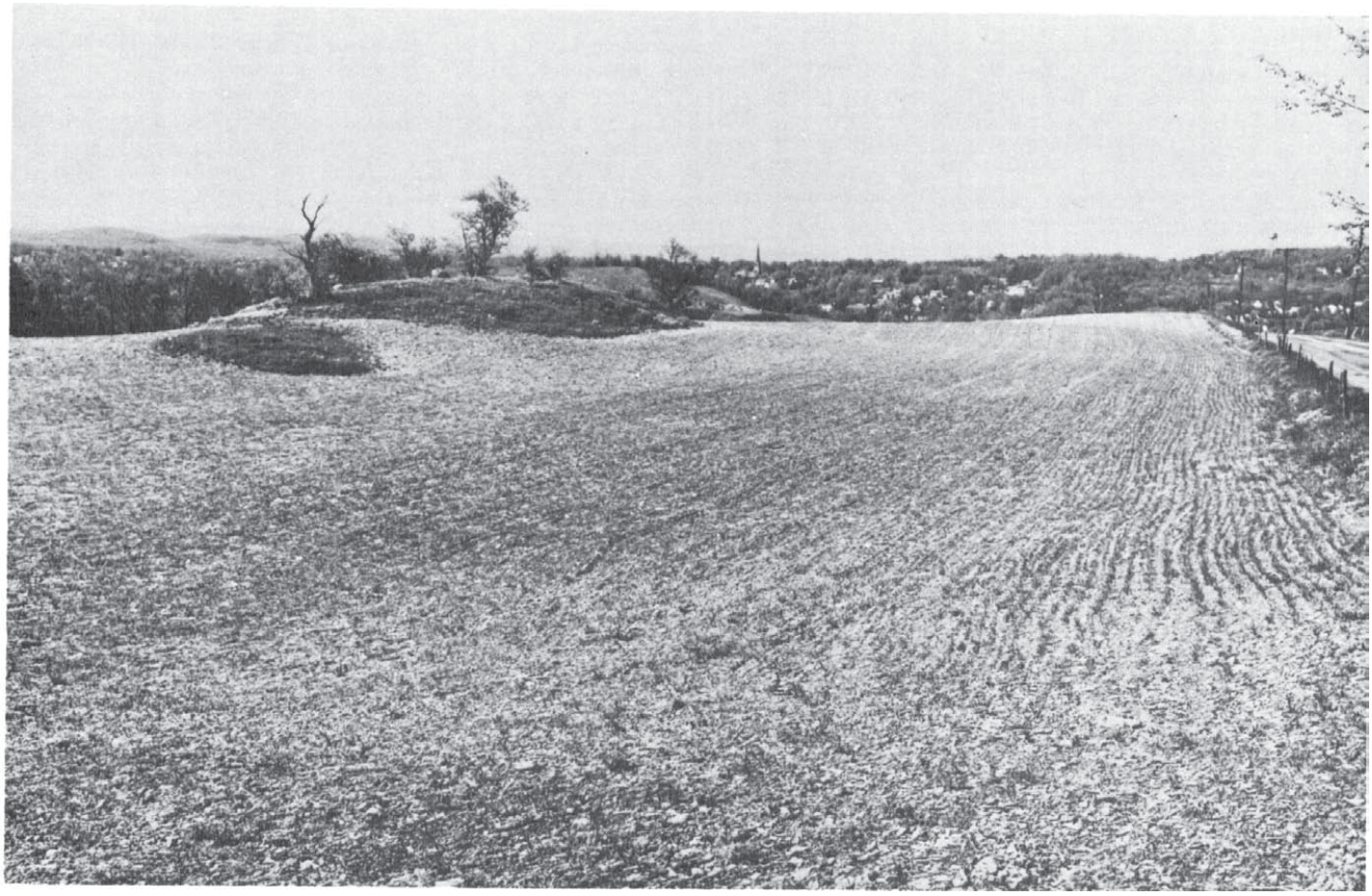

Figure 4.—Shale outcrop interferes with fieldwork on Nassau rocky silt loam.

Shallowness, steep slopes, droughtiness, rapid runoff, the erosion hazard, and Rock outcrop are severe limitations. This complex is poorly suited to row crops. It is better suited to pasture, woodland, and wildlife. Capability unit VIs–15; woodland group 5x1.

Nassau-Rock outcrop complex, 25 to 45 percent slopes (NfE).—This complex is about 75 percent Nassau soils and 25 percent shale Rock outcrop. The profile of the Nassau soil is similar to the one described as representative of the series, but the depth to bedrock is about 12 inches. Shale Rock outcrop is most common along the top of the slopes.

Droughtiness, shallowness, rapid runoff, the erosion hazard, steep slopes, and Rock outcrop are severe limitations. This complex is suited to pasture, woodland, and wildlife. Capability unit VIIs–21; woodland group 5x1.

Nassau-Rock outcrop complex, extremely stony (Ng).—This complex is about 85 percent Nassau soils and about 15 percent shale Rock outcrop. The landscape is one of complex slopes that range from sloping to moderately steep and change abruptly at intervals of 50 to 150 feet. Shale Rock outcrop is along the top of the slopes in about 20 percent of the mapped areas. The Nassau soil is generally about 13 inches thick near the top of the slopes.

Droughtiness, shallowness, the erosion hazard, and complex slopes limit the use of this complex for cultivation even under special management. Capability unit VIIs–21; woodland group 5x1.

Norwich Series

The Norwich series consists of deep, nearly level, very poorly drained soils that are shallow over a fragipan. These soils are in swales of the uplands in the broad middle belt in the Kittatinny Mountain. They formed in glacial till deposit that is high in reddish sandstone, siltstone, and shale.

In a representative profile the surface layer is very dark grayish-brown silt loam 8 inches thick. The upper 7 inches of the subsoil is gray channery silt loam that has strong-brown and yellowish-brown mottles. The lower 23 inches is a fragipan of very firm, brittle, gray and reddish-gray channery silt loam. The substratum to a depth of 60 inches is mottled, slightly firm to friable, reddish-gray channery loam.

Available water capacity is moderate. A seasonal high water table is at the surface in winter and early in spring. Permeability is slow. Natural fertility is moderate.

The stony surface layer and the lack of good drainage outlets limit the use of these soils to pasture and woodland.

Representative profile of Norwich silt loam in an area of Norwich very stony silt loam, 0 to 3 percent slopes,

¾ mile south of Crandon Lake, ¼ mile into lane of Copely Tree farm, 100 feet south of lane:

A1—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable, sticky when wet; many fine roots; 10 percent stones; strongly acid; gradual, wavy boundary.

Bg—8 to 15 inches, gray (5Y 5/1) channery silt loam; common strong-brown and yellowish-brown mottles; weak, medium, subangular blocky structure; friable, sticky; few fine roots in upper part; 15 percent stones and channers; strongly acid; gradual, wavy boundary.

Bx1g—15 to 24 inches, gray (5YR 5/1) channery silt loam; few, coarse, yellowish-brown (10YR 5/4) mottles; weak, very coarse, prismatic structure; very firm, brittle; 20 percent stones and channers; strongly acid; gradual wavy boundary.

Bx2g—24 to 38 inches, reddish-gray (5YR 5/2) channery silt loam; common, coarse, yellowish-brown (10YR 5/4) mottles; moderate, very coarse, prismatic structure; very firm, brittle; 20 percent stones and channers; strongly acid; gradual, wavy boundary.

Cg—38 to 60 inches, reddish-gray (5YR 5/2) channery loam; many, coarse, brownish-yellow and yellowish-brown mottles; massive; slightly firm to friable; 30 percent stones and channers; strongly acid.

The solum ranges from 36 to 48 inches in thickness. Depth to the fragipan is 15 to 20 inches, and depth to bedrock is 4 feet or more. The content of coarse fragments ranges from a trace to 35 percent in the A and Bg horizons and from 15 to 45 percent in the Bx and C horizons. The coarse fragments, dominantly flat sandstone or siltstone, range from 6 to 24 inches in length. Contrasting layers of locally derived material, 15 to 20 inches thick, are common above the fragipan. Unless limed, these soils are strongly acid.

The A horizon is 10YR in hue, 2 to 3 in value, and 2 in chroma. The Bg horizon ranges from 5Y in local material to 5YR in glacial till. It has a value of 4 or 5 and a chroma of 2 or less. The Bx horizon ranges from 7.5YR to 5YR in hue and is 4 or 5 in value and 1, 2, or 3 in chroma. It contains mottles that differ one or two hues from the matrix and that have a value and chroma of 4 to 6. It is very firm and brittle. The C horizon is similar in color to the Bx horizon. It is loam or gravelly loam and is friable to firm and slightly brittle.

Norwich soils are associated with Wurtsboro and Carlisle soils. They have a darker colored A horizon and a grayer B horizon than Wurtsboro soils. They have less organic material than Carlisle soils.

Norwich silt loam, 0 to 3 percent slopes (NhA).—This soil has a profile similar to the one described as representative of the series, but it contains fewer stones and very few other coarse fragments in the upper part. It is in nearly level depressions. The surface layer is thicker in local areas than in the profile described as representatives because the soil has received deposition from adjacent steeper slopes.

Included with this soil in mapping are small pockets of Carlisle muck and swampy areas and isolated areas of stony and channery soils, better drained soils, and finer textured soils. Many mapping units consist of diverse soils in very complex patterns. These soils are generally similar but differ in minor properties.

This soil has limited use for pasture. Much of it is woodland. Drainage outlets are difficult to obtain. Drained areas are used for pasture and cultivated crops. Capability unit IVw–44; woodland group 5w1.

Norwich very stony silt loam, 0 to 3 percent slopes (NoA).—The profile of this soil is the one described as representative of the series. Included in mapping in places are areas where alluvium has been deposited and the surface layer is thicker than in the representative profile. Also included are small pockets of Carlisle muck and Swamp, small nonstony areas, small areas of better drained soils, and areas of an extremely stony soil that has a finer textured subsoil (fig. 5).

The content of stones and cobblestones, the wetness, and the difficulty in obtaining adequate drainage outlets make this soil poorly suited to cultivation. Capability unit VIIs–45; woodland group 5w1.

Oquaga Series

The Oquaga series consists of moderately deep, gently sloping to steep, well drained to excessively drained soils underlain by shattered sandstone and shale bedrock. These soils formed in glacial till derived primarily from acid, red sandstone, and shale. They are in the Kittatinny Mountain.

In a representative profile in a wooded area, a 2-inch layer of humus overlies the mineral soil. The surface layer is pinkish-gray loam 4 inches thick. The upper 6 inches of the subsoil is brown gravelly loam. The lower 14 inches is reddish-brown gravelly loam. The substratum is 6 inches of brown very gravelly loam underlain by shale and sandstone bedrock at a depth of 30 inches.

Natural fertility is moderate. Permeability is moderately rapid. Available water capacity is moderately low because the soils are stony and are only moderately deep over bedrock.

Most areas of these soils are forested or used for unimproved pasture. These soils generally are extremely stony and poorly suited to cultivated crops.

Representative profile of Oquaga loam in an area of Oquaga extremely stony loam, 3 to 8 percent slopes, ⅓ mile west of Blue Mountain Lakes Office, 30 feet from north side of road, in a wooded area:

O2—2 inches to 0, very dark brown (10YR 2/2) humus held together in mat by fine roots; abrupt, wavy boundary.

A2—0 to 4 inches, pinkish-gray (7.5YR 6/2) loam; weak, fine, granular structure; friable; many fine roots; 15 percent stones and channers; strongly acid; clear, wavy boundary.

B21—4 to 10 inches, brown (7.5YR 5/4) gravelly loam; weak, fine, granular structure; friable; few medium and large roots; 30 percent stones and channers; strongly acid; gradual, wavy boundary.

B22—10 to 24 inches, reddish-brown (5YR 5/4) gravelly loam; weak, fine, granular structure; friable; few large roots; 35 percent channers and stones; strongly acid; diffuse boundary.

C—24 to 30 inches, brown (7.5YR 5/4) very gravelly loam; crude granular structure; friable; 75 percent channers and stones; very strongly acid; gradual, irregular boundary.

R—30 inches, reddish-brown (5YR 4/4) partly weathered and fractured shale and sandstone bedrock.

The solum ranges from 24 to 36 inches in thickness. Depth to bedrock ranges from 24 to 40 inches and is about 30 inches in many profiles. The content of coarse fragments ranges from 30 to 40 percent in the solum and from 30 to 80 percent in the C horizon. Unless limed, these soils are strongly acid or very strongly acid.

The B horizon ranges from 7.5YR to 5YR in hue and is 4 or 5 in value and chroma; the color varies with the amount of red sandstone material in the soil. The C horizon is loam or sandy loam and in places is gravelly or very gravelly.

Oquaga soils are associated with Swartswood, Lackawanna, and Wurtsboro soils. They differ from those soils in not having a fragipan and are shallower over bedrock.

Figure 5.—**Extremely stony soil mapped with Norwich very stony silt loam.**

Oquaga extremely stony loam, 3 to 8 percent slopes (OmB).—The profile of this soil is the one described as representative of the series. Stones 2 to 5 feet apart cover 10 to 15 percent of the surface. Included in mapping are areas of red sandstone outcrops that make up about 2 percent of the mapping units and areas of soils where the depth to bedrock is less than 24 inches.

This soil is wooded or is vegetated with brushy plants. Runoff is slow. The abundant stones and moderate depth make this soil unsuited to cultivated crops. It is better suited to woodland and wildlife. Capability unit VIIIs–21; woodland group 3x1.

Oquaga extremely stony loam, 8 to 25 percent slopes (OmD).—The profile of this soil is similar to the one described as representative of the series, but the depth to bedrock is about 25 inches. About 2 percent of the mapping unit is included areas of red sandstone outcrops and 5 to 10 percent is areas of soils that are less than 24 inches deep over bedrock.

This soil is wooded. Stoniness and depth to bedrock make it better suited to wildlife and woodland than to crops. Runoff is medium to rapid. The hazard of erosion is severe in areas where timber has been removed. Capability unit VIIs–21; woodland group 3x1.

Oquaga-Rock outcrop association, moderately steep (OrD).—This association is 50 to 75 percent extremely stony Oquaga soils and 10 to 20 percent bedrock Rock outcrop. The bedrock is hard quartzite, sandstone, or interbedded sandstone and shale. Slopes are dominantly 15 to 25 percent. Included in mapping are small areas of extremely stony Swartswood and Lackawanna soils and some areas of less sloping and less stony Oquaga soils.

This association is chiefly wooded. It is used for recreation, wood crops, and wildlife. Some areas, especially the less sloping included soils, have been cleared and used for pasture or hay. Capability unit VIIs–21; woodland group 3x1.

Otisville Series

The Otisville series consists of deep, gently sloping to very steep, excessively drained, acid soils underlain by stratified very gravelly sand. These soils formed in glacial deposit, such as kames, eskers, and moraines.

In a representative profile the plow layer is very dark grayish-brown gravelly loamy sand 6 inches thick. The subsoil is strong-brown and yellowish-brown gravelly loamy sand 10 inches thick. The substratum to a depth of 60 inches is stratified very gravelly sand.

Available water capacity is low. Permeability is rapid. Natural fertility is low.

Most areas of these soils are wooded. Some less sloping areas have been cleared and farmed to small grain, hay, and pasture. The soils are very droughty. Added fertilizer leaches out rapidly.

Representative profile of Otisville gravelly loamy sand, 3 to 15 percent slopes, in Byram Township, ½ mile

upstream from Roseville (Wright Pond), 300 feet east of stream, on edge of gravel pit:

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) gravelly loamy sand; weak, fine, granular structure; very friable; many fine roots; many fine to coarse pores; 15 percent gravel and cobblestones; strongly acid; abrupt, smooth boundary.

B2—6 to 12 inches, strong-brown (7.5YR 5/6) gravelly loamy sand; weak, fine and medium, granular structure; very friable; few fine roots; many coarse pores; 25 percent gravel, cobblestones, and small stones; strongly acid; clear, wavy boundary.

B3—12 to 16 inches, yellowish-brown (10YR 5/4) gravelly coarse loamy sand; single grain; loose; many coarse and very coarse pores; 30 percent gravel, cobblestones, and small stones; strongly acid; clear, smooth boundary.

C—16 to 60 inches, light olive-brown (2.5Y 5/4) stratified very gravelly sand; single grain; loose; 60 percent gravel and cobblestones, very few stones; strongly acid.

The solum ranges from 14 to 24 inches in thickness. Depth to bedrock is 10 feet or more. The content of coarse fragments, dominantly gravel size, range from 15 to 40 percent in the upper horizons and to as much as 70 percent in the C horizon. Unless limed, these soils are strongly acid. The B horizon ranges from 7.5YR to 10YR in hue and 4 to 6 in value and chroma. The brightest colors dominate the upper part of the B horizon.

Otisville soils are associated with Riverhead and Pompton soils. They contain more sand and gravel and less clay than those soils.

Otisville gravelly loamy sand, 3 to 15 percent slopes (OtC).—The profile of this soil is the one described as representative of the series. Included in mapping are areas of Riverhead sandy loam, areas of Rockaway gravelly loam, and areas of Otisville soils that have a cobbly surface layer. These included soils generally are inextensive.

Most of the acreage is woodland. Some areas are used for small grain, hay, and pasture crops. The low available water capacity and low natural fertility result in low yields. Erosion control is needed in the steeper areas. Capability unit VIIs–12; woodland group 4s1.

Otisville gravelly loamy sand, 15 to 35 percent slopes (OtD).—Included with this soil in mapping are areas of cobbly or stony Otisville soils, Rockaway gravelly loam, and Riverhead sandy loam, 8 to 25 percent slopes.

Most of the acreage is woodland. Some areas are used for pasture and for infrequent hay crops. Capability unit VIIs–12; woodland group 4s1.

Palmyra Series

The Palmyra series consists of deep, well-drained, nearly level to steep soils underlain by stratified, calcareous sand and gravel deposit. These soils are in high positions on glacial outwash plains, kames, and kame terraces.

In a representative profile the surface layer is very dark grayish-brown and grayish-brown gravelly fine sandy loam 12 inches thick. The subsoil is dark-brown gravelly fine sandy loam 14 inches thick. The substratum to a depth of 60 inches is stratified, calcareous, grayish-brown sand and gravel.

Available water capacity is moderate. Permeability is moderate in the surface layer and subsoil and rapid in the substratum. Natural fertility is moderately high.

The less sloping areas of these soils are well suited to crops.

Representative profile of Palmyra gravelly fine sandy loam, 3 to 8 percent slopes, at the edge of a sand and gravel pit, along County Route No. 517, at the Sussex-Warren county line.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) gravelly fine sandy loam; moderate, medium, granular structure; friable; many fine roots; 20 percent gravel; slightly acid; clear, smooth boundary.

A&B—8 to 12 inches, grayish-brown (10YR 5/2) gravelly fine sandy loam; weak, medium, granular structure; friable; many fine roots; 20 percent gravel; 15 percent dark-brown (7.5YR 4/4) spots ¼ to 2 inches in diameter; slightly acid; clear, irregular boundary.

B21t—12 to 18 inches, dark-brown (7.5YR 4/4) gravelly heavy fine sandy loam, moderate, medium, subangular blocky structure; friable; grayish-brown (10YR 5/2) sandy loam ped coatings in tongues 3 inches to 2 feet apart that branch and diminish with depth; 30 percent gravel; slightly acid; gradual, irregular boundary.

B22t—18 to 26 inches, dark-brown (7.5YR 4/4) gravelly heavy fine sandy loam; moderate, medium, subangular blocky structure; friable; patchy clay films on ped faces; 30 percent gravel; slightly acid; abrupt, irregular boundary, cone-shaped tongues of B horizon extend 12 to 18 inches into C horizon.

IIC—26 to 60 inches, grayish-brown (10YR 5/2), stratified, medium and fine sand and gravel; single grain; loose; mildly alkaline; calcareous.

The solum ranges from 18 to 32 inches in thickness. Depth to bedrock is more than 6 feet. The content of coarse fragments, dominantly gravel, ranges from 10 to 20 percent in the A and A&B horizons, 20 to 30 percent in the Bt horizon, and 40 to 60 percent in the IIC horizon. Reaction ranges from slightly acid in the A horizon to mildly alkaline in the C horizon.

The Ap or A1 horizon has a hue of 10YR, a value of 3 or 4, and a chroma of 2. It is gravelly fine sandy loam or gravelly sandy loam. Where plowing is deep, the A&B horizon has been mixed into the Ap horizon. The B horizon ranges from 7.5YR to 5YR in hue and is 4 or 5 in value and 4 in chroma. It is generally gravelly heavy fine sandy loam but ranges to sandy clay loam or loam. The C horizon is a salt-and-pepper mixture of the grayish-brown unweathered gravel and the bright yellowish-brown and strong-brown strongly weathered limestone gravel.

Palmyra soils are associated with Hero, Fredon, and Hazen soils. They do not contain the mottles that are common in Hero soils. They do not have the low-chroma matrix colors that are common in the Fredon soils. They contain more fine sand and clay in the upper part of the B horizon than Hazen soils.

Palmyra gravelly fine sandy loam, 0 to 3 percent slopes (PaA).—Included with this soil in mapping are small areas of Hero soils that need drainage in places and small areas of limestone ledge.

This soil is used extensively for alfalfa, corn, and other crops associated with dairy farming. Capability unit I–6; woodland group 2o1.

Palmyra gravelly fine sandy loam, 3 to 8 percent slopes (PaB).—The profile of this soil is the one described as representative of the series. Included in mapping are small areas of nearly level soils and small areas of limestone ledge. Also included are small areas of Hero loam that collect water from adjacent steeper soils and need drainage in places.

This soil is used extensively for alfalfa, corn, and other crops associated with dairy farming. Erosion control is

needed in cultivated areas. Capability unit IIe–6; woodland group 2o1.

Palmyra gravelly fine sandy loam, 8 to 25 percent slopes (PaD).—The profile of this soil is similar to the one described as representative of the series, but the depth to sand and gravel averages about 18 inches. This soil is in rolling to hilly positions on the landscape. Included in mapping are spots where slopes are less than 8 percent.

This soil is used for pasture, hay, and occasionally for row crops. Runoff is moderate to rapid. The hazard of erosion is severe in cultivated areas. Erosion control is needed. Capability unit IV–11; woodland group 2r1.

Pits, Sand and Gravel

Pits, sand and gravel (Pt) consists of active and abandoned pits and any adjoining areas of fill from overburden that result from the mining of sand, gravel, and borrow material. Sand and gravel pits are the most extensive kinds of pits and are commonly associated with glacial outwash material from which Riverhead and Otisville soils formed. Some are on stony and cobbly glacial till. Most pits are in uplands and are 6 to 20 feet deep. Some have been sources of both sand and gravel.

Some areas have been dredged in mining the sand and gravel and large ponds have formed. Some of these have been converted to use for swimming, fishing, or skating. Rehabilitation of sand and gravel pits is frequently difficult because fertility is low and the material is erodible. Capability unit unassigned; woodland group unassigned.

Pompton Series

The Pompton series consists of deep, nearly level, somewhat poorly drained soils that formed on glacial outwash plains. Coarse fragments are mostly granitic gneiss gravel. The soils are underlain by thick sand and gravel beds.

In a representative profile the plow layer is dark-brown fine sandy loam 8 inches thick. The upper 20 inches of the subsoil is yellowish-brown fine sandy loam. The lower 5 inches is mottled, light brownish-gray gravelly sandy loam. The substratum to a depth of 60 inches is light brownish-gray gravelly loamy sand.

Permeability is moderate or moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. Natural fertility is moderate. A seasonal high water table is at a depth of 1 to 2 feet in winter and spring. These soils are not generally subject to stream overflow, but nearly level areas or depressions are ponded for 12- to 24-hour periods following heavy rain, especially during spring thaw.

If drained, these soils are suited to corn, vegetables, hay, and pasture. Undrained areas are pastured or wooded.

Representative profile of Pompton fine sandy loam, 0 to 3 percent slopes, 2 miles east of Andover Borough, on south side of Erie Lackawanna Railroad, opposite lower end of Wrights Road, in a field:

Ap—0 to 8 inches, dark-brown (10YR 3/3) fine sandy loam; moderate, medium, granular structure; very friable; 5 percent gravel; medium acid; abrupt, smooth boundary.

B1—8 to 15 inches, yellowish-brown (10YR 5/6) fine sandy loam; few, fine, faint, light olive-brown (2.5Y 5/4) and olive-yellow (2.5Y 6/6) mottles in the lower part; weak, medium, subangular blocky structure; friable; strongly acid; clear, wavy boundary.

B2—15 to 28 inches, yellowish-brown (10YR 5/4) fine sandy loam; common, medium, faint, grayish-brown (2.5Y 5/2) and olive-yellow (2.5Y 6/6) mottles and medium, distinct, dark-brown (7.5YR 4/4) mottles; weak, medium, subangular blocky structure; friable, slightly sticky; strongly acid; gradual, wavy boundary.

B3—28 to 33 inches, light brownish-gray (2.5Y 6/2) gravelly sandy loam; common, fine, distinct, strong-brown (7.5YR 5/6) and yellowish-red mottles; massive; matrix is friable, many mottles are firm; 15 percent gravel; strongly acid; clear, wavy boundary.

C—33 to 60 inches, light brownish-gray (2.5Y 6/2) gravelly loamy sand; common, large, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; single grain; loose; 25 percent gravel; strongly acid.

The solum ranges from 24 to 36 inches in thickness. The gravel content ranges from 5 to 20 percent in the solum and from 5 to more than 65 percent in individual strata of the C horizon. There are few, if any, stones and cobblestones. Unless limed, these soils are strongly acid or medium acid.

The A horizon is 10YR in hue, 3 or 4 in value, and 2 or 3 in chroma. The B horizon ranges from 10YR to 2.5Y in hue, from 4 to 6 in value, and from 2 to 6 in chroma. It contains mottles that range from 7.5YR to 2.5Y in hue, from 4 to 6 in value, and from 2 to 6 in chroma. It ranges from fine sandy loam to sandy loam and in places is gravelly. The C horizon ranges from 7.5YR to 2.5Y in hue, from 4 to 6 in value, and from 2 to 4 in chroma. It typically is stratified and is loamy sand or sand and in places is gravelly.

Pompton soils are associated with Riverhead, Otisville, and Preakness soils. They contain mottles and Riverhead and Otisville soils do not. They do not have the grayish-brown matrix colors that are common in the B horizon of Preakness soils.

Pompton fine sandy loam, 0 to 3 percent slopes (PvA).—Included with this soil in mapping are areas of sandy loam and gravelly sandy loam; small areas of Pompton fine sandy loam, 3 to 8 percent slopes; and small areas of Riverhead and Preakness soils.

If artificially drained, this soil is used for corn, hay, and pasture. Excessive wetness delays use of undrained areas. Capability unit IIw–25; woodland group 2w1.

Preakness Series

The Preakness series consists of deep, nearly level, poorly and very poorly drained soils. They are in low positions on glacial outwash plains. They formed in material derived mostly from granitic rocks.

In a representative profile the surface layer is sandy loam 14 inches thick. It is black in the upper 8 inches and black and dark grayish-brown and black in the lower 6 inches. The subsoil is mottled, grayish-brown light sandy loam 14 inches thick. The substratum to a depth of 60 inches is gray loamy sand.

If the soil is drained, available water capacity is moderate. Permeability is moderately rapid. Natural fertility is moderate. The water table is near the surface during much of the year.

Drainage is needed if these soils are farmed. Drainage outlets are difficult to obtain in places. Woodland is restricted to water-tolerant species.

Representative profile of Preakness sandy loam, 1 mile northeast of U.S. Highway No. 206, on east side of Lake Lackawanna Road, 100 feet into wooded area:

A11—0 to 8 inches, black (10YR 2/1) sandy loam; moderate, fine, granular structure; very friable; strongly acid; clear, smooth boundary.

A12—8 to 14 inches, black (10YR 2/1) and dark grayish-brown (2.5Y 4/2) light sandy loam; very weak, medium, subangular blocky structure; very friable; strongly acid; clear, wavy boundary.

Bg—14 to 28 inches, grayish-brown (2.5Y 5/2) light sandy loam; many yellowish-brown (10YR 5/8) and light olive-brown (2.5Y 5/6) mottles; massive with pockets of very weak, fine, subangular blocky structure; very friable; strongly acid; gradual, wavy boundary.

IIC—28 to 60 inches, gray (5Y 5/1) loamy sand; few, medium and coarse, light olive-brown (2.5Y 5/6) and yellowish-brown (10YR 5/8) mottles; single grain; loose; strongly acid.

Th solum is 26 to 32 inches thick over loamy sand. Depth to bedrock is more than 6 feet. The gravel content is only in a trace amount in the upper part of the profile but typically increases with increasing depth. Unless limed, these soils are strongly acid.

The A horizon has a hue of 10YR or 2.5Y, a value of 2 or 3, and a chroma of 1 or 2. The A12 horizon has a value of 2 to 4 and a chroma of 1 or 2. The B horizon matrix ranges from 10YR to 2.5Y in hue and is 4 or 5 in value and 2 or less in chroma. It contains mottles that are similar in hue and value, but range from 2 to 8 in chroma. The B horizon ranges from sandy loam to gravelly sandy loam in the upper part and to loamy sand or gravelly loamy sand below a depth of 25 inches. The C horizon matrix typically ranges from 4 to 6 in value and from 1 to 4 in chroma. It contains mottles that have a somewhat wider range. It is loamy sand or sand and contains gravelly or very gravelly strata.

Preakness soils are associated with Pompton, Riverhead, and Carlisle soils. They have a grayish-brown B horizon and Pompton and Riverhead soils do not. They typically have a darker colored A horizon than these soils. They have more mineral and less organic material than Carlisle soils.

Preakness sandy loam (Pw).—Included with this soil in mapping are small areas of Carlisle muck, areas of Pompton and Riverhead soils, and small areas where the surface layer is silt loam.

This soil is wooded. A water table near the surface for prolonged periods in spring and winter and the hazard of short-duration flooding restrict use. If artificially drained, this soil can be used for cultivated crops, hay, or improved pasture. Capability unit IVw–44; woodland group 4w1.

Raynham Series

Raynham soils are deep, nearly level to gently sloping, poorly drained to somewhat poorly drained silty soils on terraces. These soils formed in water-laid deposits of silt and very fine sand.

In a representative profile the plow layer is dark grayish-brown silt loam 8 inches thick. The subsoil is silt loam 20 inches thick. It is olive brown in the upper 9 inches and is mottled, dark grayish brown in the lower 11 inches. The substratum to a depth of 60 inches is gray silt loam and very fine sandy loam mottled with dark reddish brown, brown, and yellowish red.

Available water capacity is high. Permeability is moderately slow or moderate. Natural fertility is high.

Drained areas of these soils are suited to corn, hay, and pasture.

Representative profile of Raynham silt loam, 0 to 5 percent slopes, in Wantage Township, ½ mile north of joint boundaries of Wantage, Frankford, and Lafayette Townships, 150 feet east of Lehigh and New England Railroad, and 25 feet north of Wantage Township bridge, on east bank of Papakating Creek:

Ap—0 to 8 inches, dark grayish-brown (2.5Y 4/2) silt loam; strong, fine and medium, granular structure; friable; many fine and medium roots; many worm channels; slightly acid; clear, smooth boundary.

B21—8 to 17 inches, olive-brown (2.5Y 4/4) silt loam; many, medium, faint, olive-brown (2.5Y 4/4) and many, medium, prominent, brown (10YR 5/3) mottles; weak, fine, subangular blocky structure; friable; many fine roots; many worm channels; slightly acid; gradual, wavy boundary.

B22—17 to 28 inches, dark grayish-brown (2.5Y 4/2) silt loam; common, fine, brown (10YR 5/3) and light brownish-gray (2.5Y 6/2) mottles; weak, medium, platy structure parting to weak, very fine, subangular blocky; slightly firm; few fine roots; slightly acid; gradual, irregular boundary.

C1—28 to 42 inches, gray (N 5/0) silt loam; many, fine, prominent, dark reddish-brown (2.5YR 3/4) and brown (7.5YR 5/4) mottles; massive; firm; thin patchy silt and clay films on some voids and channels; few fine roots; slightly acid; clear, wavy boundary.

C2—42 to 60 inches, gray (5Y 5/1) very fine sandy loam; approximately 40 percent dark reddish-brown (2.5YR 3/4) and yellowish-red (5YR 4/8) mottles; massive; friable; slightly acid.

The solum ranges from 20 to 38 inches in thickness. Depth to bedrock is always more than 6 feet and generally is more than 10 feet. Reaction ranges from slightly acid to neutral. The content of coarse fragments in the solum is 0 to 2 percent. The profile generally ranges from silt loam to very fine sandy loam throughout, but in many places the C horizon contains a strata of sand or loamy sand.

The Ap horizon has a hue of 10YR or 2.5Y, a value of 4 or 5, and a chroma of 2. The B horizon matrix has a hue of 2.5Y, a value of 4 or 5, and a chroma of 0 to 4. It contains mottles that range from 2.5Y to 2.5YR in hue, 3 to 6 in value, and from 0 to 4 in chroma. Consistence ranges from firm to friable.

Raynham soils are associated with Livingston, Bath, and Hoosic soils. They do not have the fragipan that is common to Bath soils. They do not have the gray, fine-textured B horizon that is common to Livingston soils. They are not so sandy and gravelly as Hoosic soils.

Raynham silt loam, 0 to 5 percent slopes (RaB).—Included with this soil in mapping are areas of Braceville soils and Livingston soils and areas where the substratum is fine sandy loam.

This soil is used for corn, hay, and pasture. Drainage is needed for optimum yields. Capability unit IIIw–36; woodland group 4w1.

Riverhead Series

The Riverhead series consists of deep, well-drained, gently sloping to steep soils that are underlain by sand and gravel at a depth of 22 to 36 inches. These soils are on glacial outwash plains.

In a representative profile the plow layer is very dark grayish-brown sandy loam about 7 inches thick. The subsoil is strong-brown sandy loam 23 inches thick. The substratum to a depth of 60 inches is stratified loamy sand that contains some gravel.

Available water capacity is moderate. Permeability is moderately rapid in the surface layer and subsoil and rapid in the substratum. Natural fertility is low.

These soils are well suited to farming. Because the available water capacity is moderate, irrigation is needed for high-value crops.

Representative profile of Riverhead sandy loam, 3 to 8 percent slopes, at the intersection of Route 206 and Lake Lackawanna Road, in a field:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; very friable; 10 percent fine to medium gravel; strongly acid; clear, wavy boundary.

B—7 to 30 inches, strong-brown (7.5YR 5/6) sandy loam; weak, medium, subangular blocky structure; friable; 10 percent gravel; strongly acid; gradual, irregular boundary.

C—30 to 60 inches, light yellowish-brown (2.5Y 6/4), stratified loamy sand; single grain; loose; 10 percent gravel; strongly acid.

The solum is 22 to 36 inches thick over sand containing some gravel. Depth to bedrock is more than 6 feet. The gravel content ranges from 0 to 15 percent in the solum and from 5 to 35 percent in the C horizon. Unless limed, these soils are strongly acid.

The Ap horizon is 10YR in hue, 3 or 4 in value, and 2 in chroma. The B horizon is 7.5YR to 10YR in hue, 4 or 5 in value, and 4 to 6 in chroma. The B horizon is dominantly sandy loam but ranges to loamy sand in the lower part of some profiles. The C horizon is 10YR to 2.5Y in hue, 5 or 6 in value, and 4 to 6 in chroma. The C horizon is stratified loamy sand, sand, or gravelly sand.

Riverhead soils are associated with Pompton, Otisville, Preakness, and Rockaway soils. They do not have the mottles that are common in Pompton soils and the grayish-brown B horizon that is common in Preakness soils. They contain more clay and less gravel and sand than Otisville soils. They do not have the fragipan that is common in Rockaway soils.

Riverhead sandy loam, 3 to 8 percent slopes (RhB).—The profile of this soil is the one described as representative of the series. Included in mapping are small areas where the surface layer is loam, many areas where the content of gravel ranges to 25 percent, and areas of nearly level soils.

This soil is used for alfalfa, corn, vegetables, and fruit. Capability unit IIe–7; woodland group 3o1.

Riverhead sandy loam, 8 to 25 percent slopes (RhC).—The profile of this soil is similar to the one described as representative of the series, but the depth to the substratum is 20 to 24 inches. Included in mapping are areas of Otisville gravelly loamy sand and areas where the content of gravel ranges to 25 percent.

This soil is used for hay, silage crops, and fruit. Runoff is medium or rapid. The hazard of erosion is moderately severe. Erosion control is needed in cultivated areas. Capability unit IVe–15; woodland group 3r1.

Rockaway Series

The Rockaway series consists of deep, well-drained, gently sloping to very steep soils that have a fragipan in the lower part of the subsoil. These soils formed in coarse-textured or moderately coarse textured glacial till. They are on uplands.

In a representative profile the plow layer is dark grayish-brown gravelly loam 7 inches thick. The upper 23 inches of the subsoil is yellowish-brown, strong-brown, and dark-brown gravelly loam. The lower part is a fragipan of very firm, dark-brown and yellowish-brown gravelly sandy loam 14 inches thick. The substratum to a depth of 65 inches is very firm, light yellowish-brown gravelly sandy loam.

Available water capacity is moderate above the very firm, brittle fragipan. Permeability is moderately rapid above the fragipan and slow in the pan. Natural fertility is moderate. Root penetration is restricted in the fragipan.

Most of the acreage is wooded or idle. The less sloping nonstony soils are suited to corn, fruit trees, hay, and pasture.

Representative profile of Rockaway gravelly loam, 3 to 8 percent slopes, in Sparta Township, ¼ mile south of Saint Mary's Episcopal Church, 100 feet west of Conestoga Trail, in a hayfield:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) gravelly loam; weak, medium, granular structure; friable; many fine and medium roots; many medium and coarse pores; 20 percent gravel; medium acid; clear, smooth boundary.

B1—7 to 11 inches, yellowish-brown (10YR 5/6) gravelly loam; weak, medium, subangular blocky structure; friable; many fine and medium roots; many medium pores; 20 percent gravel; strongly acid; gradual, wavy boundary.

B21t—11 to 18 inches, strong-brown (7.5YR 5/6) gravelly loam; moderate, medium, subangular blocky structure; friable, slightly sticky when wet; weak clay bridging and thin patchy clay films on ped faces; many roots; many fine and medium pores; 15 percent gravel; strongly acid; gradual, wavy boundary.

B22t—18 to 30 inches, dark-brown (7.5YR 4/4) gravelly loam; moderate, coarse, subangular blocky structure; moderately firm; bridging and pore filling common; thin discontinuous clay films on many ped faces and on pebbles; few large and many fibrous roots; few large pores; 20 percent gravel; strongly acid; gradual, wavy boundary.

Bx—30 to 44 inches, dark-brown (7.5YR 4/4) and yellowish-brown (10YR 5/4) gravelly sandy loam; massive; very firm and brittle; most pores filled; patchy thin to thick clay films on ped faces; few roots; 25 percent gravel and cobblestones; strongly acid; diffuse, irregular boundary.

Cx—44 to 65 inches, light yellowish-brown (10YR 6/4) gravelly sandy loam; few, coarse, faint, light brownish-gray (2.5Y 6/2) and yellowish-brown (10YR 5/6) mottles; massive; very firm and brittle; 35 percent gravel and cobblestones; strongly acid.

The solum ranges from 30 to 50 inches in thickness. Depth to the fragipan ranges from 20 to 30 inches. Depth to gneissic bedrock is generally 48 inches or more and in places ranges to 10 feet or more. Unless limed, these soils are dominantly strongly acid. The content of coarse fragments ranges from 10 to 35 percent in the solum and to as much as 50 percent in the C horizon.

The A1 horizon, where present, has a hue of 10YR or 7.5YR, a value of 3, and a chroma of 2 or 3. It ranges from 1 to 3 inches in thickness. The Ap horizon has a hue of 10YR or 7.5YR, a value of 4, and a chroma of 2 or 3. The B1 and B2t horizons have a hue of 10YR or 7.5YR, a value of 4 or 5, and a chroma of 4 to 6. These horizons range from gravelly loam to gravelly sandy loam. The Bx horizon matrix has a hue of 7.5YR or 10YR, a value of 4 or 5, and a chroma of 4 to 6. It is sandy loam or loam and in places is gravelly. The Bx and Cx horizons are firm to very firm and brittle.

Rockaway soils are associated with Hibernia, Whitman, and Riverhead soils. They do not have the grayish mottles in the upper part of the B horizon that are common in Hibernia soils. They do not have the gray colors that are common in Whitman soils. They have a fragipan and Riverhead soils do not. They do not have the loose, stratified gravelly and sandy C horizon that Riverhead soils have.

Rockaway gravelly loam, 3 to 8 percent slopes (RoB).—The profile of this soil is the one described as representative of the series. Included in mapping are two similar soils. One of these soils has a medium acid subsoil, and the other lacks a fragipan. Both are inextensive and are

similar to this Rockaway soil in limitations and management. Also included are areas of Hibernia soils and spots of Rockaway very stony loam. The Hibernia soils mainly occur at the base of steeper slopes and make up about 15 percent of the area.

This soil is used for row crops, hay, pasture, and woodland. Many areas are now idle and are reverting to woodland or are used for community development purposes. The hazard of erosion is moderate. Erosion control is needed in cultivated areas. Capability unit IIe–3; woodland group 3o1.

Rockaway gravelly loam, 8 to 15 percent slopes (RoC).—Included with this soil in mapping in some areas are two similar soils. One of these soils has a medium acid subsoil, and the other does not have a fragipan. Both are inextensive and are similar to this Rockaway soil in limitations and management. Also included are spots of Rockaway very stony loam. Small seep areas occur where the slope changes.

This soil is used for row crops, hay, pasture, and woodland. Many areas are reverting to woodland. Runoff is medium. The hazard of erosion is moderate. Erosion control is needed in cultivated areas. Capability unit IIIe–3; woodland group 3o1.

Rockaway gravelly loam, 15 to 25 percent slopes (RoD).—The profile of this soil is similar to the one described as representative of the series, but the depth to the fragipan is slightly less. Included in mapping are small areas of Rockaway very stony loam and Rock outcrop. Also included in some areas are two similar soils; one has a medium acid subsoil, and the other does not have a fragipan. Both are inextensive and are similar to this Rockaway soil in limitations and management. Concave pockets and places where the slope changes tend to be seepy.

This soil is used for hay, pasture, woodland, and infrequent row crops. Many areas are idle. Runoff is rapid. The hazard of erosion is severe in cultivated areas. Erosion control is needed. Capability unit IVe–3; woodland group 3r1.

Rockaway very stony loam, 5 to 25 percent slopes (RpD).—The profile of this soil is similar to the one described as representative of the series, but the content of stones, 5 to 30 feet apart, is about 3 percent in the surface layer and subsoil. Included in mapping are small concave pockets that collect water and areas of Rockaway loam. Also included in some areas are two similar soils; one has a medium acid subsoil, and the other does not have a fragipan. Both are inextensive and are similar to this Rockaway soil in limitations and management.

This soil is used for woodland and pasture and as individual home sites. In the less sloping areas, the stone content is the primary limitation for intensive use. Capability unit VIs–19; woodland group 3r1.

Rockaway very stony loam, 25 to 40 percent slopes (RpE).—The profile of this soil is similar to the one described as representative of the series, but it contains stones, 5 to 30 feet apart, and about 3 percent of the surface area is covered with stones. Included in mapping are two similar soils; one has a medium acid subsoil, and the other does not have a fragipan. Both are inextensive and are similar to this Rockaway soil in limitations and management. Small areas of Rock outcrop are also included.

This soil is used for woodland. Steep slopes and the high stone content severely limit the use of this soil for most other uses. Capability unit VIIs–21; woodland group 3r1.

Rockaway-Rock outcrop association, sloping and moderately steep (RrD).—This association is 25 to 40 percent bedrock outcrop or soil material less than 10 inches thick over bedrock and 30 to 45 percent stony to extremely stony Rockaway soils. Slopes range from 8 to 25 percent. Included in mapping are small areas of similar soils where bedrock is at a depth of 10 to 40 inches and elongated, narrow areas of gently sloping soils along the ridge crests. Also included in depressions and seep areas are spots of Whitman and Hibernia soils and muck.

Most of this association is wooded. Some areas are used for pasture. The Rock outcrop and shallow soils, the content of stones, and the steep slopes make this association unsuitable for cultivation. Capability unit VIIs–21; woodland group 3x1.

Rock Outcrop

Rock outcrop is extensive in areas of steep Oquaga soils and very steep Nassau soils. Three mapping units that are predominantly Rock outcrop are described in the paragraphs that follow.

Rock outcrop-Nassau association, very steep (RsF).—This association is 30 to 60 percent Rock outcrop, rubble, or soil material less than 10 inches thick and 30 to 60 percent Nassau soils. Slopes range from 25 to 45 percent. In some areas, the Rock outcrop is a 6- to 12-inch ledge at the top of steep Nassau soils. In 10 percent of the areas, Rock outcrop forms almost vertical cliffs, many feet above the surface. The outcrops are separated only by very narrow areas.

This association is used for pasture, woodland, and watershed protection. Woodland and pasture production are severely restricted by Rock outcrop. Capability unit VIIIs–23; woodland group 5x1.

Rock outcrop-Oquaga association, steep (RtE).—This association is 40 to 60 percent bedrock outcrop, rock rubble, or soil material less than 10 inches thick and 20 to 35 percent extremely stony Oquaga soils. Slopes range from 25 to 35 percent. Bedrock is generally alined in a northeast to southwest direction. The bedrock faces have cracks and crevices that are filled or partly filled with soil material, in which trees and shrubs grow. The Oquaga soils are on the lower slopes. Included in mapping are small areas of extremely stony Lackawanna and Swartswood soils in narrow areas, like steps, between bedrock outcrop. Also included are small areas of very steep or moderately steep Rock outcrop or soils.

Most of this association is in State forests, camps, recreation areas, and private woodland. Capability unit VIIIs–23; woodland group 3x1.

Rock outcrop-Rockaway association, steep (RvE).—This association is 70 to 90 percent bedrock outcrop, rock rubble, or soil material less than 10 inches thick and 5 to 20 percent extremely stony Rockaway soils. Slopes range from 25 to 35 percent. The Rockaway soils occupy

less steep areas at the base of slopes and elongated ridge crests. The bedrock faces have cracks that are filled or partly filled with soil material, in which trees and shrubs grow. Included in mapping are areas of soils where the depth to bedrock is 10 to 40 inches and some wet spots.

This association is used for watershed protection and recreation, such as hiking and skiing, where the Rock outcrop is not too numerous. Woodland production is severely limited because stands are of low density and harvesting is difficult. Residential sites are seriously restricted because the abundant rock outcrop and the steep slopes make the area inaccessible and severely limit septic tank systems. Capability unit VIIIs–23; woodland group 3x1.

Sloan Series

The Sloan series consists of deep, level and nearly level, very poorly drained soils. These soils formed in alluvium washed from nearby uplands. They are on flood plains along the Wallkill, Paulins Kill, and Pequest Rivers and along some of the major streams in the county. These flood plains are subject to frequent, generally annual, flooding.

In a representative profile the surface layer is black silt loam 10 inches thick. The subsoil is distinctly mottled gray silty clay loam 30 inches thick. The substratum to a depth of 60 inches is mottled, gray gravelly sandy loam.

Available water capacity is high. Permeability is moderate. Natural fertility is high. Typically, the water table is at or near the surface most of the year.

Most of the acreage is wooded. Most of the cleared acreage is pastured because flooding is a hazard. Corn is grown in the few areas that are not flooded every year. Improving drainage is difficult.

Representative profile of Sloan silt loam, in an area of Sloan and Wayland silt loams, ½ mile east of intersection of County Routes No. 94 and 15, at Lafayette, 1,300 feet south of bridge on State Route No. 94 over Paulins Kill, between old railroad bed and river:

A11—0 to 10 inches, black (10YR 2/1) silt loam; moderate, medium, granular structure; friable; very sticky; slightly acid; abrupt, smooth boundary.

A12—10 to 15 inches, very dark gray (10YR 3/1) silt loam; moderate, medium, subangular blocky structure; friable; sticky to very sticky; slightly acid; gradual, wavy boundary.

B2g—15 to 32 inches, gray (10YR 5/1) silty clay loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; moderate, medium, angular blocky structure; slightly firm; sticky and plastic; neutral; gradual, wavy boundary.

B3g—32 to 45 inches, gray (5Y 5/1) silty clay loam; many, distinct, dark yellowish-brown (10YR 4/4) and brownish-yellow (10YR 6/6) mottles; weak, medium, angular blocky structure; friable and sticky; neutral; gradual, wavy boundary.

IICg—45 to 60 inches, gray (5Y 5/1) gravelly sandy loam; many, coarse, distinct, yellowish-brown (10YR 5/6) and brownish-yellow (10YR 6/6) mottles; massive; friable; mildly alkaline.

The solum is 30 inches or more thick. The alluvial deposits are more than 40 inches thick over stratified material. Small amounts of gravel are present in the lower part of some soils. Reaction ranges from slightly acid in the A horizon to mildly alkaline in the C horizon.

The A1 horizon has a hue of 10YR, a value of 2 or 3, and a chroma of 1 or 2. The B horizon is dominantly gray; hue ranges from 5Y to 10YR, value is 4 or 5, and chroma is 1 or 2. It contains mottles that have a hue of 10YR, a value of 4 to 6, and a chroma of 4 or 6. The B horizon is dominantly silty clay loam, but is silt loam in places. It has weak to moderate, medium to coarse, subangular and angular blocky structure and moderate, medium, prismatic structure. The IIC horizon is stratified with varying textures. It is gleyed and mottled.

Sloan soils are associated with Wayland and Carlisle soils. In contrast with Wayland soils, they have a gray B horizon. They have a thicker A horizon than Wayland soils. They have more mineral and less organic material than Carlisle soils.

Sloan and Wayland silt loams (Sm).—Most areas are nearly equal parts of Sloan and Wayland soils. Some are dominantly one or the other. These soils are in low positions on the landscape. Included in mapping are small areas of loamy, sandy, gravelly, and other better drained soils. Also included are a few small isolated areas of Carlisle soils or other shallow organic soils.

Most of the acreage is used for summer pasture, woodland, and wetland wildlife. Wild grasses, sedges, and reeds and red maple, elm, ash, and white oak trees are most abundant in undrained areas. Outlets for improved drainage systems are generally not available. Capability unit VIw–46; woodland group 4w1.

Swamp

Swamp (Sp) is low land where the water table is at the surface at least 10 months of the year. It is along sluggish streams and drainageways, in low areas that have poor surface outlets and a very high water table, and in areas around natural ponds. The surface layer is very dark gray or gray. The texture of the surface layer and content of organic matter are highly variable. The subsurface layer ranges from coarse to fine. The subsurface layer and underlying material contain a layer that is firm, but not necessarily brittle. Some areas are stony, but rarely very stony or extremely stony.

Swamp maple is a dominant natural species; some areas have many dead or dying trees. This mapping unit has potential for wetland wildlife habitat development. Most areas are natural water retention and storage areas. Capability unit VIIIw–37; woodland group 5w1.

Swartswood Series

The Swartswood series consists of deep, well-drained, gently sloping to very steep soils that have a fragipan in the lower part of the subsoil. These soils formed in glacial till derived chiefly from gray and brown quartzite, conglomerate, and sandstone.

In a representative profile in a wooded area, a 2-inch layer of partly decomposed leaf litter and black or dark-brown organic material overlies the mineral soil. The next layer is 2 inches of grayish-brown very stony sandy loam. The upper 28 inches of the subsoil is yellowish-brown very stony gravelly loam or very stony gravelly sandy loam. The lower part to a depth of 60 inches is a fragipan of very firm, brittle, dark-brown gravelly sandy loam.

Available water capacity is moderate. Permeability is moderate above the fragipan and moderately slow in the pan. Natural fertility is moderate. Runoff varies according to slope.

Nonstony and less sloping areas of these soils are suited to farming.

Representative profile of Swartswood very stony loam, 3 to 8 percent slopes, in Montague Township, across the road from Mashipacong Pond, 200 feet into hardwood forest:

O1—2 inches to 1 inch, dark-brown (7.5YR 4/2) leaf litter; strongly acid; abrupt, smooth boundary.

O2—1 inch to 0, black (10YR 2/1) fibrous mat of decayed leaves, roots, and stems; strongly acid; abrupt, smooth boundary.

A2—0 to 2 inches, grayish-brown (10YR 5/2) sandy loam; weak, fine, granular structure; very friable; 10 percent gravel and cobblestones, stones common; very strongly acid; abrupt, irregular boundary.

B21ir—2 to 5 inches, yellowish-brown (10YR 5/6) gravelly loam; moderate, fine, granular structure; 15 percent gravel, stones common; very strongly acid; clear, wavy boundary.

B22—5 to 19 inches, yellowish-brown (10YR 5/4) gravelly loam; weak, medium, subangular blocky structure; friable; few, thin, patchy clay films on channels; very large roots; 15 percent gravel, stones common; very strongly acid; gradual, wavy boundary.

B23—19 to 30 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; weak, medium and coarse, subangular blocky structure; slightly firm; 20 percent gravel, stones common; very strongly acid; clear, wavy boundary.

Bx—30 to 60 inches, dark-brown (7.5YR 4/4) gravelly sandy loam; massive; very firm, brittle; 30 percent gravel, cobblestones, and stones; very strongly acid.

The solum ranges from 40 to 70 inches in thickness. Depth to the fragipan ranges from 24 to 36 inches. Depth to rock is 48 inches or more. The content of coarse fragments, ordinarily dominantly gravel size, ranges from 10 to 45 percent. Unless limed, these soils are very strongly acid.

Most surface stones have been removed in cleared fields. The O, A2, and B21ir horizons have been mixed in tilled fields to form a grayish-brown (10YR 5/2) or brown (10YR 4/3) Ap horizon. The B horizon ranges from 7.5YR to 10YR in hue, from 3 through 5 in value, and from 3 through 6 in chroma. It is commonly loam but ranges to sandy loam and gravelly analogs. Above the fragipan it ranges from subangular blocky to platy. The fragipan is firm or very firm. The C horizon, if present, is similar to the Bx horizon in color, texture, and consistence. In some places the Bx and C horizons contain few to many mottles of yellowish brown (10YR 5/6), brownish yellow (10YR 6/6), and light brownish gray (10YR 6/2).

Swartswood soils are associated with Wurtsboro, Lackawanna, and Oquaga soils. Swartswood soils do not have the low chroma mottles, above the fragipan, that are common in Wurtsboro soils. They are not so red as Lackawanna soils. They are deeper over bedrock than Oquaga soils.

Swartswood gravelly loam, 3 to 8 percent slopes (SwB).—This soil has a profile similar to the one described as representative of the series, but it contains fewer stones and the gravel content ranges from 20 to 30 percent. Most stones in the surface layer have been removed. Cobblestones are common in some areas.

Included with this soil in mapping are areas where slopes are stronger than 8 percent. Seep spots occur in some areas, especially at the base of the stronger slopes.

Most areas of this soil are used for commonly grown crops and for hay, pasture, and woodland. Some areas are idle and are reverting to woodland. Erosion control is needed in cultivated areas. Capability unit IIe–3; woodland group 3o1.

Swartswood gravelly loam, 8 to 15 percent slopes (SwC).—This soil has a profile similar to the one described as representative of the series, but it contains fewer stones and the gravel content ranges from 20 to 30 percent. Most stones originally in the surface layer have been removed. Cobblestones are common in some areas. Seep spots occur in some areas, especially where the slope changes.

This soil is used for row crops, hay, pasture, and woodland. Erosion control is needed in cultivated areas. Capability unit IIIe–3; woodland group 3o1.

Swartswood gravelly loam, 15 to 25 percent slopes (SwD).—This soil has a profile similar to the one described as representative of the series, but it contains fewer stones and the gravel content ranges from 25 to 35 percent. In wooded areas the surface layer is stony. In areas used for crops, the stones have been removed. Cobblestones are common in some areas.

This soil is used for row crops, hay, pasture, and woodland. Runoff is rapid. The hazard of erosion is severe in cultivated areas. Erosion control is needed. Capability unit IVe–3; woodland group 3r1.

Swartswood and Lackawanna very stony soils, 3 to 8 percent slopes (SxB).—Most areas of this mapping unit are about 70 percent Swartswood soil and 30 percent Lackawanna soil, but some are dominantly Lackawanna soil. Stones are 5 to 30 feet apart and cover about 3 percent of the surface.

Included with these soils in mapping are small areas of sandstone and quartzite ledge and some areas where slopes are 8 to 15 percent. Concave pockets at the base of steeper slopes collect water that seeps from higher areas.

The acreage is used for woodland, wildlife, and pasture. Much of it is in State forests and youth camps. Capability unit VIs–19; woodland group 3o1.

Swartswood and Lackawanna very stony soils, 8 to 25 percent slopes (SxD).—Most areas of this mapping unit are about 70 percent Swartswood soil and 30 percent Lackawanna soil, but some are dominantly Lackawanna soil. Stones are 5 to 30 feet apart and cover about 3 percent of the surface area.

Included with these soils in mapping are small areas of sandstone and quartzite ledge and some areas where slopes are stronger than 25 percent. Concave pockets within this unit collect water that seeps from surrounding areas.

The acreage is used for woodland, wildlife, and pasture. Much of it is in State forests and youth camps. Capability unit VIs–19; woodland group 3r1.

Swartswood and Lackawanna very stony soils, 25 to 35 percent slopes (SxE).—Most areas of this mapping unit are about 70 percent Swartswood soil and 30 percent Lackawanna soil, but some are dominantly Lackawanna soil. Stones are 5 to 30 feet apart and cover about 3 percent of the surface area.

Included with these soils in mapping are less sloping areas and small areas of sandstone and quartzite ledge.

These soils are used for woodland and wildlife. Capability unit VIIs–21; woodland group 3r1.

Unadilla Series

The Unadilla series consists of deep, well-drained, nearly level to gently sloping soils on terraces adjacent to the Delaware River. The soils formed in water-deposited material high in content of very fine sand and silt.

In a representative profile the plow layer is dark-brown very fine sandy loam 9 inches thick. The subsoil is dark yellowish-brown and dark-brown very fine sandy loam 31 inches thick. The substratum to a depth of 60 inches is dark yellowish-brown fine sandy loam.

Available water capacity is high. Permeability is moderate. Natural fertility is moderate.

Nearly all areas of these soils have been cleared for farming.

Representative profile of Unadilla very fine sandy loam, 0 to 3 percent slopes, ¾ mile north and ½ mile west of Millville, in a hay field:

Ap—0 to 9 inches, dark-brown (10YR 4/3) very fine sandy loam; weak, fine, granular structure; very friable; many fine roots; many pores; slightly acid; clear, smooth boundary.

B21—9 to 20 inches, dark yellowish-brown (10YR 4/4) very fine sandy loam; weak, fine, subangular blocky structure parting to weak, fine, granular; very friable; many pores; common fine roots; dark-brown (7.5YR 4/4) coatings in worm and root channels; medium acid; gradual, wavy boundary.

B22—20 to 40 inches, dark-brown (7.5YR 4/4) very fine sandy loam; weak, fine, subangular blocky structure; slightly firm to friable; common roots; medium acid; gradual, wavy boundary.

C—40 to 60 inches, dark yellowish-brown (10YR 4/4) light fine sandy loam; weak, fine, granular structure; very friable; medium acid.

Depth to bedrock is more than 60 inches and generally ranges to more than 10 feet. The profile ranges from very fine sandy loam to silt loam and to fine sand below a depth of 40 inches. There are few, if any, cobblestones and stones. Unless limed, these soils range from strongly acid to medium acid.

The Ap horizon ranges from 10YR to 7.5YR in hue and is 3 or 4 in value and 2 or 3 in chroma. The B horizon ranges from 10YR to 7.5YR in hue and is 4 or 5 in value and 4, 5, or 6 in chroma. It is dominantly friable, but the B22 horizon is firm in places. The B horizon is very fine sandy loam and silt loam. The C horizon ranges from 10YR to 2.5Y in hue, from 4 to 6 in value, and from 2 to 4 in chroma. It is friable to loose.

Unadilla soils are associated with Chenango and Colonie soils. They contain more silt and very fine sand and less gravel in the solum than Chenango soils. They contain more clay in the B horizon than Colonie soils.

Unadilla very fine sandy loam, 0 to 3 percent slopes (UnA).—The profile of this soil is the one described as representative of the series. Included in mapping are spots of Chenango gravelly sandy loam and Colonie loamy sand.

This soil is well suited to corn, alfalfa, and most other locally grown crops. Capability unit I–6; woodland group 3o1.

Unadilla very fine sandy loam, 3 to 8 percent slopes (UnB).—Included with this soil in mapping are a few small areas where slopes are more than 8 percent. Also included are areas of Chenango gravelly sandy loam and Colonie loamy sand.

This soil is well suited to corn, alfalfa, and most other locally grown crops. Runoff is medium. The hazard of erosion is moderate. Erosion control is needed in cultivated areas. Capability unit IIe–6; woodland group 3o1.

Valois Series

The Valois series consists of deep, gently sloping to steep, well-drained soils on uplands. These soils formed in a mantle of glacial till underlain by slate, shale, or phyllite bedrock.

In a representative profile the plow layer is very dark grayish-brown shaly loam 7 inches thick. The subsoil is dark yellowish-brown and yellowish-brown shaly loam 41 inches thick. The substratum to a depth of 60 inches is brown shaly loam.

Natural fertility is moderate. Permeability and the available water capacity are moderate.

These soils are fairly well suited to corn, small grain, vegetables, hay, and pasture. Corn and alfalfa are the main crops. Steep areas are better suited to hay, pasture, or woodland than to most other uses.

Representative profile of Valois shaly loam, 8 to 15 percent slopes, in village of Greendell, near maintenance garage, in a hayfield:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) shaly loam; weak, fine, granular structure; very friable; many fine and few medium roots; 20 percent partly weathered, gravel-size shale fragments; medium acid; clear, smooth boundary.

B21—7 to 15 inches, dark yellowish-brown (10YR 4/4) shaly loam; moderate, medium, granular structure; friable; few medium and large roots; 20 percent partly weathered, gravel-size shale fragments; medium acid; clear, smooth boundary.

B22—15 to 27 inches, yellowish-brown (10YR 5/4) shaly loam; moderate, medium, subangular blocky structure; friable; few large roots; 20 percent partly weathered, gravel-size shale fragments; strongly acid; gradual, wavy boundary.

B3—27 to 48 inches, yellowish-brown (10YR 5/4) shaly loam; massive; slightly firm; 25 percent partly weathered shale fragments; strongly acid.

C—48 to 60 inches, brown (10YR 5/3) shaly loam; massive; friable; 35 percent shale fragments; strongly acid.

The solum ranges from 36 to 48 inches in thickness. Depth to hard bedrock is more than 4 feet and ranges to 10 feet or more. Unless limed, these soils range from very strongly acid to slightly acid.

The Ap horizon is very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3). The B horizon ranges from 7.5YR to 2.5Y in hue and is 4 or 5 in value and 4, 5, or 6 in chroma. It is shaly loam or shaly silt loam. The content of partly weathered shale fragments in the B horizon ranges from 15 to 35 percent. The C horizon ranges from 10YR to 2.5Y in hue.

Valois soils are associated with Nassau, Bath, and Albia soils. They are deeper over bedrock and contain less shale fragments than Nassau soils. They contain more shaly coarse fragments in the B horizon than Bath soils and lack the fragipan common in those soils. In contrast with Albia soils, they are not mottled and they do not have a fragipan.

Valois shaly loam, 3 to 8 percent slopes (VaB).—Included with this soil in mapping are areas where the solum is less than 36 inches thick, small areas where the content of shale fragments is less than 15 percent, and some areas where slopes are less than 3 percent. Also included are some areas of moderately eroded soils and small areas of Nassau and Bath soils.

This soil is used for commonly grown field crops and hay and pasture. Runoff is medium. The hazard of ero-

sion is moderate. Erosion control is needed in cultivated areas. Capability unit IIe–3; woodland group 3o1.

Valois shaly loam, 8 to 15 percent slopes (VaC).—The profile of this soil is the one described as representative of the series. Included in mapping are areas of soils where the combined thickness of the surface layer and subsoil is less than 36 inches. Also included are small, gently sloping concave pockets of Albia soils and small areas of Nassau soils. Eroded spots in some cultivated fields are lighter in color. Crop yields are lower in these areas.

This soil is used for the commonly grown field crops and for hay and pasture. Runoff is moderately rapid. The hazard of erosion is moderate. Erosion control is needed in cultivated areas. Capability unit IIIe–3; woodland group 3o1.

Valois shaly loam, 15 to 25 percent slope (VaD).—The profile of this soil is similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is less than 36 inches and the content of shale fragments is higher. Included in mapping are small areas of Nassau soils. Where this soil is adjacent to Nassau soils, the content of shale and slate is higher than typical.

This soil is better suited to pasture, alfalfa, and other hay crops than to most other uses. Small to medium-size eroded spots are likely to occur in areas that have been used for row crops for long periods. Runoff is rapid. The hazard of erosion is severe in cultivated areas and erosion control is needed. Capability unit IVe–3; woodland group 3r1.

Wallkill Series

The Wallkill series consists of deep, nearly level, very poorly drained mineral soils underlain by organic deposit. These soils are in low positions on the landscape along margins of Carlisle muck, adjacent to uplands, and along streams that run through organic soils.

In a representative profile the plow layer is dark-gray silt loam 8 inches thick. The substratum is mottled, gray silt loam 10 inches thick. The next layer to a depth of 60 inches is dark reddish-brown and black organic material.

Available water capacity is high. Natural fertility is high. Runoff is very slow. Permeability is moderate. The water table is at or near the surface most of the time. These soils are subject to occasional stream overflow.

Most of the acreage is wooded. Cleared areas are used mostly for pasture. Drained areas are used for corn or special crops.

Representative profile of Wallkill silt loam, 100 feet north of a farm lane, 1,800 feet east of the junction of Oil City Road and State Route 284, 0.8 mile south of the New York-New Jersey State line:

Ap—0 to 8 inches, dark-gray (10YR 4/1) silt loam; weak, medium, granular structure; friable, sticky and slightly plastic; common fine roots; medium acid; clear, smooth boundary.

Cg—8 to 18 inches, gray (10YR 5/1) heavy silt loam; common, fine, distinct, yellowish-red (5YR 5/8) mottles; massive; firm, sticky and slightly plastic; few fine roots; medium acid; abrupt, smooth boundary.

IIOa1—18 to 28 inches, dark reddish-brown (5YR 2/2 on broken face and rubbed) sapric material; about 10 percent fibers, about 5 percent when rubbed; massive; firm; fibers are mostly woody; strongly acid; clear, wavy boundary.

IIOa2—28 to 40 inches, black (5YR 2/1 on broken face and rubbed) sapric material; about 10 percent fibers; massive; soft and friable; few woody chips ¼ to 1 inch in diameter; medium acid; clear, wavy boundary.

IIOe—40 to 60 inches, dark reddish-brown (5YR 3/2 changing on exposure to black, 5YR 2/1) hemic material; about 30 percent fibers, 15 percent when rubbed; massive; friable; many woody coarse fragments ¼ to 3 inches in diameter; neutral.

The mineral soil is 16 to 30 inches thick over an organic layer that is 20 to 60 inches or more thick. Reaction ranges from strongly acid to neutral.

The Ap, or A1, horizon ranges from black (10YR 2/1) to dark grayish brown (2.5Y 4/2). In some profiles the C horizon is either replaced or partly replaced by a B horizon that has weak prismatic or blocky structure. The C, or B, horizon is dominantly silt loam but ranges to silty clay loam in some subhorizons. It ranges from olive gray (5Y 5/2) to gray (10YR 5/1). The underlying O horizon is sapric or hemic material and contains woody or herbaceous material.

Wallkill soils are associated with Carlisle, Sloan, and Wayland soils. They are mineral soils underlain by organic deposit, and the associated soils are organic throughout.

Wallkill silt loam (Wa).—Slopes generally are less than 2 percent. In most areas as much as 25 percent is an included mineral soil less than 16 inches deep over organic material. Also included are areas of Carlisle, Wayland, and Sloan soils and small areas of thin organic soils.

Undrained areas are woodland or are used for hay and pasture. Elm, red maple, and other water-tolerant species are common. Drained areas are used for corn, sod, pasture, and limited vegetable crops. Capability unit IIIw–41; woodland group 5w1.

Washington Series

The Washington series consists of deep, well-drained, gently sloping to steep soils. These soils formed on uplands in glacial till material underlain by limestone bedrock.

In a representative profile the plow layer is very dark grayish-brown loam 8 inches thick. The subsoil is dark yellowish-brown and dark-brown loam about 34 inches thick. The substratum to a depth of 60 inches is gravelly loam.

Available water capacity is high, and permeability is moderate. Natural fertility is high.

Less sloping areas of these soils are well suited to a wide variety of crops and to woodland.

Representative profile of Washington loam, 3 to 8 percent slopes, in Vernon Township; 1 mile northwest of Prices Switch on Price Road, 20 feet into field on the north side of Price Road:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, granular structure; friable; 10 percent gravel; slightly acid; clear, wavy boundary.

B1—8 to 12 inches, dark yellowish-brown (10YR 4/4) loam; weak, medium and coarse, granular structure; friable; 10 percent angular and semi-round gravel; slightly acid; gradual, wavy boundary.

B21t—12 to 24 inches, dark-brown (7.5YR 4/4) heavy loam; moderate, medium and fine, subangular blocky structure parting to weak, thin, platy; friable; thin coat-

ings of slightly darker material on 20 percent of ped faces; many medium roots; 15 percent angular and semi-round gravel; slightly acid; clear, wavy boundary.

B22t—24 to 34 inches, dark-brown (7.5YR 4/4) heavy loam; moderate, coarse, subangular blocky structure; slightly firm; thin to moderately thick silt and clay films on 20 to 30 percent of ped faces; 15 percent angular and semi-round gravel; slightly acid; gradual, clear boundary.

B3—34 to 42 inches, dark yellowish-brown (10YR 4/4) loam; weak, coarse and medium, subangular blocky structure; friable; 15 percent angular and semi-round gravel; slightly acid to neutral; clear, irregular boundary.

C—42 to 60 inches, yellowish-brown (10YR 5/4) gravelly loam; massive; friable; 25 percent angular and semi-round gravel; neutral.

The solum ranges from 40 to 50 inches in thickness. Depth to bedrock is 5 feet or more. Reaction ranges from medium acid to neutral in the solum, and is neutral in the C horizon. The content of coarse fragments ranges from 10 to 35 percent by volume in the solum, and to as much as 55 percent in the C horizon. The coarse fragments are angular gravel and cobblestones, and stones are present in some profiles.

The Ap horizon has a hue of 10YR, a value of 3 to 4, and a chroma of 2 or 3. It is loam and some areas are very stony. The B horizon has a hue of 10YR to 7.5YR, a value of 4 or 5, and a chroma of 3 to 6. It ranges from sandy loam through loam and silt loam to clay loam. The C horizon has a hue of 10YR, a value of 5 or 6, and a chroma of 4. In some profiles the lower part of the B or C horizon contains few, faint mottles that have gray interiors and bright exteriors. The C horizon ranges from gravelly sandy loam to gravelly loam.

Washington soils are associated with Wassaic and Lyons soils. They are deeper over bedrock than Wassaic soils. They do not have the gray B horizon that is common in Lyons soils.

Washington loam, 3 to 8 percent slopes (WhB).—The profile of this soil is the one described as representative of the series. Included in mapping in the southern part of the county are soils in which the combined thickness of the surface layer and subsoil is less than 40 inches. Also included in most areas and dominant in a few is a moderately well drained soil that has gray mottles at a depth of about 2 feet. Improved drainage is needed in these areas. Also included are some areas where the content of gravel in the surface laver is 20 percent or more.

This soil is used for corn, alfalfa, and other hay and silage crops. Erosion control is needed. Capability unit IIe–3; woodland group 1o1.

Washington loam, 8 to 15 percent slopes (WhC).—In some cultivated areas, part of the original surface layer has been removed by erosion. Included in mapping are small areas of soils in which the combined thickness of the surface layer and subsoil is less than 40 inches. Also included are spots of Wassaic gravelly loam, 3 to 15 percent slopes.

This soil is used for corn, alfalfa, and other hay and silage crops. Runoff is medium. The hazard of erosion is moderate. Erosion control is needed. Capability unit IIIe–3; woodland group 1o1.

Washington loam, 15 to 25 percent slopes (WhD).—Included with this soil in mapping are small areas where the combined thickness of the surface layer and subsoil is less than 40 inches. Also included are a few areas of Washington loam where slopes are steeper and areas of Wassaic silt loam, 15 to 30 percent slopes.

This soil has been used for hay, pasture, and woodland. Runoff is rapid. The hazard of erosion is severe in cultivated areas. Erosion control is needed. Capability unit IVe–3; woodland group 1r1.

Washington very stony loam, 3 to 15 percent slopes (WkC).—The profile of this soil is similar to the one described as representative of the series, but the content of stones and boulders in the surface layer and subsoil is about 3 percent. Stones are 5 to 30 feet apart, and boulders dominate. Many boulders are beneath the surface of the soil and only 1 or 2 feet are exposed. Slopes are complex. In some areas slopes range from nearly level to sloping within a distance of 75 to 100 feet. In others the slope variation from nearly level to sloping is 100 to 300 feet.

Included with this soil in mapping is a small area of a very stony, somewhat poorly drained soil that has gray mottles at a depth of about 2 feet. A few of the mapping units are dominantly moderately well drained soils. Also included are small areas of Wassaic loam, 3 to 15 percent slopes, and small areas of limestone ledge, both along the crest of some slopes.

This soil is used for pasture and woodland. A few areas have been cleared and used for corn and alfalfa or for suburban residential development. Capability unit VIs–19; woodland group 1o1.

Washington very stony loam, 15 to 25 percent slopes (WkD).—The profile of this soil is similar to the one described as representative of the series, but boulders and cobblestones are on the surface area and in the profile. The boulders are dominant. Many are 6 to 10 feet or more in width and height and only 1 to 2 feet are exposed. Slopes are complex. In some areas they are long and fairly even, and in others they are short and rolling. Included in mapping are some areas where the slope is more than 25 percent. Also included are narrow bands of Wassaic silt loam, 15 to 30 percent slopes, and narrow bands of limestone ledge, both along the top of slopes.

This soil is used for pasture and woodland. Runoff is rapid. The hazard of erosion is severe. Erosion control is needed in pastures. Some areas have been cleared for use as residential developments. Capability unit VIIs–21; woodland group 1r1.

Washington-Wassaic complex, 3 to 15 percent slopes ((WlC).—This complex is about 60 percent Washington soil and 40 percent Wassaic soil. These soils are undulating to rolling. Slopes are short. The Wassaic soil generally occupies the crests and upper slopes, and the Washington soil the lower positions. Included in mapping are small areas of limestone outcrop.

These soils are used for alfalfa, corn, pasture grasses, and trees. Runoff is moderate to moderately rapid. The hazard of erosion in cleared areas is moderate to moderately severe. Erosion control is needed in farmed areas. Capability unit IIIe–18; woodland group 1o1.

Washington-Wassaic complex, 15 to 25 percent slopes (WlD).—This complex is about 60 percent Washington soil and 40 percent Wassaic soil. Slopes are short and rolling. The Wassaic soil generally occupies the crests and upper slopes. The Washington soil generally occupies the lower slopes. Included in mapping are some small areas of limestone ledge along the crests of slopes.

These soils are used mainly for hay, pasture, and woodland. Runoff is rapid. The hazard of erosion is severe in cultivated areas. Erosion control is needed. Capability unit IVe–11; woodland group 1r1.

Wassaic Series

The Wassaic series consists of well-drained, gently sloping to steep soils that are moderately deep over limestone bedrock. These soils are on uplands. They formed in swales and hillsides between prominent limestone ledges. Slopes are generally short and complex and vary within short distances.

In a representative profile the surface layer is dark grayish-brown silt loam 3 inches thick. The subsurface layer is yellowish-brown silt loam 6 inches thick. The upper 4 inches of the subsoil is dark-brown heavy loam. The lower 11 inches is reddish-brown gravelly clay loam. The substratum is brown gravelly loam. Hard gray limestone bedrock is at a depth of 30 inches.

Available water capacity and permeability are moderate. Natural fertility is high.

Most areas of these soils are used for hay, pasture, or general crops.

Representative profile of Wassaic silt loam, 3 to 15 percent slopes, in Stillwater Township, 1½ miles north of village of Stillwater, 800 feet into wooded area east of County Road No. 517:

A1—0 to 3 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; many fine roots; 10 percent cobblestones and gravel; medium acid; abrupt, smooth boundary.

A2—3 to 9 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine, subangular blocky structure; friable; many fine and medium roots; 10 percent cobblestones and gravel; medium acid; abrupt, wavy boundary.

B&A—9 to 13 inches, dark-brown (7.5YR 4/4) heavy loam; weak, medium and fine, subangular blocky structure; friable, slightly sticky; thin silt films on ped surfaces; many medium roots; 10 percent cobblestones and gravel; slightly acid; clear, wavy boundary.

B2t—13 to 24 inches, reddish-brown (5YR 4/4) gravelly clay loam; moderate, medium, subangular blocky structure; firm, plastic; thin and moderately thick clay films; many medium roots; 15 percent gravel; neutral; clear, wavy boundary.

IIC—24 to 30 inches, brown (7.5YR 5/2) gravelly loam; massive; firm; 30 percent broken fragments of limestone bedrock; alkaline; gradual, wavy boundary.

IIR—30 inches, hard gray limestone bedrock.

The solum ranges from 20 to 36 inches in thickness. Depth to bedrock is 20 to 40 inches. The content of coarse fragments, mainly small subangular cobblestones and angular gravel, ranges from 0 to 15 percent. Unless limed, these soils are medium acid to alkaline.

In cultivated areas the A1 and A2 horizons have been mixed to form a dark-brown Ap horizon. The B&A or B1 horizon has a hue of 7.5YR, a value of 4 or 5, and a chroma of 3 to 5. The B&A, or B1, horizon ranges from loam to silt loam. The B2t horizon has a hue ranging from 5YR to 7.5YR, a value of 4 or 5, and a chroma of 4. In many places, the B horizon is underlain by bedrock. The C horizon, where present, is typically weathered residuum from the underlying rock. It is fine sandy loam, loam, or silt loam. It is 15 to 50 percent coarse fragments, and the percentage increases with increasing depth.

Wassaic soils are associated with Washington and Lyons soils. They are shallower over rock than Washington soils. They do not have the grayish B horizon that is common in Lyons soils.

Wassaic silt loam, 3 to 15 percent slopes (WmC).—The profile of this soil is the one described as representative of the series. Slopes vary widely within short distances. The underlying limestone bedrock is cavernous in places. Included in mapping are limestone ledges, most commonly along the crests of slopes. Also included are some deeper Washington soils in gently sloping areas.

This soil is used for hay, pasture, and woodland. Capability unit IIIe–18; woodland group 2o1.

Wassaic silt loam, 15 to 30 percent slopes (WmD).—The profile of this soil is similar to the one described as representative of the series, but the depth to bedrock averages about 24 inches. The underlying limestone bedrock is cavernous in places. Included in mapping are spots of limestone ledge, most commonly along the crests of slopes.

This soil is used for pasture and woodland. Capability unit IVe–11; woodland group 2r1.

Wassaic-Rock outcrop association, moderately steep (WnD).—This association is 20 to 35 percent limestone bedrock outcrop and 20 to 60 percent Wassaic soil. The limestone ledges often extend 12 to 24 inches above the surface and range from 50 to 100 feet apart. Slopes range from 15 to 25 percent. Included in mapping in areas between outcrops are shallow soils. Also included are some small areas that are as much as 80 percent bedrock ledge or very shallow soils. Small areas of deep, well-drained soils that are large enough for homesites are also included.

This association is used for woodland, pasture, watershed protection, wildlife, and recreation. Rock outcrop is extensive enough to be a major limitation to production of crops. Use for residences is restricted by inaccessibility and hazards to septic systems. Capability unit VIIs–21; woodland group 3x1.

Wayland Series

The Wayland series consists of deep, poorly drained soils on flood plains that are subject to frequent, generally annual stream overflow.

In a representative profile the surface layer is very dark grayish-brown silt loam 6 inches thick. The upper 40 inches of the substratum is dark-gray and gray silt loam. The lower part to a depth of 60 inches is gray fine sandy loam.

Available water capacity is high. Permeability is moderate or moderately slow in the substratum. Natural fertility is high. The water table is generally near the surface except during long dry periods.

Most areas of these soils are pasture.

The Wayland soils in Sussex County are mapped only with Sloan soils.

Representative profile of Wayland silt loam, in an area of Sloan and Wayland silt loams, in Tranquility Mills, on west bank of Pequest River, 300 feet south of bridge:

A1—0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; few, fine, dark-brown (7.5YR 4/4) mottles along some root channels; strong, coarse, granular structure; friable, sticky; neutral; gradual, smooth boundary.

C1g—6 to 24 inches, dark-gray (10YR 4/1) silt loam; common, fine, dark reddish-brown (5YR 3/4) and reddish-

brown (5YR 4/4) mottles; massive; friable, sticky; neutral; gradual, smooth boundary.

C2g—24 to 46 inches, gray (10YR 5/1) silt loam; common, fine, reddish-brown (5YR 4/4) mottles; massive; slightly firm, sticky; slightly alkaline; gradual, wavy boundary.

IIC3—46 to 60 inches, gray (10YR 5/1) fine sandy loam; massive; very friable; mildly alkaline.

The silty deposits are 36 inches thick or more. Depth to bedrock is 5 feet or more. Reaction ranges from neutral to mildly alkaline.

The A horizon matrix is mottled with dark brown and dark reddish brown. The C horizon matrix has a hue of 2.5Y to 10YR, a value of 4 or 5, and a chroma of 1. It contains mottles that have a hue of 10YR to 5YR, a value of 3 to 5, and a chroma of 4 to 6. It is massive, friable to firm silt loam or silty clay loam. The IIC horizon ranges from fine sandy loam to silty clay loam.

Wayland soils are associated with Sloan, Carlisle, and Wallkill soils. They have a thinner A horizon than Sloan soils. They are mineral soils and have less organic material than Carlisle and Wallkill soils.

Whitman Series

The Whitman series consists of deep, nearly level, very poorly drained soils underlain by a fragipan. These soils are in low positions on glaciated uplands. They formed in material derived mainly from gneiss and granite.

In a representative profile the surface layer is black sandy loam 10 inches thick. It contains many stones. The upper 10 inches of the substratum is gray sandy loam. The lower part to a depth of 65 inches is a fragipan of very firm, olive-gray gravelly sandy loam.

Available water capacity is moderate. Internal drainage is slow. Permeability is moderate above the fragipan and slow in the pan. Natural fertility is moderate.

Most areas are wooded with red maple and elm. Only scattered areas have been cleared and drained for pasture. These soils are wet most of the year. They are well suited to excavated ponds.

Representative profile of Whitman sandy loam in an area of Whitman extremely stony sandy loam, in Byram Township, 1½ miles north of upper end of Lake Musconetcong, at intersection of road to Beard Pond and tributary of Lubbers Run:

A1—0 to 10 inches, black (10YR 2/1) sandy loam; moderate, fine, granular structure; friable, sticky; many roots; 15 percent stones, dominantly 12 to 24 inches in diameter; medium acid; abrupt, wavy boundary.

C1g—10 to 20 inches, gray (5Y 5/1) sandy loam; few, fine, prominent, dark-brown (7.5YR 4/4) and dark reddish-brown (5YR 3/4) mottles; massive; firm to slightly firm; few fine roots; 10 percent cobblestones and small stones; strongly acid; gradual, irregular boundary.

C2xg—20 to 65 inches, olive-gray (5Y 5/2) gravelly sandy loam; few, fine, distinct, light olive-brown (2.5Y 5/6) and olive-yellow (2.5Y 6/6) mottles that increase in number in lower part; massive; very firm, brittle; 20 percent gravel, cobblestones, and stones; strongly acid.

Depth to the fragipan ranges from 10 to 25 inches. Depth to bedrock is 60 inches or more. The content of coarse fragments, dominantly stones and cobblestones, ranges from 15 to 35 percent. The coarse fragments generally are more abundant in the upper 12 to 24 inches. Reaction is dominantly strongly acid, but ranges to slightly acid.

The A1 horizon is 10YR 2/1 or 2/2. The Cg and Cxg horizons range from 10YR to 5Y in hue, from 4 to 6 in value, and from 0 to 2 in chroma. Mottles in the Cg horizon are reddish brown to olive yellow. The Cg horizon is dominantly sandy loam or gravelly sandy loam but in some places is fine sandy loam. The Cx horizon is very firm and brittle.

Whitman soils are associated with Hibernia and Rockaway soils. They do not have brownish colors above the fragipan that are common in Hibernia and Rockaway soils.

Whitman extremely stony sandy loam (Wo).—Slopes of this soil range from 0 to 3 percent. Stones are 2 to 5 feet apart. Included in mapping are scattered areas of Whitman gravelly loam. Also included are areas where the surface layer is gray or black and is more than 10 inches thick.

This soil is wooded. Stone clearing and drainage are needed if it is used for pasture and many other purposes. Capability unit VIIs–45; woodland group 5w1.

Wooster Series

The Wooster series consists of deep, well-drained, gently sloping to very steep soils that have a fragipan in the lower part of the subsoil. These soils formed on uplands in glacial till deposit of limestone, sandstone, and shale. Areas of Rock outcrop are common.

In a representative profile the plow layer is dark grayish-brown loam 8 inches thick. The upper 14 inches of the subsoil is yellowish-brown silt loam. The next 10 inches is dark yellowish-brown gravelly silt loam. The lower 16 inches is a fragipan of very firm, dark-brown channery loam. The substratum to a depth of 60 inches is yellowish-brown channery sandy loam.

Available water capacity is moderate above the fragipan and low in the pan. Permeability is moderate above the fragipan and moderately slow in the pan. Natural fertility is moderate.

Most areas are woodland. Some have been cleared for farming but most are idle and reverting to woodland.

Representative profile of Wooster loam, 3 to 8 percent slopes, in Wallpack Township, ¼ mile west of Wallpack center, 30 feet southwest of a township road, in a pasture:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; many fine and medium roots; 10 percent angular to semiround gravel; medium acid; abrupt, smooth boundary.

B1—8 to 14 inches, yellowish-brown (10YR 5/4) silt loam; moderate, medium, subangular blocky structure; friable to slightly firm; many roots; many coarse pores and worm channels; 10 percent gravel; medium acid; gradual, wavy boundary.

B21t—14 to 22 inches, yellowish-brown (10YR 5/4) heavy silt loam; moderate, coarse, subangular blocky structure; slightly firm; many roots; many fine and medium pores; few large pores; many patchy clay films on peds and some bridging between grains; 15 percent gravel; medium acid; gradual, wavy boundary.

B22t—22 to 32 inches, dark yellowish-brown (10YR 4/4) heavy gravelly silt loam; moderate, coarse, subangular blocky structure; firm; few medium and large roots; many small pores; thin discontinuous clay films on ped faces; 20 percent gravel; medium acid; gradual, wavy boundary.

Bx—32 to 48 inches, dark-brown (7.5YR 4/4) channery loam; weak, very coarse, prismatic structure; very firm, brittle; patchy clay films on ped faces; 20 percent angular and subrounded limestone and sandstone coarse fragments as much as 6 inches in diameter; medium acid; abrupt, wavy boundary.

C—48 to 60 inches, yellowish-brown (10YR 5/6) channery sandy loam; massive; firm; very few fine roots; 30 percent angular to subrounded limestone and sandstone coarse fragments 1 to 10 inches in length; slightly acid grading to mildly alkaline in lower part.

The solum ranges from 40 to 60 inches or more in thickness. Depth to bedrock is 40 inches or more. Depth to the fragipan ranges from 24 to 36 inches. Unless limed, these soils range from strongly acid to medium acid in the solum and to mildly alkaline in the C horizon. The content of thin, flat, angular to subrounded shale, sandstone, or limestone fragments as much as 15 inches long ranges from 5 to 25 percent in the A, B1, and B2t horizons and from 15 to 35 percent in the Bx and C horizons. In many places the soil is stony.

The Ap horizon has a value of 4 or 5 and a chroma of 2 or 3. In uncultivated areas, an A1 horizon is present that is 1 to 3 inches thick and is similar in color to the Ap horizon but it has a value of 2 or 3. A thin, paler colored A2 horizon occurs in places. The B1 horizon is yellowish-brown (10YR 5/4) or dark yellowish-brown (10YR 4/4) loam or silt loam and gravelly or channery analogs. The Bx horizon has a hue of 7.5YR or 10YR, a value of 4 or 5, and a chroma of 4, 5, or 6. It ranges from loam or silt loam to clay loam and channery, gravelly, or flaggy analogs. It is brittle and very firm to hard. The C horizon matrix ranges from 5Y to 7.5YR in hue and is 4 or 5 in value and 4, 5, or 6 in chroma. Color variegations associated with weathered limestone or sandstone fragments are present in the C horizon. The C horizon ranges from sandy loam to silt loam and is typically channery, gravelly, or flaggy. It is friable to very firm.

Wooster soils are associated with Wassaic and Nassau soils. They are deeper over bedrock than those soils.

Wooster loam, 3 to 8 percent slopes (WsB).—The profile of this soil is the one described as representative of the series. Wooded areas are stony. The content of cobblestones is as much as 15 percent, and cobblestones are concentrated at or near the surface. In a few areas the depth to bedrock is only 30 inches. In such areas the firm, brittle fragipan is either thin or absent. In places, concave pockets at the base of steeper slopes collect water that seeps from higher areas.

This soil has been used for alfalfa, corn, and hay. Most of it is now idle and reverting to woodland or is used for recreation. Erosion control is needed in cultivated areas. Capability unit IIe–3; woodland group 2o1.

Wooster loam, 8 to 15 percent slopes (WsC).—In much of the wooded area this soil is stony. The content of cobblestones is as much as 15 percent, and cobblestones are concentrated at or near the surface. In some areas the depth to bedrock is only 30 inches. In these areas the firm, brittle fragipan is either thin or absent. Toe slopes and concave pockets collect water from surrounding slopes.

This soil is used for alfalfa, corn, hay, pasture, and woodland. Most of it is now idle or is used for recreation. Erosion control is needed in cultivated areas. Capability unit IIIe–3; woodland group 2o1.

Wooster loam, 15 to 25 percent slopes (WsD).—Wooded areas of this soil are stony. The content of cobblestones is as much as 15 percent, and cobblestones are concentrated at or near the surface. In a few areas the depth to bedrock is about 30 inches. In these areas, the firm, brittle fragipan is either thin or absent. Ledges of bedrock outcrop along crests of some slopes. Water that moves laterally over the fragipan occasionally seeps to the surface layer at the base of the more gentle slopes.

This soil is used for pasture and woodland. Most of it is now idle or reverting to woodland. Erosion control is needed in pastures. Capability unit IVe–3; woodland group 2r1.

Wooster loam, 25 to 35 percent slopes (WsE).—Wooded areas of this soil are stony. The content of cobblestones is as much as 15 percent, and cobblestones are concentrated at the surface. In places the depth to bedrock is about 30 inches. In these areas the firm, brittle fragipan is either thin or absent. Ledges of bedrock outcrop along the crests of some slopes.

This soil is used for pasture and woodland. Much of it is now idle or reverting to woodland. It has potential for skiing. Capability unit VIe–3; woodland group 2r1.

Wurtsboro Series

The Wurtsboro series consists of deep, moderately well drained, gently sloping to moderately steep soils that have a fragipan in the subsoil. These soils are on uplands. They formed in moderately coarse textured glacial till derived predominantly from acid gray and brown quartzite, conglomerate, and sandstone.

In a representative profile in a wooded area, a 1-inch layer of partly decomposed leaf litter and a 1-inch layer of black or dark brown organic matter overlies the mineral soil. The next layer is dark grayish-brown gravelly loam 3 inches thick. The upper 17 inches of the subsoil is yellowish-brown gravelly loam. The lower part is a fragipan of very firm, brittle, yellowish-brown gravelly sandy loam.

Available water capacity is moderate. Permeability is moderate above the fragipan and moderately slow in the pan. Natural fertility is moderate. A seasonal high water is at a depth of 1½ to 2½ feet.

Nonstony areas of these soils are used for general crops or pasture.

Representative profile of Wurtsboro gravelly loam described in an area of Wurtsboro very stony loam, 0 to 8 percent slopes, in Hampton Township, ¾ mile west of Kemah Lake road intersection, 150 feet into wooded area on north side of Crandon Lake Road:

O1—2 inches to 1 inch, very dark brown (10YR 2/2) leaf litter; strongly acid, abrupt, smooth boundary.

O2—1 inch to 0, black (10YR 2/1) fibrous mat of decayed leaves, roots, and stems; strongly acid; abrupt, smooth boundary.

A2—0 to 3 inches, dark grayish-brown (10YR 4/2) gravelly loam; weak, fine, granular structure; very friable; 30 percent stones and gravel; strongly acid; abrupt, irregular boundary.

B21ir—3 to 7 inches, yellowish-brown (10YR 5/6) gravelly loam; weak, medium, granular structure; friable; many fine and medium roots; 25 percent stones and gravel; strongly acid; clear, wavy boundary.

B22—7 to 20 inches, yellowish-brown (10YR 5/4) gravelly loam; few, medium, faint, light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky structure; friable; many large and medium tree roots; 20 percent stones and gravel; strongly acid; gradual, wavy boundary.

Bx—20 to 72 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; common, coarse, distinct, gray (10YR 6/1) mottles; massive; very firm, brittle; 30 percent coarse fragments, dominantly gravel; strongly acid.

The solum ranges from 48 to 72 inches in thickness. Depth to the fragipan is 17 to 24 inches. Depth to bedrock is 5

feet or more. The content of coarse fragments, dominantly stones and cobblestones above the fragipan and gravel in the firm layer, ranges from 10 to 35 percent. Unless limed, these soils are very strongly acid.

In cleared fields, most surface stones and cobblestones have been removed and the upper horizons have been mixed to form a dark grayish-brown (10YR 4/2) Ap horizon that is 6 to 10 inches thick. The B horizon has a hue of 10YR or Ap horizon that is 6 to 10 inches thick. The B horizon has a hue of 10YR or 7.5YR, a value of 4 or 5, and a chroma of 2 through 6. It ranges from loam to sandy loam. The Bx horizon contains mottles that have the same hue, a value of 5 or 6, and a chroma of 1 to 6. The C horizon ranges from very firm to friable sandy loam to fine sandy loam.

Wurtsboro soils are associated with Swartswood, Lackawanna, and Norwich soils. They contain low-chroma mottles above the fragipan and Swartswood soils do not. They do not have the red hues that are common in Lackawanna soils and the gray colors common in Norwich soils.

Wurtsboro gravelly loam, 3 to 8 percent slopes (WtB).—This soil has a profile similar to the one described as representative of the series, but it has fewer stones. Included in mapping are spots of Wurtsboro gravelly loam, 8 to 15 percent slopes, and Swartswood gravelly loam, 3 to 8 percent slopes. Seep spots are likely where the slope changes.

This soil is used for row crops, hay, pasture, and woodland. Capability unit IIw–24; woodland group 3o1.

Wurtsboro gravelly loam, 8 to 15 percent slopes (WtC).—This soil has a profile similar to the one described as representative of the series, but it contains gravel and has fewer stones. Most stones and cobblestones have been removed from the surface layer. Included in mapping are small areas of Wurtsboro gravelly loam, 3 to 8 percent slopes. Seep spots occur in areas where the slope changes.

This soil is used for row crops, hay, pasture, and woodland. Erosion control is needed in cultivated areas. Capability unit IIIe–28; woodland group 3o1.

Wurtsboro very stony loam, 0 to 8 percent slopes (WuB).—The profile of this soil is the one described as representative of the series. Seep spots are likely to occur in areas where the slope changes.

This soil is used for woodland and pasture. Capability unit VIs–19; woodland group 3o1.

Wurtsboro very stony loam, 8 to 20 percent slopes (WuC).—The profile of this soil is similar to the one described as representative of the series, but stones are 5 to 30 feet apart on the surface area and in the surface layer. Slopes are complex and vary within short distances. Included in mapping are spots of extremely stony or gravelly Wurtsboro soils. Seep spots occur in areas where the slope changes.

This soil is used for woodland and pasture. Numerous stones interfere with pasture management. Capability unit VIs–19; woodland group 3r1.

Use and Management of the Soils

General practices of good soil management for cultivated crops and pasture are suggested on the pages that follow. The capability grouping used by the Soil Conservation Service, in which the soils are grouped according to their suitability for crops, is explained, and use and management of each soil in the county is suggested by capability unit. The estimated productivity of principal crops under two levels of management are shown in table 2. The index figures are converted to estimated acre yields in table 3.

This part of the survey also contains information on the suitability of the soils for woodland and general suggestions for improving wildlife habitat. It reports data from engineering tests and interpretations of soil properties that affect highway construction and other engineering structures. It also contains information on limitations of the soils to be considered in town and country planning.

Crops and Pasture

Field crops commonly grown in Sussex County are corn and oats. Plants suitable for pasture or hay are alfalfa, alsike clover, ladino clover, red clover, birdsfoot trefoil, timothy, orchardgrass, bromegrass, and bluegrass. Special crops commonly grown are sweet corn, tomatoes, lettuce, onions, and other crops adapted to the area.

Although the soils of Sussex County vary in their suitability for specific crops and require different management, some basic or general management is needed on practically all of the soils. The major needs are maintaining fertility, controlling erosion, and providing drainage. The management of specified groups of soils is described under "Management by Capability Units." Specific information can be obtained by consulting a representative of the Soil Conservation Service, the Agricultural Extension Service, or the Agricultural Experiment Station at Rutgers University.

Because most of the soils in the county are naturally acid and low in content of plant nutrients, additions of lime and fertilizer are needed. Such additions should be based on the results of soil test, on the need of the crop, and on the expected level of yields. For assistance in determining the kind and amount of fertilizer and lime to apply, farmers should consult the Agricultural Extension Service at Rutgers University.

The soils of Sussex County are naturally medium in organic-matter content. The content of organic matter can be maintained or increased by proper residue management, such as plowing in cover crops, growing a sod crop in the cropping sequence, or returning both animal manure and crop residues to the soil. All crops respond well to commercial fertilizer. On soils subject to rapid leaching, more than one application of fertilizer during a growing season is beneficial.

Controlling erosion is one of the main management needs on the sloping to steep soils in the county. Erosion is a hazard on about 25 percent of the cultivated acreage. Because erosion is most serious when the cultivated crop is growing, or soon after the crop has been harvested, a cropping sequence should be selected that keeps loss of soil and water to a minimum. Practices of erosion control commonly used in the county are contour stripcropping, contour tillage, minimum tillage, utilizing crop residue, planting cover crops, and constructing diversions, terraces, and waterways.

Wetness is a hazard on about 15 percent of the acreage suitable for cultivated crops. Few practices are needed for improving drainage on moderately well drained soils. Crops grow well on most somewhat poorly drained,

poorly drained, and very poorly drained soils where excess water has been removed by surface drains, subsurface drains, or both. Many soils are wet as a result of runoff from adjacent areas, a slowly permeable subsoil, a fluctuating water table, or a combination of these. In some places runoff from adjacent higher areas can be diverted. In places random to parallel tile drains or shallow surface drains are needed to carry water to main natural waterways or the deep open ditches. Such soils as Albia, Braceville, Chippewa, Hibernia, and Norwich are underlain by a fragipan and are slowly permeable in the subsoil.

Tile drainage, if practical, generally provides better drainage than open ditches. Soils that have a fragipan, however, are difficult to drain, and they can be drained better by open ditches than by tile. Open ditches are more effective if they intercept the water as it moves horizontally on top of the pan. Suitable outlets are essential for both tile drainage systems and open ditches. Figure 6 illustrates how drainage conditions of the various drainage classes affect root development.

Capability grouping

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

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

In the capability 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 subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife. (None in Sussex County.)

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

Class VII soils have very severe limitations that make them unsuitable for cultivation and that

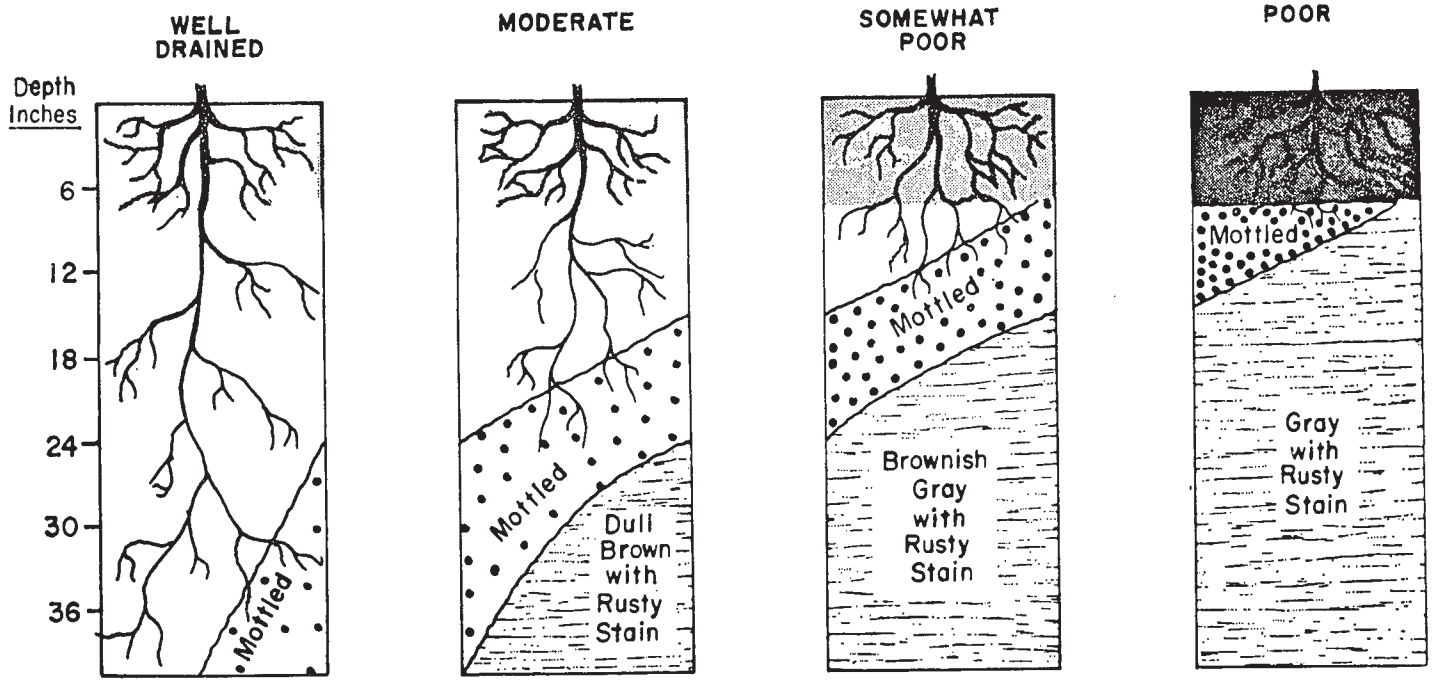

Figure 6.—Drainage sketch.

restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

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

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

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–3 or IIIe–18. 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 members generally are assigned locally, but are a part of a statewide system. All of the units in the system are not represented by the soils of Sussex County; therefore the numbers are not consecutive.

Management by capability units

The soils of Sussex County have been assigned to 31 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. Made land, sanitary land fill, as well as Pits, sand and gravel, has not been classified by capability units. These areas are variable and generally not suitable for crops or any kind of vegetation.

On the following pages each capability unit is described and management is suggested for each. The names of soil series represented are mentioned in the description of each unit, but this does not mean that all soils of a given series are in the unit. To determine the capability unit for each soil, refer to the "Guide to Mapping Units" at the back of this survey or to the description of that soil in the section "Descriptions of the Soils."

Improved and intensive levels of management mentioned for cropland and pasture on the pages that follow are defined under "Estimated Yields." A reference to low, moderate, or high available water capacity is related to a root zone of 30 inches.

The suggestions on management point out soil features that limit the use of soils for crops or pasture. Information on overcoming the limitations, however, is only general. Erosion control or drainage, for example, can be achieved by many methods or combinations of methods on any given field of any kind of soil. For specific information regarding erosion control, artificial drainage, suitable crop varieties, and other management, the reader should contact the Soil Conservation Service office or the Sussex County Agricultural Extension Service.

CAPABILITY UNIT I–6

This unit consists of well-drained, nearly level soils of the Hazen, Palmyra, and Unadilla series. These soils are on stream terraces and uplands. They formed in stratified glacial outwash deposit.

Natural fertility is moderate or moderately high, and reaction is strongly acid to slightly acid. Available water capacity is moderate to high.

These soils are easily worked. They have no limitations for field crops or pasture. They are not subject to erosion. Crops can be planted fairly early in spring. Soil structure can be maintained by planting crops that produce a large amount of residue.

The soils in this unit are suited to the field crops, hay, or pasture plants commonly grown in the county and to adapted special crops. Corn and oats are the commonly grown field crops. The soils are especially well suited to fruit and vegetable crops. The Unadilla soil is well suited to nursery crops because it contains only a small amount of gravel. If management is intensive, cultivated crops can be grown year after year. Where high-value crops are grown, irrigation can be used to advantage.

CAPABILITY UNIT IIe–3

This unit consists of deep, well-drained, gently sloping soils of the Bath, Rockaway, Swartswood, Valois, Washington, and Wooster series. These soils formed in glacial till.

Natural fertility is moderate to high, and reaction is strongly acid to neutral. Available water capacity is moderate or high. Permeability is slow to moderate in the subsoil. Runoff is slow to medium. The hazard of erosion is the major limitation. In cultivated areas, particularly on long slopes, erosion control is needed. In frequently cultivated areas, maintaining fertility, good soil structure, and organic-matter content is needed.

These soils are suited to field crops and grasses and legumes commonly grown in the county. If management is intensive, cultivated crops can be grown frequently. If management is not intensive, the cropping sequence should include close-growing crops, grasses, and legumes. Large amounts of crop residues are needed to maintain tilth and control erosion.

CAPABILITY UNIT IIe–6

This unit consists of well-drained, gently sloping soils of the Hazen, Palmyra, and Unadilla series. These soils

are on stream terraces and uplands. They formed in stratified glacial outwash deposit.

Natural fertility is moderate or moderately high, and reaction is strongly acid to slightly acid. Available water capacity is moderate to high. Runoff is medium, and the hazard of erosion is moderate.

The erosion hazard, especially on long slopes, limits the use of these soils for row crops. The soils are suited to most crops grown in the county and to hay and pasture. They can be used year after year for cultivated crops and special crops if erosion is controlled, crop residue is managed, and fertility is maintained at a high level. They are well suited to irrigation. Deep-rooted and drought-resistant grasses and legumes, such as alfalfa, Ladino clover, orchardgrass, and bromegrass, are best suited.

CAPABILITY UNIT IIe–7

Riverhead sandy loam, 3 to 8 percent slopes, the only soil in this unit, is a gently sloping, deep, well-drained soil of the glacial outwash plains.

Reaction is strongly acid. Available water capacity is moderate. Permeability is moderately rapid in the subsoil.

A moderate hazard of erosion is the major limitation for cultivated crops. Erosion control is of primary importance. Conserving moisture and maintaining the organic-matter content are other management needs.

All crops commonly grown in the county can be grown on this soil. Because the soil tends to be droughty, crops that mature early in summer are better suited than crops that mature late in summer. If erosion is controlled, cultivated crops can be grown year after year. High value crops, such as vegetables, generally require irrigation. Alfalfa and other deep-rooted legumes that can withstand drought are the most suitable for production of hay.

CAPABILITY UNIT IIw–24

This unit consists of deep, moderately well drained, nearly level and gently sloping soils of the Braceville and Wurtsboro series. These soils have a firm, dense fragipan in the subsoil. They are on terraces and glacial till uplands.

Natural fertility is moderate, and reaction is very strongly acid to slightly acid. Available water capacity is moderate or low. Permeability is moderately slow or slow in the fragipan. Internal drainage and roots are also restricted in this layer.

Wetness is the major limitation. Erosion is a hazard on the gently sloping soils. Random tile lines generally provide adequate drainage, but a combination of diversion terraces, shallow surface drains, and tile drains is needed in some places.

If adequately drained, these soils are suited to most crops grown in the county. Under a high level of management, cultivated crops can be grown frequently. Cover crops and the proper use of crop residue are needed to maintain good soil structure, good tilth, and organic-matter content. Grasses and legumes that tolerate some wetness are suitable for hay and pasture.

CAPABILITY UNIT IIw–25

This unit consists of moderately well drained and somewhat poorly drained, nearly level and gently sloping soils of the Hero and Pompton series. These soils are on terraces and glacial outwash plains.

Natural fertility is moderate, and reaction is strongly acid to neutral. Available water capacity is moderate. Permeability is moderately rapid in the subsoil. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Wetness is the major limitation. Tile drainage is generally effective in removing excess water.

If adequately drained, these soils are well suited to corn, oats, hay, and pasture. Under a high level of management, they can be cultivated year after year. Good management provides cover crops and proper use of crop residue. Grasses and legumes that tolerate some wetness are best suited to hay and pasture.

CAPABILITY UNIT IIw–32

Middlebury loam, the only soil in this unit, is nearly level and moderately well drained to somewhat poorly drained. It is on bottom lands and is subject to occasional flooding, particularly in winter and early in spring.

Reaction is medium acid. Available water capacity is high.

Flooding and wetness are the major limitations. The water table can be lowered by installing tile drains where outlets are available. Diversion terraces can be used to intercept excessive runoff from nearby higher areas.

Where floods are not damaging and drainage is adequate, this soil is well suited to most crops commonly grown in the county. If managed intensively, it can be cultivated year after year. Grasses and legumes that tolerate some wetness are desirable.

CAPABILITY UNIT IIs–7

This unit consists of well-drained to somewhat excessively drained, gently sloping soils of the Chenango and Hoosic series. These soils are on glacial outwash plains. They have a gravelly surface layer and are shallow over sand and gravel.

Natural fertility is moderate, and reaction is strongly acid to medium acid. Available water capacity is low or moderately low. Permeability is moderately rapid in the subsoil and rapid in the substratum.

Conserving moisture is the major need in managing these soils, but management that improves fertility and increases organic-matter content also is beneficial. Plant nutrients are readily leached from these soils. For this reason, smaller amounts of fertilizers applied more frequently produce the best yields.

These soils are suited to the field crops and hay and pasture plants commonly grown in the county. They are also suited to special crops. Under intensive management, cultivated crops can be grown frequently. Because the soils are droughty, crops that mature early in summer grow better than crops that mature late in the summer and early in fall. Crop yields are reduced during long dry periods. Good management provides a cover crop, large amounts of crop residue, and a moderate to high level of fertility. Seeding mixtures for hay and pasture that include drought-resistant grasses and legumes are desirable. Irrigation can be used to advantage where high-value crops are grown.

CAPABILITY UNIT IIIe-3

This unit consists of deep, well-drained, strongly sloping soils of the Bath, Rockaway, Swartswood, Valois, Washington, and Wooster series. These soils are on glacial till uplands.

Natural fertility is moderate or high, and reaction is very strongly acid to neutral. Available water capacity is moderate or high. Permeability is slow or moderately slow in the subsoil of the Bath, Rockaway, Swartswood, and Wooster soils. It is moderate in the subsoil of the Valois and Washington soils. Runoff is medium to rapid, and the hazard of erosion is moderate.

Erosion is the major limitation. Maintaining good tilth and fertility and controlling erosion are the chief management needs.

These soils are suited to most crops commonly grown in the county and to adapted hay and pasture plants. If erosion is controlled (fig. 7) and management is intensive, cultivated crops can be grown frequently. Intensive management for field crops provides close-growing crops, grasses, and legumes and the utilization of crop residue. An adequate plant cover generally is sufficient to control erosion in hay and pasture fields.

CAPABILITY UNIT IIIe-15

Nassau rocky silt loam, 3 to 8 percent slopes, the only soil in this unit, is gently sloping, somewhat excessively drained, and shallow over bedrock. It is on uplands. It formed in material weathered from shale.

Reaction is strongly acid. Available water capacity is low. Permeability is moderate in the subsoil. Roots are restricted because the soil is shallow over bedrock. Widely spaced outcrops of shale and slate bedrock are common.

A moderate hazard of erosion and droughtiness are the major limitations. Practices that control erosion should also improve the available water capacity of the soil.

Under intensive management, cultivated crops can be grown frequently. Higher yields can be obtained from crops that mature early in summer. Returning large amounts of crop residue to the soil, maintaining fertility, and increasing the organic-matter content are beneficial. Grasses and legumes that tolerate droughtiness are desirable.

CAPABILITY UNIT IIIe-18

This unit consists of well-drained, gently sloping to sloping soils of the Washington and Wassaic series. These soils are on uplands. They formed in glacial till underlain by limestone bedrock. Wassaic soils are moderately deep over bedrock.

Natural fertility is high, and reaction is medium acid to neutral. Available water capacity is moderate or high, and permeability is moderate.

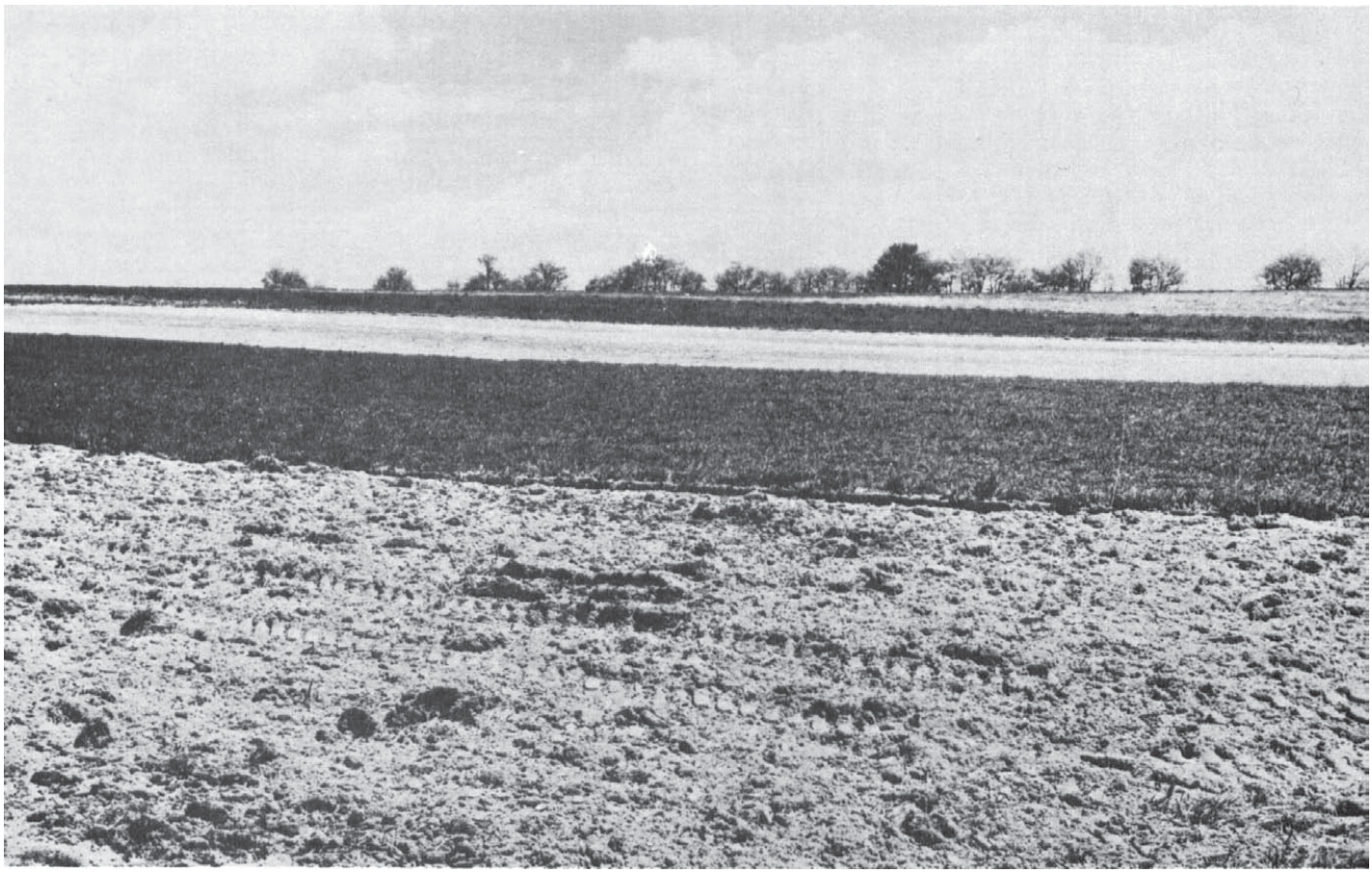

Figure 7.—**Contour stripcropping on strongly sloping soils.**

The moderate to severe hazard of erosion is the major limitation for cultivated crops. Controlling erosion is important, especially on long slopes. Maintaining soil structure and tilth also is needed.

These soils are well suited to most field crops and hay and pasture plants commonly grown in the county. Under intensive management, cultivated crops can be grown frequently.

CAPABILITY UNIT IIIe-28

This unit consists of moderately well drained and somewhat poorly drained, strongly sloping soils of the Albia and Wurtsboro series.These soils are on uplands. They formed in slate, shale, and sandstone glacial till. They have a well-defined fragipan in the subsoil.

Natural fertility is moderate, and reaction is very strongly acid to slightly acid. Available water capacity is moderate. Permeability is slow in the subsoil. The fragipan in the lower part of the subsoil restricts the penetration of roots and the movement of water and limits the amount of moisture available to plants. Runoff is medium, and the hazard of erosion is moderate.

The erosion hazard, especially on long slopes, is a major limitation. Wetness caused by seepage is also a limitation, especially on Albia soils. Wet spots generally occur at the base of slopes early in spring. Wetness generally can be reduced by random tile drains. In cultivated areas, practices also are needed to maintain fertility, good soil structure, and organic-matter content.

These soils are suited to most field crops and hay and pasture plants commonly grown in the county. Cultivated crops can be grown frequently under intensive management. Such management provides close-growing crops, grasses, and legumes and the utilization of crop residue. Grasses and legumes that tolerate wetness are better suited to these soils than most other crops. Alfalfa and other deep-rooted legumes are subject to frost heave and winterkill and are not well suited.

CAPABILITY UNIT IIIw-28

This unit consists of deep, gently sloping, somewhat pooly drained soils of the Albia and Hibernia series. These soils are on uplands. They formed in granite, slate, shale, and sandstone glacial till. They have a well-defined fragipan in the subsoil.

Natural fertility is moderate, and reaction is strongly acid to slightly acid. Available water capacity is moderate. Permeability is slow in the subsoil. The fragipan restricts penetration of roots and movement of water.

The moderately high seasonal water is the major limitation. The soils are difficult to drain because tile lines generally are not effective. Shallow surface drains and diversion terraces help to reduce excessive wetness.

If adequately drained, these soils are suited to most crops grown in the county. Under intensive management, cultivated crops can be grown frequently. These soils are suited to adapted grasses and legumes grown for hay and pasture, but forage grows better in drained areas than in undrained areas. Returning large amounts of crop residue to the soil is necessary to maintain good soil structure, tilth, and organic-matter content.

CAPABILITY UNIT IIIw-36

This unit consists of poorly drained and very poorly drained, nearly level to gently sloping soils of the Atherton, Fredon, Halsey, and Raynham series. These soils are in low areas or depressions on glacial outwash plains or terraces.

Natural fertility is moderate to high, and reaction is medium acid to mildly alkaline. Available water capacity is moderate or high. Permeability is moderately slow to moderate in the subsoil. Runoff is very slow or is ponded.

Excessive wetness is the major limitation. Drainage is difficult in places. Tile drains and surface drains are generally needed for adequate drainage. Wetness can be reduced by diverting runoff from nearby higher areas.

Drained areas are moderately well suited to most crops grown in the county. Intensive management provides crops that produce large quantities of crop residue and pasture plants can be grown on these soils, but they grow better in drained areas. Areas that are too wet for pasture are suited to adapted plantings that provide food and cover for wildlife.

CAPABILITY UNIT IIIw-41

This unit consists of very poorly drained, nearly level, organic or partly organic soils of the Carlisle and Wallkill series. These soils are in basins in the glacial till uplands. The Carlisle soil is organic. The Wallkill soil has a mineral deposit at least 16 inches thick over organic material.

Reaction is slightly acid or neutral. Available water capacity is high. Under natural conditions, these soils have a high water table during most of the year. Permeability is rapid throughout the organic material but only moderate in the mineral part of the Wallkill soil. The Carlisle soil is subject to soil blowing and to damage by fire during dry periods.

The major management needs are artificial drainage and control of the water table so that subsidence of the muck is reduced. Tile drains or open ditches, or both, generally are suitable. Diversion terraces can be constructed to intercept runoff from adjacent higher areas and to prevent temporary flooding.

If adequately drained, these soils are suited to special crops and to sod. If managed intensively, they can be cultivated continuously. They are generally well suited to irrigation. A cover crop is needed to keep the Carlisle soil from blowing. Frost damage is a hazard on these low-lying soils. Areas where installation of adequate drainage and water control systems is not feasible are well suited to plantings that provide food and cover for wildlife.

CAPABILITY UNIT IVe-3

This unit consists of deep, well-drained soils of the Bath, Rockaway, Swartswood, Valois, Washington. and Wooster series. These soils are on glacial till uplands. The Bath, Rockaway, and Swartswood soils have a fragipan in the subsoil.

Natural fertility is moderate, and reaction is strongly acid to neutral. Available water capacity is moderate or high. Permeability is moderately slow to moderate in the subsoil. The fragipan restricts roots and the move-

ment of water. It also limits the amount of water available to plants. Runoff is rapid, and the hazard of erosion is severe.

The severe hazard of erosion is the major limitation. In addition to erosion control practices are needed to maintain fertility and good soil tilth.

These soils are suited to crops commonly grown in the county. They are well suited to adapted grasses and legumes grown for hay and pasture. Under intensive management, cultivated crops can be grown occasionally. Close-growing crops, grasses, and legumes should be grown most of the time to help control erosion. Returning large amounts of crop residue to the soil improves soil structure and infiltration of water and helps to control erosion. Because a good plant cover is needed in hay meadow and pasture, grazing should be regulated to maintain enough vegetation for the control of erosion.

CAPABILITY UNIT IVe-11

This unit consists of steep, well-drained soils of the Hazen, Palmyra, Washington, and Wassaic series. These soils are on stream terraces and uplands. They formed in glacial till and stratified glacial outwash material.

Natural fertility is moderate or high, and reaction is strongly acid to slightly acid. Available water capacity is moderate to high. Runoff is rapid.

The severe hazard of erosion is the major limitation. Other concerns are maintaining good tilth and a high level of fertility.

The soils in this unit are suited to the crops commonly grown in the county. If management is intensive, cultivated crops can be grown at infrequent intervals. Grass and legumes should be grown most of the time to control erosion and reduce soil loss. A row crop can be grown occasionally if erosion is controlled. An adequate protective cover is needed in winter.

These soils are well suited to adapted grasses and legumes grown for hay and pasture. Under good management, these plantings provide excellent cover that helps to control erosion. During long dry periods, however, yields are low.

CAPABILITY UNIT IVe-15

This unit consists of strongly sloping to steep, well-drained to somewhat excessively drained soils of the Chenango, Hoosic, Nassau, and Riverhead series. These soils are on glacial outwash and glacial till uplands. They have a gravelly, shaly, or sandy surface layer. They are shallow or are moderately deep over bedrock or sand and gravel.

Natural fertility is moderate or low, and reaction is strongly acid to medium acid. Available water capacity is low to moderate. Permeability is moderate or moderately rapid in the subsoil. The Chenango, Hoosic, and Riverhead soils have a rapidly permeable substratum. Runoff is medium to rapid.

A moderate to severe hazard of erosion is the major limitation. Droughtiness is also a hazard. Practices that help to control erosion, increase available water to plants, maintain a high level of fertility, and return large amounts of crop residue to the soil are needed.

If intensively managed, these soils are suited to most crops grown in the county and to adapted grasses and legumes grown for hay and pasture. Because the amount of available water is limited and the hazard of erosion is serious, oats and close-growing forage crops are better suited than row crops. Close-growing crops, grasses, and legumes should be grown most of the time. Drought-resistant grasses and legumes should be included in seeding mixtures.

CAPABILITY UNIT IVw-44

This unit consists of poorly drained and very poorly drained, nearly level soils of the Chippewa, Livingston, Lyons, Norwich, and Preakness series. These soils are in low areas on uplands and stream terraces. They formed in glacial till and slack-water deposits.

Natural fertility is moderate to high, and reaction is strongly acid to neutral. Available water capacity is moderate to high. Permeability is slow in the subsoil in most of these soils but is moderately rapid in the Preakness soil. Runoff is slow or is ponded. These soils have a high water table during most of the year. They dry out and warm up very slowly. If tilled or grazed when too wet, they become compacted or cloddy.

Excessive wetness is a major limitation. All but the Preakness soil are poorly suited to tile drainage. The amount of surface water generally can be reduced by open ditches and by intercepting and diverting runoff from nearby higher areas.

Drained areas of these soils are moderately well suited to most general farm crops commonly grown in the county. Areas that cannot be drained are suited to permanent pasture and to plantings that provide food and cover for wildlife. These soils are poorly suited to special crops that can withstand wet conditions, but they are suited to hay and pasture. Under intensive management, cultivated crops can be grown occasionally. Areas used for hay and pasture require some drainage. They should be seeded to grasses and legumes that can tolerate wetness.

CAPABILITY UNIT IVs-12

Colonie loamy fine sand, 3 to 8 percent slopes, the only soil in this unit, is a deep, gently sloping, well-drained to excessively drained soil on glacial outwash plains and terraces. It has a loamy fine sand surface layer and is underlain by sand.

Natural fertility is low, and reaction is strongly acid to medium acid. Available water capacity is low. Permeability is moderate rapid in the subsoil. Runoff is slow to medium, and the hazard of erosion is moderate.

Droughtiness is the major limitation. This porous soil is easily leached of plant nutrients. Practices that increase the content of organic matter, replace plant nutrients, and control erosion are needed.

This soil is better suited to adapted grasses and legumes than to general cultivated crops and special crops. Drought-resistant grasses and legumes are best suited to hay and pasture. This soil requires intensive management. Unless irrigated, this soil is better suited to crops that are planted early in spring and that mature before dry periods than it is to crops that mature late in summer. Where water is available for irrigation, vegetables and other high-value crops can be grown with good results. Maintaining a high level of fertility and return-

ing crop residue to the soil are good management practices.

CAPABILITY UNIT VIe-3

This unit consists of well-drained, very steep soils of the Bath and Wooster series. These soils formed in glacial till deposit.

Natural fertility is moderate, and reaction is strongly acid to neutral. Available water capacity is moderate. Permeability is moderately slow in the fragipan. Runoff is rapid, and the hazard of erosion is severe.

These soils generally are not suited to cultivated crops. Under intensive management, they are suited to adapted grasses and legumes for hay or permanent pasture. Such management provides an adequate level of fertility and an adequate plant cover for erosion control.

CAPABILITY UNIT VIe-13

This unit consists of cobbly sandy loams of the Chenango series. These are deep, sloping to steep, well-drained soils on uplands. They formed in glacial outwash material.

Natural fertility is moderate, and reaction is medium acid. Available water capacity is moderately low.

The steep slopes, severe hazard of erosion, and abundant cobblestones make these soils unsuitable for cultivated crops, and only moderately suitable for forage crops. Adapted grasses and legumes, such as alfalfa, Ladino clover, birdsfoot trefoil, orchardgrass, and bromegrass, are suitable under a high level of management. Pastures can be renovated by disking, fertilizing, and seeding instead of plowing and preparing a seedbed. The use of tractors and other equipment is limited on the steeper slopes. Management that maintains fertility and a good plant cover is needed, and care should be taken so that pastures are not overgrazed.

CAPABILITY UNIT VIw-46

This capability unit consists of nearly level, very poorly drained and poorly drained soils of the Sloan and Wayland series and Alluvial land, wet. These soils and Alluvial land, wet, are on flood plains where stream overflow is frequent. They formed in alluvial material washed from nearby uplands.

Reaction is slightly acid. Available water capacity is high. Permeability is slow to moderate.

Excessive wetness is the major limitation. These soils are better suited to pastures of bluegrass, Ladino clover, and reed canarygrass than to field crops or hay because flooding is frequent and drainage is very poor.

Stream overflow and excess water are the major limitations. The soils are in low areas and are difficult to drain in many places. Tile and surface drainage are generally needed for adequate drainage. Land leveling and smoothing have been used in places to improve surface drainage.

CAPABILITY UNIT VIs-15

Only Nassau-Rock outcrop complex, 15 to 25 percent slopes, is in this capability unit. It is 15 percent Rock outcrop. The Nassau soil is shallow and somewhat excessively drained. It formed in material weathered from acid slate and shale bedrock.

Reaction is strongly acid in the Nassau soil. Available water capacity is low. Permeability is moderate, and runoff is rapid.

The severe hazard of erosion and shallowness to bedrock are the major limitations. Rock outcrop interferes with the use of farm machinery.

This complex is suited to pasture, trees, and wildlife. It is moderately well suited to drought-resistant grasses and legumes, but a good stand is difficult to establish. Permanent pasture does not do well during dry periods and is easily damaged by overgrazing. Maintaining adequate fertility and a protective cover are management needs. Renovating by disking, fertilizing, and seeding instead of by plowing is preferred because the erosion hazard is so severe.

CAPABILITY UNIT VIs-19

This unit consists of very stony, gently sloping to steep, somewhat poorly drained to well-drained soils of the Bath, Hibernia, Lakawanna, Rockaway, Swartswood, Washington, and Wurtsboro series. These soils are on terraces and uplands. They formed in mixed glacial till.

Natural fertility is moderate to high, and reaction is very strongly acid to neutral. Available water capacity is moderate. Permeability is slow to moderate in the subsoil.

These soils are generally too stony to be suitable for field crops or hay. They are suited to adapted trees and other vegetation grown for wildlife. The steep slopes are susceptible to erosion unless they are protected by permanent vegetation. Some areas can be renovated and reseeded to adapted grasses and legumes, but controlled grazing is necessary to maintain a good stand. Management is needed that provides an adequate protective cover.

CAPABILITY UNIT VIIe-10

This unit consists of well-drained, very steep soils of the Hazen and Palmyra series. These soils are on terraces and uplands.

Natural fertility is moderate to high, and reaction is medium acid to slightly acid. Available water capacity and permeability are moderate.

These soils are highly susceptible to erosion unless they are protected by permanent vegetation. Their suitability for crops is limited by steepness, roughness, and difficulty in using machinery. Some areas can be renovated and reseeded to adapted grasses and legumes. Grazing should be restricted during dry periods. Ladino clover, bromegrass, orchardgrass, and alfalfa are the better suited grasses and legumes. These soils are suited to adapted trees and to other vegetation grown for wildlife.

CAPABILITY UNIT VIIs-12

This unit consists of deep, well-drained to excessively drained, gently sloping to very steep soils of the Colonie and Otisville series. These soils are on glacial outwash plains and terraces. They formed in stratified glacial outwash material.

Natural fertility is low, and reaction is strongly acid to medium acid. Available water capacity is low. Permeability is moderately rapid to rapid in the subsoil. The soils are extremely droughty.

Most areas are woodland. These soils are susceptible to erosion unless a protective cover is maintained. Their use for pasture is limited by steepness and the low available water capacity. Maintaining sod is difficult, and care should be taken not to overgraze pasture. Ladino clover, red clover, orchardgrass, bromegrass, and birdsfoot trefoil are the better suited grasses and legumes. Adapted trees and other vegetation can be planted for wildlife and erosion control.

CAPABILITY UNIT VIIs–21

The soils in this unit are very stony or extremely stony, gently sloping to very steep, well-drained to excessively drained soils of the Bath, Lackawanna, Nassau, Oquaga, Rockaway, Swartswood, Washington, and Wassaic series. These soils formed in material weathered from gray shale and slate and in mixed glacial deposit.

Natural fertility is low to high, and reaction is strongly acid to neutral. Available water capacity is low to moderate. Permeability is moderately slow to moderately rapid in the subsoil.

These soils generally are wooded and are better suited to trees than to most other uses. Because the stone content is high, they are not suitable for cultivation and the potential for pasture is limited. Ladino clover, red clover, birdsfoot trefoil, orchardgrass, bromegrass, and timothy are the most suitable pasture plants. Stoniness and steep or very steep slopes restrict the use of these soils mainly to timber, wildlife, recreation, or to protection of the watershed. Timber harvests are hindered by the stones and very steep slopes. The forest needs protection from fire and from grazing by cattle.

CAPABILITY UNIT VIIs–45

The soils in this unit are very stony or extremely stony, nearly level or gently sloping, deep, and somewhat poorly drained to very poorly drained. They are soils of the Albia, Chippewa, Lyons, Norwich, and Whitman series. They are in low areas and depressions. They formed in material weathered from glacial till. All but the Lyons soils have a fragipan in the subsoil.

Fertility is moderate to high, and reaction is strongly acid to mildly alkaline. Available water capacity is moderate to high. Permeability is slow in the subsoil. The water table is high during most of the year. Runoff is slow and, at times, water is ponded.

Because the stone content is high and the water table is high, these soils are not suited to cultivated crops, hay, or pasture. Between the stones the soil material is generally deep and is suited to adapted trees and to plantings that provide food and cover for wildlife.

CAPABILITY UNIT VIIIw–37

This unit consists only of Swamp, which occurs along streams and drainageways, in depressions that have poor drainage outlets, and in areas around natural ponds. The water table is at the surface. Swamp is ponded during most of the year. It is better suited to adapted trees and to plantings for wildlife than to most other uses.

CAPABILITY UNIT VIIIs–23

This unit consists of extremely rocky areas and extremely stony to stony, shallow to deep, moderately steep to very steep soils of the Nassau, Oquaga, and Rockaway series. The Rock outcrop, extremely stony soils, and steep slopes are unsuitable for crops, pasture, or commercial woodland. Such land is better suited to wildlife or to watershed protection than to most other uses.

Estimated yields

Table 2 shows, for most soils in Sussex County, the estimated productivity index or yield rating for the principal crops. The rating is given for two levels of management and ranges from 1, indicating the lowest yields, to 10, indicating the highest. The index figures are converted to estimated acre yields in table 3.

The yield ratings in colums A of table 2 are those obtained under common management and those in columns B are obtained under intensive management. An intensive level of management increases the intake of water and the available water capacity of the soils; disposes of excess water by appropriate means; controls erosion; provides suitable methods of plowing, preparing seedbed, and cultivating; controls weeds, diseases, and insects; maintains fertility and the pH at an optimum level; provides the trace elements, such as zinc, cobalt, manganese, and copper, if they are needed; selects high-yielding crop varieties suited to the soil; and plants, cultivates, and harvests at the proper time and in the proper way.

A common level of management, ordinarily followed by most farmers in the county, provides some but not all of the practices listed under intensive management, or practices that are not adequate for the crop.

Woodland

The 1970 projection of the New Jersey Soil and Water Conservation Needs Inventory (*11*) states that 217,000 acres, or about 64 percent of the total land area in Sussex County, is woodland. About 25 percent of the woodland is in public land holdings, such as High Point State Park, Stokes State Forest, New Jersey Fish and Game Tracts, Newark Watershed, and Delaware Water Gap National Recreation Area.

The average farm woodlot in Sussex County is 20 acres. Trees have been planted on some farms, but most of the large planted areas are on State-owned or city owned land.

Forest cover types occurring in the county include northern hardwood, white pine-northern hardwood, hemlock-northern hardwood, and oak-northern hardwood.

Idle fields tend to seed naturally with aspen, redcedar, red maple, and ash. Secondary species that occupy the sites are black cherry, sugar maple, and oak.

Woodland groups

To assist woodland owners in planning, the soils of Sussex County have been assigned to five woodland suitability groups. Each group is made up of soils that have similar potential productivity, similar limitations and hazards, and similar suitability for kinds of trees. The woodland suitability groups in the county are briefly described in table 4. The table also shows the potential productivity, the limitations and hazards, and the trees suitable for each group. To find the names of the soils in

TABLE 2.—*Estimated yield index of principal crops on arable soils under two levels of management*

[Ratings range from 1, the lowest, to 10, the highest. Yield equivalents for numerical ratings are listed in table 3. Figures in columns A indicate the yields obtained under common management; those in columns B indicate the yields obtained under the best current management. Absence of a figure indicates the crop generally is not grown on the soil specified]

Soil	Corn				Oats		Hay			
	Grain		Silage				Alfalfa-grass		Clover-grass	
	A	B	A	B	A	B	A	B	A	B
Albia gravelly loam, 3 to 8 percent slopes	1	3	1	3			4	6	7	8
Albia gravelly loam, 8 to 15 percent slopes	1	3	2	3			4	6	7	8
Atherton loam	1	3	1	3	4	6			7	8
Bath loam, 3 to 8 percent slopes	5	6	5	6	8	9	6	7	9	10
Bath loam, 8 to 15 percent slopes	4	5	4	5	8	9	6	7	9	10
Bath gravelly loam, 15 to 25 percent slopes	3	5	3	5	6	8	5	6	7	8
Braceville gravelly sandy loam, 0 to 3 percent slopes	6	7	6	7	8	9	7	8	9	10
Braceville gravelly sandy loam, 3 to 8 percent slopes	5	6	5	6	8	9	7	8	9	10
Chenango gravelly fine sandy loam, 3 to 8 percent slopes	4	5	4	5	8	9	6	7	7	8
Chenango gravelly fine sandy loam, 8 to 25 percent slopes	3	4	3	4	7	8	6	7	7	8
Chenango cobbly sandy loam, 3 to 15 percent slopes	2	3	2	3	7	8	5	6	6	7
Chenango cobbly sandy loam, 15 to 35 percent slopes					6	7	4	5	5	6
Chippewa silt loam, 3 to 8 percent slopes	2	4	2	4			4	6	3	4
Colonie loamy fine sand, 3 to 8 percent slopes		3		3		5		4		4
Colonie loamy fine sand, 8 to 15 percent slopes		3		3		5		4		4
Fredon loam, 0 to 3 percent slopes	4	6	4	6			4	6	9	10
Fredon loam, 3 to 8 percent slopes	4	6	4	6			5	7	9	10
Halsey loam	3	6	3	6	5	8		6	6	9
Hazen gravelly loam, 0 to 3 percent slopes	7	8	7	8	9	10	7	8	9	10
Hazen gravelly loam, 3 to 8 percent slopes	7	8	7	8	9	10	7	8	9	10
Hazen gravelly loam, 8 to 25 percent slopes	5	7	5	7	7	9	5	7	8	9
Hero loam, 0 to 3 percent slopes	6	7	6	7	8	9	6	7	9	10
Hero loam, 3 to 8 percent slopes	6	7	6	7	8	9	6	7	9	10
Hibernia gravelly loam, 3 to 8 percent slopes	5	7	5	7	7	9	5	7	9	10
Hoosic gravelly loam, 3 to 8 percent slopes	5	6	5	6	8	9	7	8	9	10
Hoosic gravelly loam, 8 to 25 percent slopes	3	5	3	5	6	8	5	7	8	9
Lyons silt loam	2	4	2	4					4	5
Middlebury loam	6	8	6	8	8	10	6	8	9	10
Nassau rocky silt loam, 3 to 8 percent slopes	1	2	1	2	5	6	3	4	3	4
Nassau rocky silt loam, 8 to 15 percent slopes	1	2	1	2	5	6	3	4	3	4
Palmyra gravelly fine sandy loam, 0 to 3 percent slopes	6	7	6	7	8	9	7	8	9	10
Palmyra gravelly fine sandy loam, 3 to 8 percent slopes	6	7	6	7	8	9	7	8	9	10
Palmyra gravelly fine sandy loam, 8 to 25 percent slopes	5	6	5	6	7	8	6	7	6	7
Pompton fine sandy loam, 0 to 3 percent slopes	5	7	5	7	6	8	6	8	8	10
Preakness sandy loam	1	4	1	4					7	9
Raynham silt loam, 0 to 5 percent slopes	3	5	3	5	3	5	3	5	7	8
Riverhead sandy loam, 3 to 8 percent slopes	5	6	5	6	7	8	7	8	6	7
Riverhead sandy loam, 8 to 25 percent slopes	4	5	5	6	7	8	7	8	6	7
Rockaway gravelly loam, 3 to 8 percent slopes	5	6	5	6	8	9	7	8	9	10
Rockaway gravelly loam, 8 to 15 percent slopes	4	5	4	5	8	9	6	7	9	10
Rockaway gravelly loam, 15 to 25 percent slopes	2	4	2	4	6	8	4	6	7	9
Swartswood gravelly loam, 3 to 8 percent slopes	5	6	5	6	9	10	7	8	9	10
Swartswood gravelly loam, 8 to 15 percent slopes	4	5	4	5	8	9	7	8	9	10
Swartswood gravelly loam, 15 to 25 percent slopes	2	4	2	4	5	7	5	7	5	8
Unadilla very fine sandy loam, 0 to 3 percent slopes	7	8	5	6	9	10	7	8	9	10
Unadilla very fine sandy loam, 3 to 8 percent slopes	7	8	5	6	9	10	7	8	9	10
Valois shaly loam, 3 to 8 percent slopes	5	6	5	6	8	9	6	7	9	10
Valois shaly loam, 8 to 15 percent slopes	4	5	4	5	8	9	6	7	9	10
Valois shaly loam, 15 to 25 percent slopes	2	4	2	4	6	8	4	6	7	9
Wallkill silt loam	4	6	4	6		7			7	9
Washington loam, 3 to 8 percent slopes	8	9	8	9	9	10	8	9	8	9
Washington loam, 8 to 15 percent slopes	8	9	8	9	9	10	8	9	8	9
Washington loam, 15 to 25 percent slopes	6	8	6	8	7	9	6	8	6	8
Washington-Wassaic complex, 3 to 15 percent slopes	7	8	7	8	8	9	8	9	8	9
Washington-Wassaic complex, 15 to 25 percent slopes	6	7	5	6	7	8	7	8	7	8
Wassaic silt loam, 3 to 15 percent slopes	6	7	6	7	8	9	7	8	8	9
Wassaic silt loam, 15 to 30 percent slopes	5	6	5	6	7	8	6	7	8	9
Wooster loam, 3 to 8 percent slopes	5	6	5	6	8	9	6	7	9	10
Wooster loam, 8 to 15 percent slopes	5	6	5	6	8	9	6	7	9	10
Wooster loam, 15 to 25 percent slopes	3	5	3	5	6	8	4	6	6	8
Wurtsboro gravelly loam, 3 to 8 percent slopes	4	5	4	5	7	8	6	7	7	8
Wurtsboro gravelly loam, 8 to 15 percent slopes	3	4	3	4	6	7	6	7	7	8

TABLE 3.—*Yield conversion table*

[The symbol > means more than]

Rating	Corn		Oats	Hay	
	Grain	Silage		Alfalfa-grass	Clover-grass
	Bu.	*Tons*	*Bu.*	*Tons*	*Tons*
1 [1]	50–60	10–12	35–40	1. 0–1. 5	1. 2–1. 5
2	60–70	12–14	40–45	1. 5–2. 0	1. 5–1. 8
3	70–80	14–16	45–50	2. 0–2. 5	1. 8–2. 0
4	80–90	16–18	50–55	2. 5–3. 0	2. 0–2. 2
5	90–100	18–20	55–60	3. 0–3. 5	2. 2–2. 5
6	100–110	20–22	60–65	3. 5–4. 0	2. 5–2. 8
7	110–120	22–24	65–70	4. 0–4. 5	2. 8–3. 0
8	120–130	24–26	70–75	4. 5–5. 0	3. 0–3. 2
9	130–140	26–28	75–80	5. 0–5. 5	3. 2–3. 5
10	>140	>28	>80	>5. 5	>3. 5

[1] A rating of 1 can be less than the yield shown.

each group, refer to the "Guide to Mapping Units" at the back of this survey. Yields for the range of site indexes, or productivity, are shown in table 5.

Average site index is the height attained by dominant trees at 50 years of age in a well-managed stand, natural or planted, that has not been subject to disease, insect infestations, or fire damage. Because site index plots in the county were not available for many of the soils and kinds of trees, information on soils in other areas was used to estimate the site index classes.

Each woodland group is identified by a three-part symbol, for example, 2o1. The first element of the symbol is a number that indicates potential productivity of the soils in the group. It is based on the average site index.

The second element of the symbol is a letter that denotes the subclass, or an important soil property that imposes a moderate or severe hazard in woodland use and management. The letter *x* denotes stoniness or rockiness; *w*, excessive wetness; *t*, toxic substances; *d*, restricted roots; *c*, clayey soils; *s*, sandy soils; *f*, fragmental or skeletal soils; *r*, relief or slope; *o*, slight or no limitations.

Suitable species listed in table 4 are the kinds of native trees that should be favored in management and the kind of trees that are suitable for planting.

The third element of the symbol is a numeral that indicates the degree of hazard or limitation and general suitability of the soils for certain kinds of trees.

Erosion hazard is rated according to the risk of erosion on well-managed woodland that is not protected by special practices. It is *slight* if only a small loss of soil is expected, even when trees are harvested. The erosion hazard is *moderate* if runoff is not controlled, the plant cover is not adequate for protection, and a moderate loss of soil is expected. Where the erosion hazard is moderate, erosion control is needed on skid trails and logging roads immediately after trees are harvested. The erosion hazard is *severe* if steep slopes, rapid runoff, and slow infiltration and permeability make the soil susceptible to severe erosion. In these areas harvesting and other logging should be done across the slope as much as possible. It is advisable to lay out skid trails and logging roads on mild slopes so that excess water can be disposed of safely during logging. Immediately after logging, erosion control is needed on both the logging roads and the skid trails.

Equipment restriction refers to steep slopes, stones, excess water, and other factors that limit the use of ordinary equipment in pruning, thinning, harvesting, and other woodland management. The rating is *slight* if there are very few limitations on the type of equipment or the time of year that the equipment can be used. It is *moderate* if slopes are moderately steep, if heavy equipment is restricted by wetness during the wettest periods, or if the equipment moderately damages the roots. It is *severe* if many types of equipment cannot be used, if the time equipment cannot be used is more than 3 months in a year, or if the use of the equipment severely damages tree roots and the structure of the soils.

Seedling mortality refers to the loss of naturally occurring or planted seedlings as influenced by kinds of soil or topographic conditions when plant competition is not a limiting factor. Seedling mortality is *slight* if less than 25 percent of the seedlings are expected to die. It is *moderate* if the percentage is between 25 and 50 percent. Seedling mortality is *severe* if more than 50 percent of the seedlings are expected to die.

Plant competition refers to the rate at which brush, grass, and undesirable trees are likely to invade. Plant competition is *slight* if unwanted plants do not prevent adequate natural regeneration and early growth or do not interfere with the growth of planted seedlings. It is *moderate* if competing plants delay but do not prevent establishment of a normal fully stocked stand by natural regeneration or from planted seedlings. Competition is *severe* if natural or artificial regeneration is not adequate and intensive site preparation and maintenance, including weeding, are needed.

Windthrow hazard is rated on the basis of characteristics that affect the development of roots and the firmness that the roots anchor the trees so that they resist the force of the wind. The windthrow hazard is *slight* if no trees are expected to be blown down in commonly occurring winds. It is *moderate* if roots hold the tree firmly and the tree is stable except when the soil is excessively wet and the velocity of the wind is high. The hazard is *severe* if the soil and tree roots do not give enough stability to keep trees from blowing over during moderate or high winds or when the soil is very wet, and if individual trees are likely to be blown over when they are released on all sides.

Wildlife [2]

Sussex County has abundant and varied wildlife resources enjoyed by residents and visitors throughout the year. The high population of deer, rabbits, and songbirds can readily be observed from roads and rural residences. In areas open for hunting relatively good success is enjoyed for deer and rabbits. Pheasants are also found in farming areas and in the vicinity of areas regularly stocked for hunting. Many birds help in controlling

[2] Prepared by EUGENE A. WHITAKER, biologist, Soil Conservation Service.

insect pests, and others consume large quantities of weed seeds. Predators, such as skunks, foxes, hawks, and owls, in addition to being an interesting part of the environment, help to keep small rodents in check.

The varied relief and fields in early stages of succession now provide generally good wildlife habitat. Urbanization and the continuing reversion of open fields to brush and trees are gradually reducing the amount and variety of quality wildlife habitat. Only a few large areas support wetland wildlife. Geese and ducks are common on the lakes and ponds in the county, and in larger numbers in fall and spring. The lakes and ponds also provide fishing.

The suitability of the soil in providing habitat is one of the important factors to be considered in producing desired populations of wildlife, and it can be a valuable planning tool (*1*). Evaluating other important factors, such as present land use and existing wildlife populations, requires onsite investigation. The information in this section, however, can be used along with a knowledge of habitat requirements of wildlife species in planning specific developments.

This section deals with the kinds of soil and kinds of plants and water developments that make up wildlife habitat. Knowing the properties of named kinds of soil makes it possible to predict the suitability of different kinds of plant cover and water management.

Elements of wildlife habitat

Each soil in Sussex County is rated in table 6 according to its potential for improving, maintaining, or creating specific wildlife habitat elements.

Grain and seed crops are domestic grain or other seed-producing annuals planted to produce wildlife food. Examples are cord, grain sorghum, wheat, millet, and buckwheat.

Domestic grasses and legumes are perennial grasses and herbaceous legumes that are planted for wildlife cover and food. Examples are fescue, switchgrass, orchard grass, trefoil, crownvetch, and clovers.

Wild herbaceous plants are native or naturally established dryland grasses and forbs (including weeds) that provide food and cover for wildlife. Examples are panicgrasses, wildrye, foxtail, barnyard grass, beggartick, pokeweed, and dandelion.

Hardwood and coniferous trees and their associated woody understory plants provide wildlife cover or food in the form of browse, nuts, buds, seeds, fruit, fruitlike cones, or foliage. In the uplands common trees are junipers, pines, oaks, beech, hickory, yellow-poplar, dogwood, sassafras, and black birch. In the lowlands the most common trees are pin and swamp oaks; beech; maple; sassafras, and birch. Examples of woody understory species are high bush blueberry, sweet pepper bush, viburnums, eldergreenbrier, blackberry, grape, sumac, bayberry, and honeysuckle. Autumn-olive, pyracantha, Amur honeysuckle, and other shrubs that can be readily planted to provide cover and winter food are also included in this group.

Wetland food and cover plants are annual and perennial wild herbaceous plants on moist to wet sites, exclusive of submerged or floating aquatics, that produce food or cover used extensively by wetland forms of wildlife. Examples are smartweed, wild millet, rushes, sedges, cutgrass, and cattails.

Shallow-water areas are areas of surface water less than 5 feet deep that are useful to wildlife. They may be natural wet areas or those created by dams or levees or other water-control devices. Examples are muskrat marshes, waterfowl feeding areas, wildlife ponds, and beaver ponds.

A rating of *good* signifies that soil conditions are favorable for the establishment, maintenance, and vigorous growth of a wide variety of climatically adapted species and that expected growth rates and seed production are above average. In shallow-water areas, it means soil conditions are favorable for natural wet areas that remain ponded for long periods or for the construction and maintenance of shallow-water areas requiring control of water levels.

A rating of *fair* signifies that soil conditions are generally favorable for climatically adapted species, but some management, such as protection from erosion, fertilization, or periodic renovation, is needed, especially for annuals. Expected growth rates and seed production are above average but can be high for certain species. For shallow-water areas, it means that soil conditions somewhat limit natural wet areas because water levels are unreliable or that creating or maintaining the shallow-water area is difficult.

A rating of *poor* signifies that soil conditions severely limit the number of species and make planting, renovation, or management difficult. Expected growth rates and seed production are below average except for possibly one or two species, and low food value perennials are dominant. For shallow-water areas, it means that soil conditions severely limit the management and construction and that the desired water control is difficult to maintain.

A rating of *very poor* signifies that soil conditions are such that few or no species of value to wildlife can be established or will grow naturally except under very intensive and generally impractical management. Wetland plants do not grow on soils that are rated very poor, and soil conditions for shallow water areas make it impossible or impractical to obtain sufficient water control to be of value to wildlife.

A combination rating using a weighted average of the habitat element ratings will show the approximate suitability of a soil for producing a desirable habitat for a given kind of wildlife. Such a rating is general. It does not take into account the position of the mapped soil to surrounding vegetation, artificial drainage, or present land use. In planning a specific area, the rating must be considered with the ratings for the specific elements and information from an onsite evaluation.

Kinds of wildlife

Table 6 also shows the suitability for openland, woodland and wetland wildlife. The levels of suitability are expressed as follows:

Good means that habitat is easily improved, maintained, or created. There are few or no soil limitations in habitat management and satisfactory results can be expected.

TABLE 4.—*Wood crops and*

Woodland groups, soil series, and map symbols	Average site index	Species to be favored—	
		In existing stands	For planting
Group 1o1: Deep, well-drained soils that have high available water capacity and slopes of less than 15 percent. Middlebury: Md, Washington: WhB, WhC, WkC, WlC,	Upland oaks: 85+ Yellow-poplar: 95+	Red oak, yellow-poplar, white ash, black walnut.	Oak, yellow-poplar, black walnut, white pine, black locust.
Group 1r1: Deep, well-drained soils that have high available water capacity and slopes of more than 15 percent. Washington: WhD, WkD, WlD.	Upland oaks: 85+ Yellow-poplar: 95+	Upland oaks, yellow-poplar, white ash, black walnut.	Yellow-poplar, black walnut, white pine, oaks.
Group 2o1: Deep and moderately deep soils that have moderate available water capacity and slopes of less than 15 percent. Chenango: ChB, ClC. Palmyra: PaA, PaB. Wassaic: WmC. Wooster: WsB, WsC.	Upland oaks: 75–85	Upland oaks, white ash, yellow-poplar.	White pine, larch, Austrian pine, Norway spruce.
Group 2r1: Deep and moderately deep soils that have moderate available water capacity and slopes of more than 15 percent. Chenango: ChD, ClD. Hibernia: HnD. Palmyra: PaD. Wassaic: WmD. Wooster: WsD, WsE.	Upland oaks: 75–85	Upland oaks, white ash, yellow-poplar.	White pine, larch, Austrian pine, Norway spruce.
Group 2w1: Deep soils that have moderately high seasonal water table. Hibernia: HmB, HnB. Pompton: PvA.	Upland oaks: 75–85	Upland oaks, pin oak, white ash, yellow-poplar.	White pine, larch
Group 3o1: Deep soils that have dominantly moderate or low available water capacity and slopes of less than 15 percent. Bath: BaB, BaC, BgB. Braceville: BrA, BrB. Hazen: HfA, HfB. Hero: HkA, HkB. Hoosic: HoB. Lackawanna: SxB. Riverhead: RhB. Rockaway: RoB, RoC. Swartswood: SwB, SwC, SxB. Unadilla: UnA, UnB. Valois: VaB, VaC. Wurtsboro: WtB, WtC, WuB.	Upland oaks: 65–75	Upland oaks, yellow-poplar, white ash.	White pine, larch, Austrian pine, Norway spruce.
Group 3r1: Deep soils that have moderate or low available water capacity and slopes of more than 15 percent. Bath: BfD, BfE, BgD, BgE. Hazen: HfD, HgE. Hoosic: HoD. Lackawanna: SxD, SxE. Riverhead: RhC. Rockaway: RoD, RpD, RpE. Swartswood: SwD, SxD, SxE. Valois: VaD. Wurtsboro: WuC.	Upland oaks: 65–75	Upland oaks, white ash, yellow-poplar.	White pine, larch, Austrian pine, Norway spruce.

factors in management

Management				
Erosion hazard	Equipment restrictions	Seedling mortality	Plant competition	Windthrow hazard
Slight	Slight	Slight	Moderate	Slight.
Moderate	Moderate	Slight	Moderate	Slight.
Slight	Slight	Slight	Moderate	Slight.
Moderate	Moderate	Slight	Moderate	Slight.
Slight	Moderate	Slight	Severe	Slight.
Slight	Slight	Slight	Slight	Slight.
Moderate	Moderate	Slight	Slight	Slight.

TABLE 4.—*Wood crops and*

Woodland groups, soil series, and map symbols	Average site index	Species to be favored—	
		In existing stands	For planting
Group 3x1: Extremely stony or rocky, gently sloping to steep soils. Oquaga: OmB, OmD, OrD. Rockaway: RrD. Rock outcrop: RtE, RvE. Wassaic: WnD.	Upland oaks: 65–75	Upland oaks, white ash	White pine
Group 4s1: Sandy soils that have low available water capacity and slopes ranging from 3 to 35 percent. Colonie: CoB, CoC. Otisville: OtC, OtD.	Upland oaks: 55–65	Upland oaks	White pine, larch
Group 4w1: Deep soils that have moderately high or high seasonal water table on uplands or flood plains. Albia: AlB, AlC. Atherton: At. Fredon: FrA, FrB. Preakness: Pw. Raynham: RaB. Sloan: Sm. Wayland: Sm.	Upland oaks: 55–65	Pin oak, white ash, red maple, walnut.	Pin oak, red gum
Group 5d1: Shallow soils over slate or shale bedrock. Nassau: NaB, NaC.	Upland oaks: <55	Uplands oaks, white ash	White pine, larch
Group 5w1: Deep soils that have seasonal or constantly high water table. Alluvial land, wet: Ar. Carlisle: Ca. Chippewa: CnB. Halsey: Ha. Lyons: Ly, Lz. Norwich: NhA, NoA. Swamp: Sp. Wallkill: Wa. Whitman: Wo.	Northern hardwoods: <52.	White ash, walnut, red spruce.	Generally not feasible
Group 5x1: Extremely stony or rocky soils, gently sloping to steep. Albia: AmB. Chippewa: CmB. Nassau: NfD, NfE, Ng. Rock outcrop: RsF.	Upland oaks: 55+	Upland oaks and associated hardwoods.	Planting limited to non-rocky areas, pines.

factors in management—Continued

Management				
Erosion hazard	Equipment restrictions	Seedling mortality	Plant competition	Windthrow hazard
Slight	Severe	Slight	Slight	Slight.
Slight to moderate	Slight to moderate	Slight to moderate	Slight	Slight.
Slight	Severe	Severe	Severe	Severe.
Slight	Slight	Severe	Moderate	Moderate.
Slight	Severe	Severe	Severe	Severe.
Slight	Severe	Moderate	Severe	Slight.

TABLE 5.—*Yields from upland oaks and yellow-poplar in fully stocked, natural stands*

Site index	Age of stand	Merchantable volume			
		Upland oaks		Yellow-poplar	
	Years	*Board feet*	*Cords*	*Board feet*	*Cords*
50	30	300	6	----------	--------
	40	1, 300	13	----------	--------
	50	2, 900	19	----------	--------
	70	7, 400	30	----------	--------
60	20	----------	--------	----------	--------
	30	800	10	900	8
	40	2, 900	19	2, 400	15
	50	5, 700	26	5, 100	21
	70	11, 600	39	----------	--------
70	20	----------	--------	600	7
	30	1, 600	15	2, 400	15
	40	5, 000	25	5, 100	23
	50	8, 800	33	10, 300	31
	70	16, 000	47	----------	--------
80	20	----------	--------	1, 100	10
	30	3, 000	20	4, 900	21
	40	7, 800	31	10, 200	31
	50	12, 400	41	16, 000	41
	70	21, 000	56	----------	--------
90	20	----------	--------	1, 800	13
	30	4, 600	24	7, 800	27
	40	10, 800	37	14, 800	39
	50	16, 000	48	22, 100	52
	70	26, 200	65	----------	--------
100	20	----------	--------	3, 100	17
	30	----------	--------	11, 000	32
	40	----------	--------	19, 600	47
	50	----------	--------	29, 100	62
	70	----------	--------	----------	--------

Fair means that habitat can be improved, maintained, or created on these soils, but moderate soil limitations affect habitat management or development. A moderate intensity of management and fairly frequent attention may be required to ensure satisfactory results.

Poor means that habitat can be improved, maintained, or created on these soils, but the soil limitations are severe. Habitat management may be difficult and expensive and require intensive effort. Results are questionable.

Very poor means that it is impractical to attempt to improve, maintain or create habitats under prevailing soil conditions. Unsatisfactory results are probable.

Openland wildlife are pheasant, meadowlark, field sparrow, killdeer, cottontail rabbit, red fox, woodchuck, and other mammals and birds of crop fields, pastures, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines.

About 10 percent of the acreage in the county is naturally good for the development of habitat for openland wildlife. These are generally the good agricultural soils, such as Bath loam and the gently sloping phases of Wooster loam. These soils are also good for urban uses. Areas abandoned from farming naturally revert to brush and trees. About 10 percent is fair. This acreage consists of soils that have impaired drainage, such as Alluvial land; steeper phases of good deep soils like Riverhead sandy loam; and somewhat droughty soils like Hoosic gravelly loam. On these soils some difficulty is to be expected in establishing and maintaining annual food plants. About 65 percent of the county is poor for openland wildlife habitat development. This acreage is sloping, rocky, and poorly drained. Very poorly drained Swamp and Whitman soils and Rock outcrop are rated very poor.

Woodland wildlife are ruffed grouse, woodcock, thrushes, vireos, woodpeckers, squirrel, grey fox, raccoon, white-tailed deer, and other mammals and birds of wooded areas containing either hardwood or coniferous trees and shrubs, or a mixture of both.

About 40 percent of the county consists of deep soils that have high or moderate available water capacity, such as Washington, Wooster, and Wurtsboro soils, and are rated good for development of woodland habitat. Approximately 25 percent is rated fair. These soils are the poorly drained Atherton loam and Fredon loam. About 25 percent is rated poor. About 10 percent is droughty or very poorly drained and is rated very poor.

Wetland wildlife are ducks, geese, herons, shore birds, kingfishers, muskrat, mink, beaver, and other mammals and birds of swampy, marshy, or open-water areas.

About 75 percent of Sussex County is not suited to the development of habitat for wetland wildlife. About 10 percent, the flat poorly drained Carlisle muck, Swamp, and Preakness soils, is rated good. About 10 percent, the poorly drained, slightly sloping Atherton and Wayland soils is fair. Only 5 percent of the county is rated poor.

Engineering Uses of the Soils [3]

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

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.

[3] JAMES W. STINGEL, engineer, Soil Conservation Service, helped prepare this section.

TABLE 6.—*Potential of soil for elements of wildlife habitat and kinds of wildlife*

Soil series and map symbols	Elements of wildlife habitat						Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood and coniferous trees	Wetland food and cover plants	Shallow-water developments	Openland	Woodland	Wetland
Albia:									
AlB, AlC	Poor	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
AmB	Very poor.	Very poor.	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
Alluvial land, wet: Ar	Very poor.	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Atherton: At	Poor	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
Bath:									
BaB, BaC	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
BfD	Poor	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
BfE	Very poor.	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
BgB, BgD, BgE	Very poor.	Poor	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Braceville:									
BrA	Fair	Good	Good	Good	Poor	Poor	Good	Good	Poor.
BrB	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Carlisle: Ca	Very poor.	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Chenango:									
ChB	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
ChD, ClC	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
ClD	Poor	Fair	Good	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Chippewa:									
CmB	Very poor.	Very poor.	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
CnB	Poor	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
Colonie: CoB, CoC	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
Fredon:									
FrA	Poor	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
FrB	Poor	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
Halsey: Ha	Very poor.	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Hazen:									
HfA, HfB	Fair	Good	Good	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
HfD	Poor	Fair	Good	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
HgE	Very poor.	Poor	Fair	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.

TABLE 6.—*Potential of soil for elements of wildlife habitat and kinds of wildlife*—Continued

Soil series and map symbols	Elements of wildlife habitat						Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hard wood and coniferous trees	Wet land food and cover plants	Shallow-water developments	Open-land	Wood-land	Wet-land
Hero:									
HkA	Fair	Good	Good	Good	Poor	Poor	Good	Good	Poor.
HkB	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Hibernia:									
HmB	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
HnB, HnD	Very poor.	Poor	Good	Good	Poor	Very poor.	Poor	Good	Very poor.
Hoosic: HoB, HoD	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Livingston: Lv	Very poor.	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Lyons:									
Ly	Very poor.	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Lz	Very poor.	Poor	Poor	Poor	Good	Fair	Poor	Poor	Fair.
Middlebury: Md	Fair	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Nassau:									
NaB, NaC	Poor	Poor	Fair	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
NfD, NfE, Ng	Very poor.	Very poor.	Fair	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Norwich:									
NhA	Very poor.	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
NoA	Very poor.	Poor	Poor	Poor	Good	Fair	Poor	Poor	Fair.
Oquaga: OmB, OmD, OrD	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.
Otisville: OtC, OtD	Very poor.	Poor	Fair	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Palmyra:									
PaA, PaB	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
PaD	Poor	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Pompton: PvA	Fair	Good	Good	Good	Fair	Poor	Good	Good	Poor.
Preakness: Pw	Very poor.	Poor	Poor	Poor	Good	Good	Poor	Poor	Good
Raynham: RaB	Fair	Fair	Fair	Good	Poor	Very poor.	Fair	Fair	Very poor.
Riverhead: RhB, RhC	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Rockaway:									
RoB, RoC	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
RoD	Poor	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
RpD, RpE, RrD, RvE	Very poor.	Poor	Fair	Good	Very poor.	Very poor.	Poor	Fair	Very poor.

TABLE 6.—*Potential of soil for elements of wildlife habitat and kinds of wildlife*—Continued

Soil series and map symbols	Elements of wildlife habitat						Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hard wood and coniferous trees	Wetland food and cover plants	Shallow-water developments	Openland	Woodland	Wetland
Rock outcrop:[1] RsF, RtE, RvE	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Sloan and Wayland: Sm	Very poor.	Poor	Fair	Poor	Good	Fair	Poor	Poor	Fair.
Swamp: Sp	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
Swartswood: SwB, SwC	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
SwD	Poor	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Swartswood and Lackawanna: SxB, SxD, SxE	Very poor.	Poor	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Unadilla: UnA, UnB	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Valois: VaB, VaC	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
VaD	Poor	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Wallkill: Wa	Very poor.	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Washington: WhB, WhC, WIC, WID	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
WhD	Poor	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
WkC, WkD	Very poor	Poor	Fair	Good	Very poor.	Very poor.	Poor-	Good	Very poor.
Wassaic: WmC	Fair	Good	Fair	Good	Very poor.	Very poor.	Fair	Good	Very poor.
WmD, WnD	Poor	Fair	Fair	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Whitman: Wo	Very poor.	Very poor.	Poor	Poor	Good	Fair	Very poor.	Poor	Fair.
Wooster: WsB, WsC	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
WsD, WsE	Poor	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Wurtsboro: WtB, WtC	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
WuB, WuC	Very poor.	Poor	Good	Good	Poor	Very poor.	Poor	Good	Very poor.

[1] Rating is very poor for Rock outcrop part of any specified mapping unit.

4. Plan drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 7, 8, and 9, which show, respectively, estimates of soil properties significant in engineering; soil interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 8 and 11, and it also can be used to make other useful maps.

TABLE 7.—*Estimates of soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that appear in the first column of

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification [1]		
	Bedrock	Seasonal high water table		USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Albia: AlB, AlC, AmB	>5	½–1½	0–9	Gravelly loam	ML, CL	A–4
			9–18	Gravelly loam	ML, CL	A–4
			18–60	Gravelly loam	SM, SC	A–4
Alluvial land, wet: Ar No valid estimates can be made.	>4	0				
Atherton: At	>6	0	0–12	Loam	ML, CL	A–4
			12–30	Loam	CL, ML	A–4
			30–60	Sandy clay loam	SC, CL, ML, SM	A–4
Bath: BaB, BaC, BfD, BfE, BgB, BgD, BgE.	>4	>3	0–10	Loam	GM, SM, SC, ML, CL	A–2, A–4
			10–28	Loam	SM, SC, ML, CL, GM, GC	A–2, A–4
			28–60	Gravelly loam and gravelly sandy loam.	SM, SC	A–2, A–4
Braceville: BrA, BrB	>5	1½–3	0–8	Gravelly sandy loam	SM	A–2
			8–24	Gravelly sandy loam	SM, SC, ML, CL, GM, GC	A–2, A–4
			24–36	Gravelly loam	ML, CL	A–4
			36–60	Gravelly sand	SP–SM, SW–SM	A–1, A–2
Carlisle: Ca	>6	0	0–60	Muck	Pt	
Chenango: ChB, ChD, ClC, ClD	>6	>3	0–9	Gravelly fine sandy loam	SM	A–2
			9–30	Gravelly sandy loam	SM, SC, GM, GC	A–2, A–4
			30–60	Very gravelly loamy sand	GP, GP–GM	A–1
Chippewa: CmB, CnB	>5	0–½	0–8	Silt loam	ML, CL	A–4
			8–21	Silt loam	ML, CL	A–4
			21–40	Gravelly loam	ML, CL, SC	A–4
			40–60	Gravelly fine sandy loam	SM, ML, SC, CL	A–4
Colonie: CoB, CoC	>10	>5	0–14	Loamy fine sand	SM	A–2
			14–65	Fine sand and fine sandy loam.	SM	A–2
			65–80	Sand	SM, SP–SM	A–2
Fredon: FrA, FrB	>6	0–1	0–7	Loam	CL, ML, SC	A–4
			7–26	Fine sandy loam and very fine sandy loam.	SM, ML, SC, CL	A–2, A–4
			26–60	Very gravelly sandy loam and very gravelly sand.	GP, GP–GM, GM, SP–SM	A–1, A–2
Halsey: Ha	>6	0	0–18	Loam	ML, CL	A–4
			18–30	Loam and very fine sandy loam.	SM, SC, ML, CL	A–4
			30–60	Very gravelly sand	GP–GM, SP–SM, GW–GM, SP	A–1, A–2
*Hazen: HfA, HfB, HfD, HgE For Palmyra part of HgE, see Palmyra series.	>6	>6	0–8	Gravelly loam	SM, SC, ML, CL, GM, GC	A–2, A–4
			8–24	Gravelly loam and gravelly sandy loam.	SM, SC, ML, CL, GM, GC	A–2, A–4
			24–60	Gravelly sand and sand	SM, GM, GP–GM, SP–SM	A–1, A–2
Hero: HkA, HkB	>5	1½–3	0–10	Loam	ML, CL	A–4
			10–24	Fine sandy loam and gravelly sandy loam.	SM, SC	A–2, A–4
			24–60	Very gravelly sand, gravelly sand, and sand.	GP, GP–GM, SP, SP–SM	A–1, A–2

See footnotes at end of table.

significant in engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions this table. The symbol > means more than; the symbol < means less than]

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Maximum dry density	Optimum moisture	Shrink-swell potential
	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						
Pct.					*In./hr.*	*In./in. of soil*	*pH*	*Lb./cu. ft.*	*Pct. dry wt.*	
0–15	80–90	75–85	65–75	50–70	0. 6–2. 0	[2] 0. 12–0. 16	5. 1–5. 5			Low.
0–10	80–90	75–85	70–80	55–65	0. 6–2. 0	0. 12–0. 16	5. 1–6. 0	95–105	18–23	Moderate.
0–10	70–80	65–75	50–60	35–50	<0. 2	0. 08–0. 12	5. 1–6. 5	95–105	18–23	Low.
0–2	95–100	85–100	80–90	60–70	0. 2–2. 0	[2] 0. 18–0. 22	5. 1–6. 5			Low.
0–2	90–100	85–100	60–90	50–70	0. 2–2. 0	0. 16–0. 20	5. 1–6. 5	90–105	18–28	Low.
0–5	85–95	65–90	60–90	35–55	<0. 2–2. 0	0. 10–0. 18	6. 1–7. 8	90–110	15–25	Low.
0–10	65–85	55–85	40–70	25–60	0. 6–2. 0	0. 14–0. 20	5. 1–6. 0			Low.
0–10	60–90	55–85	50–70	30–60	0. 6–2. 0	0. 14–0. 20	5. 1–6. 0	90–110	15–25	Low.
0–10	70–80	60–70	50–60	30–40	<0. 2–2. 0	0. 08–0. 12	5. 1–7. 3	100–125	10–20	Low.
0–2	80–100	70–80	50–80	25–35	2. 0–6. 0	[2] 0. 10–0. 14	5. 1–6. 0			Low.
0–2	65–90	55–85	40–65	30–60	0. 6–2. 0	0. 10–0. 14	5. 1–6. 0	100–125	10–20	Low.
0–2	65–75	60–70	50–60	50–60	0. 2–0. 6	0. 08–0. 12	5. 6–6. 0	90–105	18–23	Low.
0–2	60–70	50–65	20–40	5–10	>6. 0	0. 02–0. 05	5. 1–6. 5	110–125	10–15	Low.
					2. 0–>6. 0	[2] 0. 30–0. 45	5. 6–7. 8	20–40		Low.[3]
0–15	70–80	60–70	45–70	20–30	2. 0–6. 0	0. 10–0. 14	5. 1–5. 5			Low.
0–15	60–80	50–70	40–70	20–45	2. 0–6. 0	0. 10–0. 16	5. 1–5. 5	100–125	10–20	Low.
0–10	30–40	20–30	10–25	0–10	>6. 0	0. 03–0. 06	5. 6–6. 0	110–125	10–15	Low.
0–25	80–100	75–90	75–90	60–80	0. 6–2. 0	[2] 0. 17–0. 22	5. 6–6. 0			Moderate.
0–15	80–100	75–90	75–90	60–80	0. 2–0. 6	0. 15–0. 20	5. 6–6. 0	90–100	20–25	Moderate.
0–15	85–90	70–90	70–80	45–55	<0. 2	0. 08–0. 12	6. 1–6. 5	90–100	20–25	Low.
0–15	85–90	65–80	65–80	40–60	<0. 2	0. 08–0. 12	6. 1–6. 5	100–125	15–25	Low.
0	100	100	85–90	15–25	2. 0–6. 0	0. 09–0. 11	5. 1–6. 0			Low.
0	100	100	85–90	15–25	0. 6–6. 0	0. 05–0. 10	5. 6–6. 0	110–125	10–15	Low.
0	100	100	85–95	5–15	>6. 0	0. 02–0. 06	5. 1–6. 0	110–125	10–15	Low.
0	90–95	85–95	65–90	40–70	0. 6–2. 0	[2] 0. 16–0. 20	5. 6–6. 0			Low.
0	90–100	85–95	65–85	30–70	0. 2–2. 0	0. 16–0. 20	5. 6–6. 0	90–100	15–25	Low.
0–5	40–55	20–40	10–40	0–15	2. 0–>6. 0	0. 04–0. 10	6. 6–7. 3	110–125	10–15	Low.
0–2	95–100	85–100	60–75	50–70	0. 6–2. 0	[2] 0. 16–0. 20	5. 6–6. 5			Low.
0–2	90–100	85–100	55–75	40–60	0. 6–2. 0	0. 14–0. 18	5. 6–6. 5	100–110	15–20	Low.
5–10	50–75	40–70	20–55	0–10	>6. 0	0. 02–0. 07	6. 6–7. 8	110–125	10–15	Low.
0–5	65–95	65–80	35–65	25–65	0. 6–2. 0	0. 12–0. 16	5. 6–6. 5			Low.
0–5	65–90	65–80	40–70	25–55	0. 6–2. 0	0. 10–0. 14	5. 6–6. 5	100–125	10–20	Low.
0–10	40–90	35–90	10–40	5–15	>6. 0	0. 02–0. 08	6. 6–7. 8	110–125	10–15	Low.
0–2	95–100	85–95	60–80	50–65	2. 0–6. 0	[2] 0. 16–0. 20	5. 6–6. 5			Low.
0–2	75–90	70–85	60–70	30–40	2. 0–6. 0	0. 10–0. 16	5. 6–6. 5	100–125	10–18	Low.
0–5	40–60	30–50	20–40	0–10	>6. 0	0. 02–0. 07	5. 6–7. 8	110–125	10–15	Low.

TABLE 7.—*Estimates of soil properties*

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification [1]		
	Bedrock	Seasonal high water table		USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Hibernia: HmB, HnB, HnD	>5	½–1½	0–5	Cobbly loam	ML, CL	A–4
			5–20	Cobbly loam and gravelly loam.	SM, SC, ML, CL	A–4
			20–36	Gravelly loam	SM, SC, ML, CL	A–4
			36–72	Gravelly sandy loam	SM	A–2
Hoosic: HoB, HoD	>6	>6	0–7	Gravelly loam	SM, SC, ML, CL	A–4
			7–30	Gravelly sand loam and gravelly loamy sand.	SM	A–2
			30–60	Very gravelly sand	SP–SM, SP, GM, SM, GW, GP–GM	A–1, A–2
Lackawanna Mapped only with Swartswood soils.	>3½	>5	0–15	Gravelly fine sandy loam	SM, SC	A–2, A–4
			15–26	Gravelly loam	SM, SC, ML, CL	A–4, A–2
			26–60	Gravelly fine sandy loam and gravelly loam.	SM, SC, ML, CL	A–2, A–4
Livingston: Lv	>5	0	0–10	Silty clay loam	MH, CL, CH	A–4, A–6
			10–30	Clay	CL, CH	A–6
			30–60	Clay	CL, CH	A–6
Lyons: Ly, Lz	>4	0	0–10	Silt loam	ML, CL	A–4, A–6
			10–30	Silt loam	SM, ML, CL, SC	A–4, A–6
			30–60	Gravelly loam	SM, SC, ML, CL	A–4
Made land, sanitary land fill: Ma. No valid estimates can be made.						
Middlebury: Md	>4	1–2½	0–11	Loam	ML, CL	A–4
			11–25	Fine sandy loam	SM, SC, CL, ML	A–4
			25–65	Fine sandy loam	SM, SC	A–2, A–4
*Nassau: NaB, NaC, NfD, NfE, Ng For Rock outcrop part of NfD, NfE, and Ng, no valid estimates can be made.	1–1½	>3	0–6	Shaly silt loam	SM, GM, GC, SC, ML, CL	A–2, A–4
			6–18	Very shaly silt loam	SM, GM, GC, SC	A–2, A–4
			18	Slate or shale bedrock.		
Norwich: NhA, NoA	>4	0	0–15	Silt loam	ML, CL	A–4, A–6
			15–60	Channery silt loam and channery loam.	ML, CL, SM, SC	A–2, A–4, A–6
*Oquaga: OmB, OmD, OrD For Rock outcrop part of OrD, no valid estimates can be made.	2–3½	>5	0–24	Loam and gravelly loam	SM, ML, CL, SC	A–2, A–4
			24–30	Very gravelly loam	SM, SC	A–2, A–4
			30	Shale or sandstone bedrock.		
Otisville: OtC, OtD	>10	>5	0–16	Gravelly loamy sand	SM	A–2
			16–60	Very gravelly sand	SP, SP-SM	A–1
Palmyra: PaA, PaB, PaD	>6	>5	0–12	Gravelly fine sandy loam	SM, SC	A–4, A–2
			12–26	Gravelly fine sandy loam	SM, SC	A–4, A–6
			26–60	Fine sand and gravel	GM, SM, SP–SM	A–1, A–2
Pits, sand and gravel: Pt. No valid estimates can be made.						
Pompton: PvA	>5	1–2	0–8	Fine sandy loam	SM, SC	A–4
			8–33	Fine sandy loam, and gravelly sandy loam.	SM, SC	A–2, A–4
			33–60	Gravelly loamy sand	GM, SM, GP–GM, SP–SM	A–1, A–2
Preakness: Pw	>6	0	0–14	Sandy loam	SM	A–2, A–4
			14–28	Sandy loam	SM, SC	A–2, A–4
			28–60	Loamy sand	SM, SP–SM	A–2, A–1

See footnotes at end of table.

significant in engineering—Continued

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Maximum dry density	Optimum moisture	Shrink-swell potential
	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						
Pct.					*In./hr.*	*In./in. of soil*	*pH*	*Lb./cu. ft.*	*Pct. dry wt.*	
0–15	70–80	65–75	60–70	50–65	0. 6–2. 0	[2] 0. 12–0. 16	5. 1–5. 5			Low.
0–10	70–80	65–75	60–70	40–65	0. 6–2. 0	0. 10–0. 14	5–1–5. 5	95–105	18–23	Low.
0–10	75–85	70–80	60–80	40–60	<0. 2	0. 08–0. 12	5. 1–5. 5	95–105	18–23	Low.
0–5	80–90	70–80	60–75	25–35	<0. 2	0. 08–0. 12	5. 1–5. 5	110–125	10–15	Low.
0–2	80–90	60–80	50–65	40–60	2. 0–6. 0	0. 10–0. 14	5. 1–5. 5			Low.
0–5	70–90	60–80	30–55	20–35	2. 0–6. 0	0. 08–0. 12	5. 1–5. 5	100–125	10–18	Low.
0–5	40–65	20–60	10–30	0–15	>6. 0	0. 02–0. 08	5. 1–6. 0	110–125	10–15	Low.
5–10	65–90	60–80	50–70	35–50	0. 6–2. 0	0. 08–0. 12	5. 1–5. 5			Low.
5–10	70–90	50–80	40–70	30–60	0. 6–2. 0	0. 10–0. 14	5. 1–5. 5	95–105	18–23	Low.
5–10	70–90	50–65	40–60	30–60	<2. 0	0. 08–0. 12	5. 1–6. 5	100–125	10–18	Low.
0	95–100	95–100	90–100	80–95	0. 2–0. 6	[2] 0. 16–0. 20	6. 1–7. 3			Moderate.
0	95–100	95–100	85–95	75–95	<0. 2	0. 12–0. 16	6. 1–7. 3	85–100	25–35	Moderate.
0	95–100	95–100	80–90	75–90	<0. 2	0. 12–0. 16	6. 1–7. 8	85–100	25–35	Moderate.
0–10	90–100	85–100	65 85	70–80	0. 6–2. 0	[2] 0. 15–0. 21	6. 1–7. 3			Low.
0–10	90–100	85–90	60–90	45–80	0. 2–0. 6	0. 15–0. 20	6. 1–7. 3	90–110	15–25	Low.
0–5	80–90	70–80	60–80	40–70	0. 2–0. 6	0. 14–0. 18	6. 1–7. 8	90–110	15–25	Low.
0	95–100	95–100	85–95	60–75	0. 6–2. 0	[2] 0. 16–0. 20	5. 6–6. 0			Low.
0	95–100	95–100	60–70	40–55	0. 6–2. 0	0. 16–0. 20	5. 6–6. 0	100–110	15–20	Low.
0	95–100	95–100	70–90	30–50	2. 0–>6. 0	0. 16–0. 20	5. 6–6. 0	100–110	15–20	Low.
0–15	60–90	50–90	35–65	30–60	0. 6–2. 0	0. 15–0. 20	5. 1–5. 5			Low.
5–15	50–65	20–55	20–50	15–45	2. 0–6. 0	0. 06–0. 14	5. 1–5. 5	90–105	18–25	Low.
0–10	85–100	80–95	70–90	60–70	0. 6–2. 0	[2] 0. 18–0. 24	5. 1 5. 5			Low.
0–10	70–85	60–80	55–75	30–65	<0. 2	0. 08–0. 12	5. 1–5. 5	90–105	18–25	
0–15	70–80	60–70	50–65	25–65	2. 0–6. 0	0. 10–0. 16	5. 1–5. 5			Low.
5–10	50–80	20–70	20–60	15–50	2. 0–6. 0	0. 08–0. 14	4. 5–5. 5	100–125	10–20	Low.
0–5	95–100	55–75	50–60	15–25	>6. 0	0. 08–0. 10	5. 1–5. 5			Low.
0–10	90–100	40–50	40–50	0–10	>6. 0	0. 02–0. 06	5. 1–5. 5	110–125	10–15	Low.
0–5	80–90	60–85	35–80	30–45	0. 6–2. 0	0. 14–0. 18	6. 1–6. 5			Low.
0–5	80–95	60–85	35–80	35–50	0. 6–2. 0	0. 12–0. 16	6. 1–6. 5	90–110	15–23	Low.
0–10	40–80	35–70	30–60	5–20	>6. 0	0. 04–0. 08	7. 4–7. 8	110–125	10–15	Low.
0	85–95	85–95	65–75	35–50	0. 6–6. 0	[2] 0. 14–0. 18	5. 6–6. 0			Low.
0	80–95	80–90	60–75	30–50	0. 6–6. 0	0. 12–0. 16	5. 1–5. 5	100–125	10–18	Low.
0	35–80	35–80	20–40	5–15	>6. 0	0. 05–0. 10	5. 1–5. 5	110–125	10–15	Low.
0	95–100	95–100	70–85	30–40	2. 0–6. 0	[2] 0. 14–0. 18	5. 1–5. 5			Low.
0	95–100	80–100	55–80	30–50	2. 0–6. 0	0. 12–0. 16	5. 1–5. 5	105–125	10–18	Low.
0	65–90	40–85	45–70	10–30	>6. 0	0. 03–0. 10	5. 1–5. 5	110–125	10–15	Low.

TABLE 7.—*Estimates of soil properties*

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification [1]		
	Bedrock	Seasonal high water table		USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Raynham: RaB	>6	0–1½	0–17	Silt loam	ML, CL	A–4
			17–60	Silt loam and very fine sandy loam.	ML, CL	A–4
Riverhead: RhB, RhC	>6	>5	0–7	Sandy loam	SM, SC	A–2, A–4
			7–30	Sandy loam	SM, SC	A–2, A–4
			30–60	Loamy sand	SM, SP–SM	A–2
*Rockaway: RoB, RoC, RoD, RpD, RpE, RrD. For Rock outcrop part of RrD, no valid estimates can be made.	>4	3–5	0–7	Gravelly loam	SM, ML, SC, CL	A–4
			7–30	Gravelly loam	SM, SC, ML, CL	A–4
			30–44	Gravelly sandy loam	SM, SC, ML, CL	A–2, A–4
			44–65	Gravelly sandy loam	SM, SC	A–2, A–4
*Rock outcrop: RsF, RtE, RvE. For Nassau part of RsF, see Nassau series. For Oquaga part of RtE, see Oquaga series. For Rockaway part of RvE, see Rockaway series.						
*Sloan: Sm Mapped only with Wayland soils. For Wayland part, see Wayland series.	>5	[4] 0	0–15	Silt loam	ML, CL, OL	A–4, A–6, A–7
			15–45	Silty clay loam	ML, CL	A–4, A–6, A–7
			45–60	Gravelly sandy loam	SM, CL, ML, SC	A–4
Swamp: Sp. No valid estimates can be made.						
*Swartswood: SwB, SwC, SwD, SxB, SxD, SxE. For Lackawanna part of SxB, SxD, and SxE, see Lackawanna series.	>4	>3	0–5	Sandy loam and gravelly loam.	SM, ML, SC, CL	A–4
			5–30	Gravelly loam and gravelly sandy loam.	SM, SC, ML, CL	A–2, A–4
			30–66	Gravelly sandy loam	SM, SC	A–2
Unadilla: UnA, UnB	>6	>4	0–9	Very fine sandy loam	ML, CL	A–4
			9–40	Very fine sandy loam	ML, CL	A–4
			40–60	Fine sandy loam	SM, SC, ML, CL	A–4
Valois: VaB, VaC, VaD	>4	>5	0–7	Shaly loam	ML, CL	A–4
			7–27	Shaly loam	SM, SC, ML, CL	A–4
			27–60	Shaly loam	SM, SC, ML, CL	A–4
Wallkill: Wa	>5	0	0–18	Silt loam	ML, CL	A–4
			18–60	Muck	Pt	([5])
*Washington: WhB, WhC, WhD, WkC, WkD, WlC, WlD. For Wassaic part of WlC and WlD, see Wassaic series.	>5	>4	0–8	Loam	CL, SM, SC, ML	A–4
			8–42	Loam	ML, CL, SM, SC	A–4
			42–60	Gravelly loam	SC, SM, ML, CL	A–4, A–2
Wassaic: WmC, WmD, WnD For Rock outcrop part of WnD, no valid estimates can be made.	1½–3½	>5	0–9	Silt loam	ML, CL	A–4, A–6
			9–24	Loam and gravelly clay loam.	ML, CL	A–4, A–6
			24–30	Gravelly loam	SM, SC, ML, CL	A–4
			30	Hard gray limestone bedrock.		
Wayland Mapped only with Sloan soils.	>5	[4] 0–1	0–6	Silt loam	ML, CL	A–4, A–6
			6–46	Silt loam	ML, CL	A–4, A–6, A–7
			46–60	Fine sandy loam	ML, CL, SC, SM	A–4, A–6
Whitman: Wo	>5	0	0–10	Sandy loam	SM, SC	A–2, A–4
			10–20	Sandy loam	SM, SC	A–2, A–4
			20–60	Gravelly sandy loam	SM, SC	A–2

See footnotes at end of table.

significant in engineering—Continued

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Maximum dry density	Optimum moisture	Shrink-swell potential
	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						
Pct.					*In./hr.*	*In./in. of soil*	*pH*	*Lb./cu. ft.*	*Pct. dry wt.*	
0	100	100	95–100	70–80	0. 6–2. 0	[2] 0. 20–0. 24	5. 1–6. 5			Low.
0	100	100	95–100	50–90	0. 2–2. 0	0. 18–0. 22	6. 1–6. 5	90–100	20–25	Low.
0–2	90–100	85–95	65–75	30–40	2. 0–6. 0	0. 10–0. 14	5. 1–5. 5			Low.
0–2	90–100	85–95	60–75	25–40	2. 0–6. 0	0. 10–0. 14	5. 1–5. 5	105–125	10–18	Low.
0–5	75–95	65–90	50–75	10–30	>6. 0	0. 04–0. 10	5. 1–5. 5	110–125	10–15	Low.
0–10	70–90	65–80	50–75	40–65	2. 0–6. 0	0. 14–0. 18	5. 1–5. 5			Low.
0–10	75–90	65–80	55–75	40–65	2. 0–6. 0	0. 14–0. 18	5. 1–5. 5	100–125	10–20	Low.
0–10	75–90	65–80	55–75	25–55	<0. 2	0. 06–0. 10	5. 1–5. 5	105–125	10–18	Low.
0–10	65–80	50–80	55–65	20–40	<0. 2–2. 0	0. 06–0. 10	5. 1–5. 5	105–125	10–18	Low.
0	95–100	95–100	85–100	65–90	0. 6–2. 0	[2] 0. 20–0. 24	6. 1–6. 5			Low.
0	95–100	95–100	85–100	65–90	0. 6–2. 0	0. 18–0. 22	6. 1–7. 3	80–100	20–35	Low.
2	90–100	80–95	60–90	40–65	0. 6–6. 0	0. 12–0. 16	6. 6–7. 8	90–125	10–25	Low.
2–10	70–85	60–80	50–70	40–60	0. 6–2. 0	0. 10–0. 18	4. 5–5. 0			Low.
2–10	70–85	60–80	65–75	25–65	0. 6–2. 0	0. 10–0. 18	4. 5–5. 0	100–125	10–18	Low.
5–10	70–80	60–70	50–65	25–35	0. 2–0. 6	0. 06–0. 10	4. 5–5. 0	105–125	10–18	Low.
0	98–100	95–100	80–95	50–65	0. 6–2. 0	0. 18–0. 22	5. 1–6. 0			Low.
0	98–100	95–100	85–95	50–65	0. 6–2. 0	0. 18–0. 22	5. 1–6. 0	100–110	15–20	Low.
0	95–100	95–100	80–95	20–80	0. 6–6. 0	0. 08–0. 20	5. 1–6. 0	100–125	10–20	Low.
0–5	75–90	70–80	60–70	50–60	0. 6–2. 0	0. 11–0. 15	4. 5–5. 5			Low.
0–5	75–90	65–85	55–80	40–65	0. 6–2. 0	0. 11–0. 15	4. 5–5. 5	95–105	18–23	Low.
0–5	70–85	55–80	45–75	40–60	0. 6–6. 0	0. 10–0. 14	5. 1–6. 0	95–105	18–23	Low.
0	90–100	90–100	80–100	70–80	0. 6–2. 0	[2] 0. 20–0. 24	5. 6–6. 0			Low.
[5]	[5]	[5]	[5]	[5]	>6. 0	0. 30–0. 35	6. 1–7. 3			Low.
0–15	80–90	75–90	60–75	45–60	0. 6–2. 0	0. 18–0. 22	5. 6–7. 3			Low.
0–15	70–90	65–90	60–70	45–70	0. 6–2. 0	0. 16–0. 20	5. 6–7. 3	90–105	18–25	Low.
0–30	80–95	45–90	40–80	30–55	0. 6–6. 0	0. 12–0. 16	5. 6–7. 3	95–125	10–23	Low.
0–5	85–95	85–90	75–90	60–80	0. 6–2. 0	0. 20–0. 24	5. 6–6. 0			Low.
0–5	85–100	85–95	85–95	70–80	0. 6–2. 0	0. 16–0. 20	6. 1–7. 3	90–105	18–25	Low.
0–10	60–75	50–70	45–65	40–60	0. 6–6. 0	0. 14–0. 18	>7. 4	95–105	18–23	Low.
0	100	100	95–100	70–90	0. 6–2. 0	[2] 0. 18–0. 22	6. 6–7. 8			Low.
0	100	100	95–100	70–90	0. 2–2. 0	0. 14–0. 18	6. 6–7. 8	80–100	20–35	Low.
0	100	95–100	85–100	40–75	0. 2–2. 0	0. 14–0. 20	6. 6–7. 8	80–110	15–35	Low.
0–15	85–95	80–90	55–70	25–40	0. 6–2. 0	[2] 0. 10–0. 14	5. 1–6. 0			Low.
5–15	70–95	60–90	45–75	25–40	0. 6–2. 0	0. 08–0. 12	5. 1–6. 0	105–125	10–18	Low.
5–10	85–90	70–85	40–60	25–35	<0. 2	0. 08–0. 12	5. 1–6. 5	105–125	10–18	Low.

TABLE 7.—*Estimates of soil properties*

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification [1]		
	Bedrock	Seasonal high water table		USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Wooster: WsB, WsC, WsD, WsE	>3½	>4	0–8	Loam	ML, CL	A–4
			8–32	Silt loam and gravelly silt loam.	ML, CL	A–4
			32–48	Channery loam	ML, CL	A–4
			48–60	Channery sandy loam	SM, SC, ML, CL	A–2, A–4
Wurtsboro: WtB, WtC, WuB, WuC	>5	1½–2½	0–7	Gravelly loam	SM, ML, SC, CL	A–4
			7–20	Gravelly loam	SM, ML, CL, SC	A–4
			20–72	Gravelly sandy loam	SM, SC	A–2

[1] Texture shown in the USDA texture column is that of the representative profile described for the soil series. Ranges in texture are stated in the paragraph following the description of the representative profile for each soil series in the section "Descriptions of the Soils." The Unified and AASHO classifications reflect the ranges in texture, if any, that are referred to in that paragraph following.

[2] Additional water can be supplied by capillary action from below.

TABLE 8.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that

Soil series and map symbol	Suitability as source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Ponds
					Reservoir area
Albia: AlB, AlC, AmB	Poor: gravel and stone content excessive.	Poor: excessive fines; AmB extremely stony.	Fair: ML, CL material; excessive fines; AmB extremely stony.	Seasonal high water table perched at depth of ½ foot to 1½ feet; high frost-action potential; AmB extremely stony.	Seasonal high water table perched at depth of ½ foot to 1½ feet; slow permeability in fragipan.
Alluvial land, wet: Ar	Poor: seasonal high water table at surface.	Not suitable above 30 inches; variable below that depth.	Poor: seasonal high water table at surface; high frost-action potential.	Frequent stream overflow; seasonal high water table at surface.	Seasonal high water table at surface; frequent stream overflow.
Atherton: At	Poor: seasonal high water table at surface.	Poor: excessive fines.	Poor: seasonal high water table at surface.	Seasonal high water table at surface.	Seasonal high water table at surface; moderately slow to slow permeability.
Bath: BaB, BaC, BfD, BfE, BgB, BgD, BgE.	Fair for BaB, BaC: gravel content moderate. Poor for BfD, BfE, BgB, BgD, and BgE.	Not suitable: excessive fines.	Good: GM, GC, SM, and SC material; BgB, BgD, and BgE very stony.	Seepage above fragipan; moderate frost action potential; excessive stones in BgB, BgD, and BgE.	Stone content excessive in BgB, BgD, and BgE.

See footnotes at end of table.

significant in engineering—Continued

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Maximum dry density	Optimum moisture	Shrink-swell potential
	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						
Pct.					*In./hr.*	*In./in. of soil*	*pH*	*lb./cu. ft.*	*Pct. dry wt.*	
0–5	90–95	85–95	75–85	55–70	0. 6–2. 0	0. 15–0. 19	5. 1–6. 0	----------	----------	Low.
0–15	85–95	80–90	70–85	60–90	0. 6–2. 0	0. 15–0. 19	5. 1–6. 0	90–100	20–25	Low.
0–15	80–95	65–90	60–90	60–90	0. 2–0. 6	0. 08–0. 12	5. 1–6. 0	90–100	20–25	Low.
0–15	80–95	70–80	50–80	20–80	0. 2–2. 0	0. 10–0. 14	5. 1–7. 8	110–125	10–25	Low.
0–10	75–90	65–80	50–65	40–65	0. 6–2. 0	[2] 0. 12–0. 16	5. 1–5. 5	----------	----------	Low.
0–10	75–90	65–80	55–75	40–65	0. 6–2. 0	0. 12–0. 16	5. 1–5. 5	95–125	10–23	Low.
0–10	85–90	70–80	50–60	25–35	0. 2–0. 6	0. 08–0. 12	5. 1–5. 5	100–125	10–20	Low.

[3] High subsidence when drying.
[4] Subject to overflow.
[5] Variable.

interpretations

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for appear in the first column]

Soil features affecting—Continued						
Ponds—Con. Embankment	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Good stability; impermeable when compacted; AmB extremely stony.	Seasonal high water table; slow permeability in fragipan; AmB extremely stony.	Moderate intake rate; moderate available water capacity; slow permeability in fragipan; excessive stones in AmB.	Seasonal high water table; lateral seepage over fragipan; excessive stones in AmB.	Seasonal high water table; lateral seepage over fragipan; excessive stones in AmB.	Seasonal high water table; lateral seepage over fragipan; excessive stones in AmB.	Seasonal high water table; firm fragipan in subsoil; excessive stones in AmB.
Fair to poor stability; fair to good compaction characteristics.	Frequent stream overflow; seasonal high water table at surface.	Frequent stream overflow; seasonal high water table at surface.	(1)----------	(1)----------	Seasonal high water table at surface.	Seasonal high water table at surface; frequent stream overflow.
Poor to fair stability; poor to fair compaction characteristics; poor to fair resistance to piping.	Seasonal high water table at surface; slow to moderately slow permeability; nearly level; limited outlets.	Seasonal high water table at surface; drainage needed.	(1)----------	(1)----------	Seasonal high water at surface.	Seasonal high water table at surface; unstable trench walls.
Good stability; good compaction characteristics; poor resistance to piping; Bg very stony.	(1)----------	Moderate available water capacity; moderate intake rate.	(2)----------	(2)----------	(2)----------	Excessive stones in BgB, BgD, and BgE.

TABLE 8.—*Engineering*

Soil series and map symbol	Suitability as source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Ponds
					Reservoir area
Braceville: BrA, BrB	Poor: gravel content excessive.	Poor: excessive fines to depth of 3½ feet; seasonal high water table perched at depth of 1½ to 3 feet.	Fair in upper 2 feet; good below that depth; seasonal high water table at a depth of 1½ to 3 feet.	Seasonal high water table perched at a depth of 1½ to 3 feet; high frost-action potential.	Rapid permeability in substratum; seasonal high water table at depth of 1½ to 3 feet.
Carlisle: Ca	Poor: seasonal high water table at surface; highly organic soil material.	Not suitable: none present.	Not suitable: unstable, highly organic material.	Seasonal high water table at surface; unstable, highly organic material.	Seasonal high water table at surface; organic material.
Chenango: ChB, ChD, CIC, CID.	Poor: gravel and cobblestone content excessive.	Poor above depth of 2½ feet. Fair to good below depth of 2½ feet.	Good: GM, SM material.	Cut slopes are unstable in substratum.	Rapid permeability in substratum; excessive seepage losses.
Chippewa: CmB, CnB	Poor: seasonal high water table at depth of 0 to ½ foot; CmB extremely stony.	Not suitable: none present.	Poor: ML, CL material; seasonal high water table at a depth of 0 to ½ foot; high frost-action potential.	Seasonal high water table; frost-action potential.	Seasonal high water table; slow permeability in subsoil and substratum.
Colonie: CoB, CoC	Poor: low available water capacity; low fertility.	Poor: excessive fines above depth of 5 feet. Fair to good for sand below depth of 5 feet.	Good: SM material.	Cut slopes unstable and erodible; loose sand hinders hauling operations.	Moderately rapid to rapid permeability; deep to water table.
Fredon: FrA, FrB	Poor: seasonal high water table at depth of 0 to 1 foot.	Good below depth of 2½ feet; few fines; supply limited in places.	Fair: SM, GM material; seasonal high water table at depth of 0 to 1 foot.	Seasonal high water table at depth of 0 to 1 foot; high frost-action potential.	Seasonal high water table at depth of 0 to 1 foot; gravelly substratum; seepage losses likely.
Halsey: Ha	Poor: seasonal high water table at surface.	Good below depth of 2½ feet: seasonal high water table at surface.	Poor: ML, CL, SM, SC material; seasonal high water table at surface.	Seasonal high water table at surface; high frost-action potential.	Seasonal high water table at surface; rapid permeability in substratum.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						
Ponds—Con. Embankment	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Fair stability; fair compaction characteristics; moderate permeability when compacted.	Seasonal high water table at depth of 1½ to 3 feet; moderately slow permeability in fragipan.	Moderate intake rate; seasonal high water table at depth of 1½ to 3 feet; drainage needed.	Seasonal high water table at depth of 1½ to 3 feet; seepage above fragipan; rapid permeability in substratum.	Seasonal high water table at depth of 1½ to 3 feet; lateral seepage above fragipan.	Seasonal high water table at depth of 1½ to 3 feet; lateral seepage above fragipan.	Seasonal high water table at depth of 1½ to 3 feet; unstable trench walls.
Not suitable; organic material.	Seasonal high water table at surface; rapid permeability; subsidence problems; limited outlets.	Rapid intake rate; high available water capacity; drainage needed.	(1)----------	(1)----------	Seasonal high water table at surface.	Seasonal high water table at surface; low bearing capacity in organic material.
Fair to good stability; fair to good compaction characteristics; moderate permeability when compacted.	(1)----------	Moderately low available water capacity; moderate intake rate.	(2)----------	Moderately rapid permeability; moderately low available water capacity.	(2)----------	Unstable trench walls.
Poor to fair stability; poor to fair compaction characteristics; moderate permeability when compacted; excessive stones in CmB.	Seasonal high water table; slow permeability in subsoil; excessive stones in CmB.	Slow intake rate; excessive stones in CmB; drainage needed.	Seasonal high water table; CmB extremely stony.	Seasonal high water table; CmB extremely stony.	Seasonal high water table.	Seasonal high water table; CmB extremely stony.
Good stability; good compaction characteristics; poor resistance to piping.	(1)----------	Low available water capacity; rapid intake rate.	Moderately rapid to rapid permeability; hazard of erosion.	Moderately rapid to rapid permeability; low available water capacity.	(2)----------	Unstable trench walls; sandy.
Fair stability; fair compaction characteristics; poor resistance to piping.	Seasonal high water table at depth of 0 to 1 foot; moderately slow to moderate permeability.	Moderate intake rate; drainage needed.	Seasonal high water table at depth of 0 to 1 foot; limited outlets.	Seasonal high water table at depth of 0 to 1 foot; limited outlets.	Seasonal high water table at depth of 0 to 1 foot.	Seasonal high water table at depth of 0 to 1 foot; unstable trench walls.
Fair stability; fair compaction characteristics; poor to fair resistance to piping.	Seasonal high water table at surface; outlets limited.	Moderate intake rate; drainage needed.	(1)----------	(1)----------	Seasonal high water table at surface.	Seasonal high water table at surface; unstable trench walls.

TABLE 8.—*Engineering*

Soil series and map symbol	Suitability as source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Ponds
					Reservoir area
Hazen: HfA, HfB, HfD, HgE— For Palmyra part of HgE, see Palmyra series.	Poor: gravel content excessive.	Good below depth of 2 feet.	Fair: ML, CL, GM, GC material.	Moderate frost-action potential.	Rapid permeability in substratum; deep to water table; seepage losses likely.
Hero: HkA, HkB	Fair: moderate gravel content.	Fair below depth of 2 feet: limited in places; some fines.	Good: GM, SM material.	Seasonal high water table at depth of 1½ to 3 feet; cut slopes may be unstable.	Rapid permeability in substratum; seasonal high water table at depth of 1½ to 3 feet; seepage losses likely.
Hibernia: HmB, HnB, HnD	Poor: gravel and stone content excessive; seasonal high water table at depth of ½ foot to 1½ feet.	Poor: excessive fines; Hn very stony.	Good: GM, GC, SM, SC material; seasonal high water table at depth of ½ foot to 1½ feet.	Seasonal high water table at a depth of ½ foot to 1½ feet; high frost-action potential; HnB and HnD excessively stony.	Slow permeability in fragipan; seasonal high water table at depth of ½ foot to 1½ feet; Hn very stony.
Hoosic: HoB, HoD	Poor: gravel content excessive.	Good below depth of 2½ feet.	Good: SM, SC, GM material.	Cut slopes are unstable in substratum.	Rapid permeability in substratum; deep water table, seepage losses excessive.
Lackawanna Mapped only with Swartswood soils.	Poor: gravel and stone content excessive.	Not suitable: none present.	Good: SM material; very stony.	Lateral seepage above fragipan; depth to bedrock at more than 3½ feet.	Slow permeability; deep water table; stony.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						
Ponds—Con. Embankment	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Poor to good stability; poor to good compaction characteristics; poor to good resistance to piping; moderate permeability when compacted.	(1)	Moderate intake rate; moderate available water capacity.	Moderate gravel content; moderate permeability; gravelly substratum at depth of 2 feet; steep slopes in HfD and HgE.	Gravelly substratum at depth of 2 feet; moderate available water capacity; steep slopes in HfD and HgE.	(2)	Unstable trench walls; gravelly substratum.
Fair to poor stability; fair to poor compaction characteristics; poor resistance to piping; moderate permeability when compacted.	Seasonal high water table at depth of 1½ to 3 feet; rapid permeability in substratum.	Moderate intake rate; moderate available water capacity.	Moderately rapid permeability to depth of 2 feet; gravelly substratum; seasonal high water table at depth of 1½ to 3 feet.	Moderately rapid permeability to depth of 2 feet; gravelly substratum; seasonal high water table at depth of 1½ to 3 feet.	Seasonal high water table at depth of 1½ to 3 feet.	Seasonal high water at depth of 1½ to 3 feet; unstable trench walls.
Fair to good stability; fair to good compaction characterstics; moderate permeability when compacted; poor resistance to piping; HnB and HnD excessively stony.	Seasonal high water table at depth of ½ foot to 1½ feet; slow permeability in fragipan; HnB and HnD excessively stony.	Moderate intake rate; drainage needed; HnB steep slopes; HnB and HnD excessively stony.	Seasonal high water table at depth of of ½ foot to 1½ feet; HnB and HnD excessively stony; HnD steep slopes.	Seasonal high water table at depth of ½ foot to 1½ feet; lateral seepage over fragipan; HnB and HnD excessively stony.	Seasonal high water table at depth of ½ foot to 1½ feet; lateral seepage over fragipan.	Seasonal high water at depth of ½ foot to 1½ feet; lateral seepage over fragipan.
Fair to good stability; fair to good compaction characteristics; high permeability when compacted; poor to good resistance to piping.	(1)	Moderate intake rate; low available water capacity.	Moderately rapid permeability.	Moderately rapid permeability; low available water capacity.	(2)	Unstable trench walls; gravelly substratum.
Good stability; good compaction characteristics; moderate permeability when compacted; fair to good resistance to piping; very stony.	(1)	(1)	Slow permeability in fragipan; very stony; SxD and SxE steep slopes.	Slow permeability in fragipan; very stony; SzD and SxE steep slopes.	Slow permeability in fragipan; lateral seepage above fragipan; very stony.	Bedrock at depth of more than 3½ feet; very stony.

TABLE 8.—*Engineering*

Soil series and map symbol	Suitability as source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Ponds
					Reservoir area
Livingston: Lv	Poor: seasonal high water table at surface; moderately fine textured topsoil.	Not suitable: none present.	Poor: ML, CL, CH material; high plastic index; seasonal high water table at surface.	Seasonal high water table at surface; high frost-action potential.	Slow permeability; seasonal high water table at surface.
Lyons: Ly, Lz	Poor: seasonal high water table at surface; Lz excessively stony.	Not suitable: none present.	Poor: seasonal high water table at surface; ML, CL, SM, SC material; high frost-action potential.	Seasonal high water table at surface; Lz excessively stony; high frost-action potential.	Seasonal high water table at surface; slow permeability.
Made land, sanitary land fill: Ma. No valid estimates can be made.					
Middlebury: Md	Good to a depth of 2 feet: seasonal high water table at depth of 1 foot to 2½ feet.	Not suitable: excessive fines; fair below depth of 5 feet in places.	Fair: SM, SC, ML, CL material; seasonal high water table at depth of 1 foot to 2½ feet; high frost-action potential.	Occasional hazard of flooding; seasonal high water table at depth of 1 foot to 2½ feet; high frost-action potential.	Perivous layers in substratum; occasional hazard of flooding.
*Nassau: NaB, NaC, NfD, NfE, Ng. For Rock outcrop part of NfD, NfE, and Ng, no valid estimates can be made.	Poor: shale content excessive; Rock outcrop.	Not suitable: none present; bedrock at depth of 1 foot to 1½ feet.	Poor: bedrock at depth of 1 foot to 1½ feet; Rock outcrop.	Bedrock at depth of 1 foot to 1½ feet; NfD, NfE and in some areas of Ng steep slopes; few Rock outcrops.	Bedrock at depth of 1 foot to 1½ feet; seepage losses likely in fractured bedrock; NfD, NfE, and in some areas of Ng steep slopes.
Norwich: NhA, NoA	Poor: seasonal high water table at surface; NoA excessively stony.	Not suitable: none present.	Poor: seasonal high water table at surface; ML, CL material.	Seasonal high water table at surface; high frost-action potential.	Seasonal high water table at surface; slow permeability.
*Oquaga: OmB, OmD, OrD For Rock outcrop part of OrD, no valid estimates can be made.	Poor: stone and channer content excessive.	Not suitable: none present; bedrock at depth of 2 to 3½ feet.	Poor: bedrock at depth of 2 to 3½ feet; limited material; extremely stony.	Bedrock at depth of 2 to 3½ feet; OmD and OrD steep slopes.	Bedrock at depth of 2 to 3½ feet; moderate permeability; seepage losses likely.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						
Ponds—Con. Embankment	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Fair to good stability; fair to good compaction characteristics; good resistance to piping.	Slow permeability in subsoil; seasonal high water table at surface; limited drainage outlets.	Slow intake rate; seasonal high water table at surface; drainage needed.	(1)	(1)	Seasonal high water table at surface; poor surface drainage.	Seasonal high water table at surface; poor surface drainage.
Poor to good stability; poor to good compaction characteristics; poor to good resistance to piping.	Seasonal high water table at surface; slow permeability; Lz excessively stony.	Moderate intake rate; drainage needed.	(1)	(1)	Seasonal high water table at surface; poor surface drainage; Lz very stony.	Seasonal high water table at surface; poor surface drainage; Lz very stony.
Fair stability; fair compaction characteristics; poor to good resistance to piping.	Seasonal high water table at depth of 1 foot to 2½ feet; occasional hazard of flooding; limited drainage outlets.	Moderate intake rate; seasonal high water table at depth of 1 to 2½ feet; subject to occasional stream flooding.	(1)	(1)	Seasonal high water table at depth of 1 foot to 2½ feet.	Seasonal high water table at depth of 1 foot to 2½ feet; subject to occasional stream flooding.
Good stability; limited material; shale bedrock at depth of 1 foot to 1½ feet; Rock outcrop.	(1)	Bedrock at depth of 1 foot to 1½ feet; low available water capacity; rapid intake rate.	Bedrock at depth of 1 foot to 1½ feet; Rock outcrop.	Bedrock at depth of 1 foot to 1½ feet; low available water capacity; Rock outcrop.	Bedrock at depth of 1 foot to 1½ feet.	Bedrock at depth of 1 foot to 1½ feet; Rock outcrop.
Fair stability; fair compaction characteristics; hazard of piping; No A very stony.	Seasonal high water table at surface; slow permeability in subsoil.	Moderate intake rate; drainage needed.	(1)	(1)	Seasonal high water table at surface.	Seasonal high water at surface.
Fair stability; fair compaction characteristics; bedrock at depth of 2 to 3½ feet; stone content excessive.	(1)	Stone content excessive; moderately low available water capacity; bedrock at depth of 2 to 3½ eet; moderate intake rate	Stone content excessive; bedrock at depth of 2 to 3½ feet.	Stone content excessive; bedrock at depth of 2 to 3½ feet; moderately low available water capacity.	Bedrock at depth 2 to 3½ feet.	Bedrock at depth of 2 to 3½ feet; extremely stony.

TABLE 8.—*Engineering*

Soil series and map symbol	Suitability as source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Ponds
					Reservoir area
Otisville: OtC, OtD	Poor: sand and gravel content excessive.	Good below depth of 2 feet for sand and gravel.	Good: SM, GM, GP, GM material.	Cut slopes are unstable and erodible; loose sand and gravel in substratum.	Rapid permeability in subsoil and substratum; deep to water table; seepage losses likely.
Palmyra: PaA, PaB, PaD	Poor: gravel content excessive.	Good below depth of 2 feet.	Good: SM, SC, GM material.	Loose sand and gravel substratum; unstable and erodible in cuts.	Rapid permeability in substratum; seepage losses excessive; PaD steep slopes.
Pits, sand and gravel: Pt. No valid estimates can be made.					
Pompton: PvA	Fair: gravel content moderate; seasonal high water table at depth of 1 foot to 2 feet.	Fair below depth of 3 feet for sand and gravel; seasonal high water table at depth of 1 foot to 2 feet.	Good: SM, SC, GM, GP material; seasonal high water table at depth of 1 foot to 2 feet.	Seasonal high water table at depth of 1 foot to 2 feet; subject to ponding; high frost-action potential.	Seasonal high water table at depth of 1 foot to 2 feet; rapid permeability in substratum; seepage losses likely.
Preakness: Pw	Poor: seasonal high water table at surface.	Fair below depth of 2½ feet for sand and gravel; seasonal high water table at surface; moderate fine content.	Poor: seasonal high water table at surface; SM material.	Occasional stream overflows; seasonal high water table at surface; high frost-action potential.	Seasonal high water table at surface; subject to occasional stream overflow; moderately rapid permeability.
Raynham: RaB	Poor: seasonal high water table at surface.	Not suitable: none present.	Fair: ML, CL, SM material; seasonal high water table at surface.	Seasonal high water table at surface; high frost-action potential.	Seasonal high water table at surface.
Riverhead: RhB, RhC	Fair: gravel content moderate.	Good below depth of 2 to 3 feet for sand and gravel.	Good: SM material; deposit generally thick.	Cut slopes are unstable and erodible; loose sand and gravel in substratum; RhC steep slopes in places.	Rapid permeability in substratum; seepage losses likely.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						
Ponds—Con. Embankment	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Good stability; good compaction characteristics; moderate permeability when compacted; hazard of piping.	(1)	Low available water capacity; rapid intake rate.	Low available water capacity.	Low available water capacity.	(2)	Sandy and gravelly substratum; unstable trench walls.
Good stability; good compaction characteristics; moderate permeability when compacted; fair to good resistance to piping.	(1)	Moderate available water capacity; moderate intake rate; PaD and HgE steep slopes.	Gravelly substratum at depth of 2 feet; moderate available water capacity.	Gravelly substratum at depth of 2 feet; moderate available water capacity.	(2)	Gravelly substratum at depth of 2 feet; unstable trench walls.
Good stability; good compaction characteristics; moderate permeability when compacted; fair resistance to piping.	Seasonal high water table at depth of 1 foot to 2 feet; hazard of piping.	Drainage needed; subject to ponding.	(1)	(1)	Seasonal high water table at depth of 1 foot to 2 feet.	Seasonal high water table at depth of 1 foot to 2 feet; unstable trench walls.
Fair stability; fair compaction characteristics; hazard of piping.	Seasonal high water table at surface; subject to occasional stream overflow.	Moderately rapid intake rate; seasonal high water table at surface; drainage needed.	(1)	(1)	Seasonal high water table at surface; subject to occasional stream overflow.	Seasonal high water table at surface; poor surface drainage; subject to occasional stream overflow.
Fair to poor stability; fair to poor compaction characteristics; hazard of piping.	Seasonal high water table at surface.	Moderate available water capacity; slow intake rate; drainage needed.	(1)	(1)	Seasonal high water table at surface.	Seasonal high water table at surface; trench walls may be unstable.
Fair to good stability; fair to good compaction characteristics; pervious material.	(1)	Moderately low available water capacity; moderately rapid intake rate; RhC erosion hazard.	Moderately low available water capacity; sandy and gravelly substratum at depth of 2 feet; RhC steep slopes in places.	(2)	(2)	Sand and gravelly substratum; unstable trench walls.

TABLE 8.—*Engineering*

Soil series and map symbol	Suitability as source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Ponds: Reservoir area
*Rockaway: RoB, RoC, RoD, RpD, RpE, RrD. For Rock outcrop part of of RrD, see Rock outcrop.	Poor: gravel, cobblestones, and stone content excessive.	Poor: excessive fines, cobblestones, and stones.	Fair: ML, CL, SM, SC material; RpD, RpE, and RrD, excessively cobbly and stony.	Bedrock at depth of more than 4 feet; RpD, RpE, and RrD excessive stones and boulders.	Slow permeability in fragipan; RpD, RpE, and RrD high stone content and slopes.
*Rock outcrop: RsF, RtE, RvE. For Nassau part, see Nassau series; for Oquaga part of RtE, see Oquaga series; for Rockaway part of RvE, see Rockaway series.	Not suitable: limited material or none present.	Not suitable: none present.	Not suitable: limited material or none present.	Hard bedrock requires blasting; excessive slopes.	Steep slopes; fractured bedrock in places.
*Sloan: Sm. Mapped only with Wayland soils. For Wayland part, see Wayland series.	Poor: seasonal high water table at surface.	Not suitable: excessive fines.	Poor: ML, CL material; seasonal high water table at surface; high frost-action potential.	Seasonal high water table at surface; hazard of frequent flooding.	Pervious layer in substratum; seasonal high water table at surface; hazard of stream overflow.
Swamp: Sp. No valid estimates can be made.					
*Swartswood: SwB, SwC, SwD, SxB, SxD, SxE. For Lackawanna part of SxB, SxD, and SxE, see Lackawanna series.	Poor: gravel and stone content excessive.	Not suitable: none present.	Fair below depth of 2½ feet: SM, SC material; SxB, SxD, and SxE excessive stone content.	Lateral seepage above fragipan; bedrock at a depth of more than 4 feet.	Moderately slow permeability in subsoil; SxB, SxD, and SxE excessive stone content; SwD, SxD, and SxE steep slopes.
Unadilla: UnA, UnB	Good to depth of 40 inches.	Not suitable: none present.	Fair: SM, SC, ML, CL material; high frost-action potential.	High frost-heave potential; erodibility.	Moderate permeability in subsoil and substratum; excessive seepage losses.
Valois: VaB, VaC, VaD	Poor: shaly loam; shale content excessive.	Not suitable: none present.	Fair for ML, SM, and GM materials.	Bedrock at depth more of than 4 feet.	Moderate to moderately rapid permeability in substratum.
Wallkill: Wa	Poor: seasonal high water at surface most of the year; difficult to excavate.	Not suitable: none present; organic substratum.	Poor: ML, CL material; less than 3 feet of material over organic substratum.	Subject to occasional flooding; seasonal high water table at surface; organic substratum.	Seasonal high water table at surface; hazard of occasional flooding.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						
Ponds—Con.	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Embankment						
Fair stability; fair compaction characteristics; RpD, RpE, and RrD excessively stony.	(1)	Moderate available water capacity; moderate intake rate; RpD, RpE, and RrD excessive stones and slopes.	Moderate available water capacity; slow permeability; RpD, RpE, and RrD excessive stone content.	Moderate available water capacity; slow permeability; RpD, RpE, and RrD excessive stone content.	(2)	Bedrock at depth of more than 4 feet; RpD, RpE, and RrD high stone content.
Limited material	(1)	(1)	(1)	(1)	(1)	Hard bedrock requires blasting.
Fair stability; fair compaction characteristics; fair resistance to piping.	Hazard of frequent overflow; seasonal high water table at surface; limited outlets.	Moderate intake rate; drainage needed.	(1)	(1)	Seasonal high water table at surface.	Seasonal high water table at surface; hazard of frequent overflow; hazard of caving.
Good stability; good compaction characteristics; hazard of piping; SxB, SxD, and SxE excessive stone content.	(1)	Moderate intake rate; moderate available water capacity; SxB, SxD and SxE excessive stone content; SwD SxD, and SxE excessive slopes.	SxB, SxD and SxE excessive stone content.	SxB, SxD, and SxE excessive stone content.	(2)	Bedrock at depth of more than 4 feet; SxB, SxD and SxE high stone content; SwD, SxD, and SxE excessive slopes.
Fair to poor stability; fair to poor compaction characteristics; hazard of piping.	(1)	(2)	Moderate permeability; high erodibility.	Moderate permeability; high erodibility.	Susceptible to formation of frozen clods.	(2).
Good stability; good compaction characteristics; hazard of piping.	(1)	Moderate intake rate; moderate available water capacity.	(2)	(2)	Susceptible to formation of frozen clods.	(2).
Organic materials in substratum.	Seasonal high water table at surface; unstable ditches; nearly level; outlets difficult to locate.	Seasonal high water table at surface; excessive amount of available water; drainage needed.	(1)	(1)	Seasonal high water table at surface; poor surface drainage; poor trafficability.	Seasonal high water table at surface; poor surface drainage; poor trafficability; subject to occasional flooding.

TABLE 8.—*Engineering*

Soil series and map symbol	Suitability as source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Ponds
					Reservoir area
*Washington: WhB, WhC, WhD, WkC, WkD, WIC, WID. For Wassaic part of WIC and WID, see Wassaic series.	Fair for WhB and WhC loam; gravel content moderate. Poor for WhD, WkC, and WkD; slope or stone content excessive.	Not suitable: excessive fines.	Fair: ML, CL material; moderate frost-action potential.	Bedrock at a depth of more than 5 feet; WkC and WkD very stony.	Permeable material; sinks and channels present; WkC and WkD very stony.
*Wassaic: WmC, WmD, WnD. For Rock outcrop part of WnD, see Rock outcrop.	Fair: gravel content moderate.	Not suitable: excessive fines; bedrock at depth of 1½ to 3½ feet.	Poor: ML, CL material; limited supply; bedrock at depth of 1½ to to 3½ feet.	Bedrock at a depth of 1½ to 3½ feet; may require blasting.	Limestone bedrock at depth of 1½ to 3½ feet.
Wayland. Mapped only with Sloan soils.	Poor: seasonal high water table at depth of 0 to 1 foot.	Not suitable: excessive fines.	Poor: ML, CL material; seasonal high water table at depth of 0 to 1 foot; high frost-action potential.	Seasonal high water table at depth of 0 to 1 foot; hazard of frequent flooding.	Pervious layer in substratum; seasonal high water table at depth of 0 to 1 foot; hazard of stream overflow.
Whitman: Wo	Poor: seasonal high water table at surface; stone content excessive.	Not suitable: excessive fines; extremely stony.	Poor: seasonal high water table at surface; stone content excessive.	Seasonal high water table at surface; high frost-action potential; stone content excessive.	Seasonal high water table at surface; slow permeability in substratum.
Wooster: WsB, WsC, WsD, WsE.	Fair for WsB and WsC: gravel content moderate. Poor for WsD and WsE: slopes excessive.	Not suitable: excessive fines.	Fair: ML, CL, SM, SC material; limited supply; bedrock at depth of more than 3½ feet.	Bedrock at depth of more than 3½ feet; WsD and WsE excessive slopes.	Slow permeability and seepage rate; WsC, WsD, and WsE strong to steep slopes.
Wurtsboro WtB, WtC, WuB, WuC.	Poor: gravel and stone content excessive.	Not suitable: excessive fines.	Fair: ML, CL, SM, SC material; seasonal high water table at depth of 1½ to 2½ feet; WuB and WuC excessively stony.	Seasonal high water table at depth of 1½ to 2½ feet; high frost-action potential; bedrock at depth of more than 5 feet; WuB and WuC excessively stony.	Seasonal high water table at depth of 1½ to 2½ feet; WuB and WuC excessively stony.

[1] Not applicable.

interpretations—Continued

Soil features affecting—Continued						
Ponds—Con. Embankment	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Fair stability; fair compaction characteristics; hazard of piping; WkC and WkD very stony.	(1)	Moderate intake rate; moderate available water capacity; WkC and WkD excessive stone content.	WkC and WkD excessive stone content.	WkC and WkD excessive stone content.	Fair trafficability	Bedrock at depth of more than 5 feet; WkC and WkD very stony.
Fair to good stability; fair to good compaction characteristics; limited material; bedrock at depth of 1½ to 3½ feet.	(1)	Moderate intake rate; moderate available water capacity; WmD and WnD excessively stony.	Bedrock at depth of 1½ to 3½ feet.	Bedrock at depth of 1½ to 3½ feet.	Bedrock at depth of 1½ to 3½ feet; fair trafficability.	Bedrock at depth of 1½ to 3½ feet.
Fair stability; fair compaction characteristics; fair resistance to piping.	Hazard of frequent overflow; seasonal high water table at depth of 0 to 1 foot; limited outlets.	Moderate intake rate; drainage needed.	(1)	(1)	Seasonal high water table at depth of 0 to 1 foot.	Seasonal high water table at depth of 0 to 1 foot; hazard of frequent overflow; hazard of caving.
Stone content excessive; fair to good stability; fair to good compaction characteristics.	Stone content excessive; seasonal water table at surface; slow permeability in substratum; limited outlets.	Moderate intake rate; extremely stony; drainage needed.	(1)	(1)	Seasonal high water table at surface; poor surface drainage.	Seasonal high water table at surface; poor surface drainage; extremely stony.
Fair stability; fair compaction characteristics; hazard of piping.	(1)	Moderate intake rate; moderate available water capacity; hazard of erosion.	WsD and WsE excessive slopes.	(2)	(2)	Bedrock at depth of more than 3½ feet.
Fair stability; fair compaction characteristics; hazard of piping; WuB and WuC excessively stony.	Seasonal high water table at depth of 1½ to 2½ feet; moderately slow permeability in fragipan; WuB and WuC excessively stony.	Moderate intake rate; moderate available water capacity; seasonal high water table at depth of 1½ to 2½ feet; drainage needed.	Seasonal high water table at depth of 1½ to 2½ feet; WuB and WuC excessively stony.	Seasonal high water table at depth of 1½ to 3½ feet; WuB and WuC excessively stony.	Seasonal high water table at depth of 1½ to 3½ feet; WuB and WuC excessively stony.	Seasonal high water table at depth of 1½ to 3½ feet; bedrock at a depth of more than 5 feet.

[2] All features favorable.

TABLE 9.—*Engineering*

[Tests performed by the College of Engineering, Rutgers University, in accordance with standard

Soil series and map symbol	Site number	Sampling site		Depth from surface	Sieve analysis				
		Latitude	Longitude		Percentage passing sieve—				
					¾ inch	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
				In.					
Bath gravelly loam: BfD—— Modal.	73	41°04′14″	74°42′23″	0–10	96	85	76	63	43
				10–24	99	91	82	70	46
				24–34	96	76	67	53	35
Bath gravelly loam: BfD—— Nonmodal, high sand content.	71	41°16′20″	74°39′00″	0–7	82	67	59	39	29
				7–25	76	66	58	49	34
				25–36	83	75	68	56	40
Fredon loam: FrA—— Nonmodal, low gravel content in substratum.	54	41°11′47″	74°37′33″	0–6	100	93	88	69	43
				6–20	100	98	93	74	46
				20–28	100	99	87	78	56
Halsey loam: Ha—— Nonmodal, high sand content.	60	41°03′55″	74°41′14″	0–12	100	99	97	83	34
				12–20	100	99	98	90	41
				20–30	99	97	96	85	38
				30–84	100	98	91	63	15
Hazen gravelly loam: HfA—— Nonmodal, high sand content.	58	41°01′55″	74°45′54″	0–16	97	83	76	59	36
				16–32	100	91	83	69	46
				32–44	95	65	52	34	14
Hazen gravelly sandy loam: HgE. Nonmodal, high gravel content.	6	41°06′34″	74°37′46″	0–8	87	68	57	38	19
				8–34	97	65	42	18	11
				34–40	93	48	28	10	6
Hazen gravelly sandy loam: HgE. Modal.	46	41°08′02″	74°42′42″	0–8	96	80	68	41	34
				8–20	98	81	72	55	37
				20–40	95	81	69	57	42
				40–52	96	80	63	28	13
Lackawanna gravelly fine sandy loam: (part of SxB). Nonmodal, low fine sand content; high gravel content.	30	41°18′28″	74°42′47″	0–12	81	65	61	52	33
				12–24	61	44	43	35	22
				24–34	98	85	69	60	42
Lackawanna gravelly fine sandy loam: (part of SxB). Modal.	28	41°20′23″	74°40′39″	0–12	94	86	83	68	34
				12–30	97	88	75	65	33
				30–54	87	72	57	46	25
Lyons silt loam: Ly—— Coarser than modal, high gravel content.	25	41°08′50″	74°36′45″	0–6	89	84	78	69	49
				6–24	78	72	67	59	47
				24–41	78	71	68	61	44
Rockaway gravelly loam: RoB. Nonmodal, high sand content in surface layer.	1	41°14′7″	74°30′09″	0–8	95	88	78	60	39
				8–20	93	85	80	66	44
				20–28	89	84	79	66	45
Rockaway gravelly loam: RoB. Nonmodal, high sand content in surface layer.	21	41°12′50″	74°33′00″	0–13	88	72	65	50	33
				13–35	87	80	73	57	38
				35–48	92	85	79	62	32
Washington loam: WhB—— Nonmodal, gravel and sand content high.	15	41°51′00″	74°51′00″	0–12	91	82	76	61	34
				12–36	79	72	69	60	39
				36–48	97	92	91	80	51
Washington loam: WhB—— Nonmodal, high gravel content.	22	41°12′45″	74°29′55″	0–10	92	84	77	65	43
				10–27	96	89	80	69	45
				27–48	93	87	82	66	44

See footnotes at end of table.

test data

procedures of the American Association of State Highway Officials (AASHO) (*2*). The symbol < means less than]

Hydrometer analysis		Liquid limit	Plasticity index	Moisture density [1]		Classification	
0.05–0.005 mm.	<0.005 mm.			Maximum dry density	Optimum moisture content	AASHO	Unified
Pct.	*Pct.*	*Pct.*		*Lb./cu. ft.*	*Pct.*		
		29	5			A-4(2)	SM-SC
		21	[2] NP	116	13	A-4(2)	SM
18	8	19	7	120	11	A-2-4(0)	SM-SC
		31	8			A-2-4(0)	SM-SC
		22	6	119	12	A-2-4(0)	GM-GC
		20	6	120	12	A-4(1)	SM-SC
		41	11			A-7-5(2)	SM
26	12	32	7			A-4(2)	SM-SC
20	32	24	9			A-4(4)	CL
		[3] NL	NP			A-2-4(0)	SM
		NL	NP			A-4(1)	SM
		NL	NP	116	13	A-4(1)	SM
		NL	NP			A-2-4(0)	SM
		31	8			A-4(0)	SM-SC
		22	5			A-4(2)	SM-SC
		19	2	123	11	A-1-b(0)	SM
		36	8			A-2-4(0)	SM
		28	5			A-1-a(0)	SM-SC
		NL	NP	126	11	A-1-a(0)	SM
		34	6			A-2-4(0)	SM
25	11	32	8	102	19	A-4(0)	SM-SC
23	17	24	6			A-4(1)	SM-SC
		21	4			A-1-b(0)	SM-SC
		48	9			A-2-5(0)	GM
		33	5			A-1-b(0)	GM
25	15	22	6			A-4(1)	SM-SC
		23	5			A-2-4(0)	SM-SC
		NL	NP			A-2-4(0)	SM
		16	2			A-1-b(0)	SM
		29	7			A-4(3)	SM-SC
		30	12	111	16	A-6(3)	GC
		28	10	111	16	A-4(2)	GC
		36	9			A-4(1)	SM
25	7	30	7	101	18	A-4(0)	SM
		23	6			A-4(2)	SM
		35	6			A-2-4(0)	SM
		23	3	117	13	A-4(1)	SM
		17	2	127	10	A-2-4(0)	SM
		26	5			A-24(0)	SM-SC
		25	3	114	13	A-4(1)	SM
		26	9	115	13	A-4(3)	CL
		26	5			A-4(2)	SM-SC
		18	3	120	11	A-4(2)	SM
		21	7	121	11	A-4(2)	SM-SC

TABLE 9.—*Engineering*

Soil series and map symbol	Site number	Sampling site		Depth from surface	Sieve analysis				
		Latitude	Longitude		Percentage passing sieve—				
					¾ inch	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
				In.					
Wassaic silt loam: WmC—— Modal.	39	41°01′00″	74°46′11″	0–14	96	91	88	79	64
				14–28	100	98	94	87	71
Wurtsboro gravelly loam: WtB. Nonmodal, high sand content.	74	41°16′55″	74°38′44″	0–6	90	80	67	57	39
				6–20	91	80	74	63	44
				20–34	85	71	57	48	34

[1] Based on AASHO Designation: T 99–49.
[2] NP means nonplastic.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for engineering structures.

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

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering purposes are the Unified system (*12*) used by the Soil Conservation Service engineers, the Department of Defense, and others, and the AASHO system adopted by the American Association of State Highway Officials (*2*).

In the Unified system soils are classified according to particle size distribution, plasticity, liquid limit, and content of organic matter. Soils are grouped in 15 classes. There are 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 are designated by symbols for both classes; for example, ML–CL.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is assigned to one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 9; the estimated classification, without group index numbers, is given in table 7 for all soils mapped in the survey area.

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

Estimated soil properties

Estimates of soil properties significant in engineering are shown in table 7. These estimates are made for typical soil profiles, by layers sufficiently different to differ significantly in suitability for soil engineering works. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 7.

Depth to bedrock is the distance from the surface of the soil to the upper surface of the rock layer.

Depth to seasonal high water is distance from the surface of the soil to the highest level that ground water or water over a fragipan reaches in the soil in most years.

Soil texture is described in table 7 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particules coarser than sand, an appropriate modi-

test data—Continued

Hydrometer analysis		Liquid limit	Plasticity index	Moisture density [1]		Classification	
0.05–0.005 mm.	<0.005 mm.			Maximum dry density	Optimum moisture content	AASHO	Unified
Pct.	*Pct.*	*Pct.*		*Lb./cu. ft.*	*Pct.*		
45	15	32	10			A–4(6)	ML–CL
40	28	36	15			A–6(9)	CL
		33	8			A–4(1)	SM–SC
		24	6	108	16	A–4(2)	SM–SC
		20	6	118	11	A–2–4(0)	SM–SC

[3] NL means nonliquid.

fier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used In USDA textural classification are defined in the Glossary of this soil survey. The textures shown in the USDA texture column are those of the representative profile described for the soil series. Ranges in texture are stated in the paragraph following the description of the representative profile for each soil series in the section "Descriptions of the Soils." The Unified and AASHO classifications reflect the ranges of texture, if any, that are defined in that paragraph.

Permeability is the quality that enables soil to transmit water or air. It is estimated on basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 7 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at wilting point of most crops.

Reaction is the degree of acidity or alkalinity of an untreated soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause damage to building foundations, roads, and other structures.

Engineering interpretations

The interpretations in table 8 are based on the engineering properties of soils shown in table 7, on test data for soils in this survey area and others in nearby or adjoining counties, and on the experience of engineers and soil scientists with the soils of Sussex County. In table 8, ratings summarize the limitation of the soils for all listed purposes other than for drainage, irrigation, ponds and reservoirs, embankments, terraces and diversions, grassed waterways, winter grading, and shallow excavations. For these particular uses, table 8 lists those soil features not to be overlooked in planning, installation, and maintenance.

Topsoil is used to topdress an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as in preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability. Also considered is damage that will result at an area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 8 provide guidance in where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick. The top of this layer is within a depth of 6 feet. The ratings do not take into account thickness of overburden, depth to the water table, or other factors that affect mining of the materials. Neither do they indicate quality of the deposit.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and adequately drained and the ease of excavating the material at borrow areas.

Soil properties that most affect highway and road location are load supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness

affect ease of excavation and amount of cut and fill needed to reach an even grade.

Pond reservoirs (fig. 8) hold water behind a dam or embankment. Soils suitable for pond reservoirs have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments and dikes require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compaction. Presence of stones and organic material in a soil are among the unfavorable factors.

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

Irrigation of a soil is affected by features such as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; need for drainage; and depth to water table or bedrock.

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

Waterway layout and construction are affected by such soil properties as texture, depth, and erodibility of the soil material; presence of stones or rock outcrops; and the steepness of slopes. Other factors affecting waterways are seepage, natural soil drainage, available water capacity, susceptibility to siltation, and the ease of establishing and maintaining vegetation.

Winter grading is affected chiefly by soil features that are relevant to moving, mixing, and compacting soil when temperatures are below freezing.

Shallow excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries are those that generally require digging or trenching to a depth of less than 6 feet. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding.

Test data

All engineering test data in this survey are from sampling and testing by the College of Engineering,

***Figure 8.*—Irrigation pond on Chippewa silt loam. The pond is stocked with large-mouthed bass.**

Rutgers University (*3*, *6*). Table 9 contains engineering test data for some of the major soils in Sussex County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

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

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material.

Town and Country Planning

This section is mainly for land planners, municipal officials, developers, and landowners or users who are responsible for the preparation or evaluation of land use plans or for community development. Table 10 lists a selection of trees, shrubs, and vines for use in landscaping homes, communities, and recreation areas. Table 11 defines limitations, by mapping unit, for specified use in community developments.

A rating of *slight* in table 11 means that soil properties are generally favorable for the rated use, or limitations are minor and easily overcome. A rating of *moderate* means that some soil properties are unfavorable but can be overcome by careful planning, design, and good management. A rating of *severe* indicates soil properties so unfavorable and so difficult to correct or overcome that soil reclamation, special designs, or intensive maintenance is required. Some properties are so unfavorable for a particular use that overcoming the limitations is most difficult and costly and is commonly not practical for the rated use.

Planning and zoning officials need to consider the merits of competing uses for soils. Those best for community developments are also among the best for farming. The capability of the soils for farm crops is designated at the end of the description of each mapping unit and is explained in the section "Capability grouping."

Following are some explanations of assumptions made for the ratings in table 11.

Ratings for *foundations* of dwellings three stories or less are based on the properties of an undisturbed soil.

Septic tank absorption fields are rated for residences on normal lot sizes, but not for public buildings or trailer parks. Requirements of the New Jersey Department of Health were followed. Where seasonal water tables are listed as limitations, ratings may be more severe than percolation tests indicate if tests are made in dry seasons.

Ratings for *sanitary landfill* are based on soil properties to a 5-foot depth. Onsite investigations are needed to determine soil and water conditions if depth is more than 5 feet. Ratings indicate where onsite investigation would be most profitable. Landfill ratings are based on the trench method. All soils that have a water table within 5 feet from the surface and soils that have a rapidly permeable substratum were rated severe because pollution to ground water is a hazard. Soils having small amounts of water perched over a fragipan were rated slight or moderate, depending on the amount of water.

It is assumed that *local roads and streets* will be paved. Slope, depth to bedrock, and the stone and boulder content are somewhat more critical for parking lots than for roads because more extensive grading is required.

Ratings for *lawns*, *landscaping*, *and golf fairways* are based on soil properties that affect plant production.

It is assumed that *athletic fields* are to be used year round. If only summer use is planned, a seasonal high water is not so severe a limitation as indicated. Intensive use and a grass turf are assumed.

It is assumed that *picnic and play areas* are to be used for about 7 months, April through October. No major land shaping is assumed in the ratings.

Campsites, *trailers*, *and tents* are rated on use for about 7 months, April through October. If all season camping is anticipated, a seasonal high water table is a more severe limitation than indicated. Areas where the water table is seasonally high should be avoided, if possible, in laying out access roads.

Formation and Classification of the Soils

This section describes the major factors of soil formation and explains some of the processes in soil formation. It also defines the current system of classification and classifies the soils of Sussex County according to that system.

Factors of Soil Formation

Soils form through the interaction of five major factors. They are climate, plant and animal life, parent material, topography, and time. The relative influence of each factor usually varies from place to place. Local variations in soils are due to differences in kind of parent material and in topography and drainage. In places, one factor may dominate in the formation of a soil and determine most of its properties.

Climate

The climate of Sussex County is characteristic of a humid continental type that is marked by extreme seasonal temperature changes. It has an annual precipitation of about 44 inches and a mean annual air temperature of about 49° F. Rainfall is uniform during the growing season of May through September; the average is about 21 inches. The cool temperature has promoted the accumulation of organic matter in the surface layer of the soils. For more detailed information on climate, see the climate section under General Nature of the County.

TABLE 10.—*Guide for landscape planting*

[The letter X indicates characteristics of the specified planting]

Deciduous trees

Common and botanical plant names	Suitable drainage	Shape of mature tree	Flower	Fruit	Nut or acorn	Shade	Ornamental	Autumn foliage	Growth rate	Potential height
										Ft.
Ash, white (Fraxinus americana)	Good to somewhat poor.	Round				X	X	X	Rapid	50+
Basswood (Tilia americana)	Good to somewhat poor.	Round				X			Rapid	50+
Beech (Fagus grandifolia)	Good to somewhat poor.	Round	X			X	X		Slow	50+
Birch:										
Paper (Betula papyrifera)	Good to somewhat poor.	Round		X			X	X	Rapid	50
Yellow (B. lutea)	Good to somewhat poor.	Round					X	X	Moderate	50+
Blackgum (Nyssa sylvatica)	Good to somewhat poor.	Oval				X	X	X	Slow	50+
Butternut (Juglans cinerea)	Good and moderately good.	Round		X		X	X		Rapid	50+
Catalpa (Catalpa speciosa)	Good to somewhat poor.	Round	X				X		Moderate	50+
Chestnut, Chinese (Castanea molissima).	Good and moderately good.	Round		X			X		Rapid	25–50
Crabapple, flowering (Malus spp.)	Good and moderately good.	Round	X				X	X	Moderate	15–25
Cucumbertree (Magnolia acuminata).	Good to somewhat poor.	Oval	X			X	X	X	Moderate	50+
Dogwood, flowering (Cornus florida).	Good to somewhat poor.	Round	X				X	X	Slow	25
Ginkgo (Ginkgo biloba)	Good and moderately good.	Oval				X	X	X	Moderate	50+
Hackberry (Celtis occidentalis)	Good and moderately good.	Oval	X			X	X		Moderate	25–50
Hawthorn (Crataegus spp.)	Good to somewhat poor.	Round	X				X			15
Hickory, shagbark (Carya ovata)	Good to somewhat poor.	Oval		X		X	X		Slow	50+
Horsechestnut (Aesculus hippocastanum).	Good and moderately good.	Round	X	X		X	X		Moderate	50
Locust:										
Black (Robinia psuedoacacia).	Good and moderately good.	Oval	X						Rapid	50+
Honey (Gleditsia triacanthos).	Good and moderately good.	Oval	X			X	X		Rapid	50+
Maple:										
Red (Acer rubrum)	Good to poor	Oval				X	X	X	Rapid	50+
Sugar (A. saccharum)	Good to somewhat poor.	Round				X	X	X	Moderate	50+
Mountainash:										
American (Sorbus americana)	Good to somewhat poor.	Oval	X				X		Rapid	25–50
European (S. aucuparia)	Good to somewhat poor.	Oval	X				X		Rapid	25
Mulberry, white (Morus alba)	Good to somewhat poor.	Round					X		Rapid	25–50
Oak:										
Pin (Quercus palustris)	Good to somewhat poor.	Pyramidal.			X	X	X	X	Moderate	50+
Red (Q. borealis)	Good to somewhat poor.	Round			X	X	X	X	Rapid	50+
White (Q. alba)	Good to moderately good.	Round			X	X			Slow	50+
Sassafras (Sassafras albidum)	Good and moderately good.	Oval	X			X	X	X	Moderate	25–50
Serviceberry or Juneberry (Amelanchier canadensis).	Good and moderately good.	Round	X					X	Moderate	25–50
Yellow-poplar (Liriodendron tulipifera).	Good to somewhat poor.	Oval	X			X		X	Rapid	50+
Walnut, black (Juglans nigra)	Good and moderately good.	Round		X					Rapid	50+
Willow, weeping (Salix babylonica).	Good to poor	Umbrella.				X	X		Rapid	25–50

TABLE 10.—*Guide for landscape planting*—Continued

Evergreen trees

Common and botanical plant names	Suitable drainage	Shade tolerant	Shade	Ornamental	Windbreak	Screen	Critical area	Growth rate	Potential height
									Ft.
Aborvitae:									
American or northern white-cedar (Thuja occidentalis).	Good to somewhat poor.	No		X	X	X		Slow	50+
Oriental (T. orientalis)	Good to somewhat poor.	No		X	X	X		Slow	50+
Hemlock, eastern (Tsuga canadensis).	Good and moderately good.	Yes		X	X	X		Moderate	50+
Larch:									
European (Larix decidua)	Good and moderately good.	No	X					Rapid	50+
Japanese (L. leptolepis)	Good and moderately good.	No	X				X	Rapid	50+
Pine:									
Austrian (Pinus nigra)	Good and moderately good.	No		X	X	X		Rapid	50+
White (P. strobus)	Good to poor	Yes			X	X		Rapid	50+
Spruce:									
Norway (Picea abies)	Good to somewhat poor.	Yes		X	X	X		Moderate	50+
White (P. glauca)	Good to somewhat poor.	Yes			X	X		Moderate	50+

Evergreen shrubs

Common and botanical plant names	Suitable drainage	Ornamental	Autumn foliage	Screen	Windbreak	Critical area	Potential height
Azalea (Rhododendron supp.)	Good to poor	X					5–10
Laurel, mountain (Kalmia latifolia).	Good to somewhat poor.	X					5–15
Pine, mugo (Pinus mugo)	Good to somewhat poor.	X					10
Rhododendron (Rhododendron maximum).	Good to somewhat poor.	X		X			10–15
Yew, Japanese (Taxus cuspidata)	Good to somewhat poor.	X		X	X		[1]

Deciduous shrubs

Arrowwood (Viburnum dentatum).	Good to poor	X	X	X			10–15
Autumn-olive, cardinal (Elaeagnus umbellata).	Good and moderately good.	X		X	X	X	10–15
Azalea:							
Flame (Rhododendron calendulaceum).	Good	X					10–15
Wild honeysuckle (R. nudiflorum).	Good	X					5–10
Bayberry (Myrica caroliniensis)	Good and moderately good.	X					6–10
Blackhaw (Viburnum prunifolium).	Good to somewhat poor.					X	15–20
Coralberry (Symphoricarpos orbiculatus).	Good to somewhat poor.					X	2–6
Cranberry, highbush (Viburnum trilobum).	Good to somewhat poor.	X					10–15
Dogwood:							
Red-osier (Cornus stolonifera).	Good to poor	X	X	X			10
Silky (C. amomum)	Good to poor	X	X				10
Firethorn, Laland (Pyracantha coccinea lalandi).	Good to moderately good.						10–20
Forsythia (Forsythis spp.)	Good and moderately good.	X		X		X	10–15
Honeysuckle: Amur (Lonicera maacki).	Good and moderately good.	X		X		X	10–15
Tatarian (L. tatarica)	Good and moderately good.	X		X		X	10–15
Privet, Amur (Ligustrum amurense).	Good and moderately good.	X		X	X	X	15–20
Winterberry (Ilex verticillata)	Good to poor	X					10

[1] Variable.

TABLE 11.—*Soil limitations to be considered*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundations for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Albia:					
AlB	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet.	Moderate: seasonal high water table perched at depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; slow permeability in fragipan.	Severe: seasonal high water table at depth of ½ foot to 1½ feet.	Moderate: seasonal high water table perched at depth of ½ foot to 1½ feet.
AlC	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet.	Moderate: seasonal high water table perched at depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; slow permeability in fragipan.	Severe: seasonal high water table at depth of ½ foot to 1½ feet; strong slopes.	Moderate: seasonal high water table perched at depth of ½ foot to 1½ feet.
AmB	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; high stone content.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; high stone content.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; slow permeability in fragipan; high stone content.	Severe: seasonal high water table at depth of ½ foot to 1½ feet; excessive stones on surface.	Severe: excessive stones on surface.
Alluvial land, wet:					
Ar	Severe: frequent flooding; seasonal high water table at surface.	Severe: frequent flooding; seasonal high water table at surface.	Severe: frequent flooding; seasonal high water table at surface.	Severe: frequent flooding; seasonal high water table at surface.	Severe: frequent flooding: seasonal high water table at surface.
Atherton loam:					
At	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.
Bath:					
BaB	Slight: rippable bedrock at 4 feet or more.	Slight	Moderate: slow permeability in fragipan; deep ditches needed.	Moderate: depth to bedrock; gentle slopes.	Moderate: depth to bedrock.
BaC	Moderate: strong slopes; lateral seepage over fragipan in places.	Moderate: strong slopes.	Moderate: slow permeability in fragipan; special design needed.	Severe: strong slopes.	Moderate: depth to bedrock.
BfD	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: depth to bedrock is 4 feet or more.
BfE	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.

in town and country planning

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

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; high frost-action potential.	Moderate: seasonal high water table perched at depth of ½ foot to 1½ feet.	Severe: gravel content excessive; seasonal high water table.	Moderate: water table within depth of 20 inches for short periods during season of use.	Severe: water table within depth of 20 inches during season of use.	Moderate: water table within depth of 20 inches for short periods.
Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; high frost-action potential; strong slopes.	Moderate: seasonal high water table perched at depth of ½ foot to 1½ feet.	Severe: gravel content excessive; seasonal high water table.	Moderate: water table within 20 inches of surface for short periods during season of use.	Severe: water table within depth of 20 inches during season for use.	Moderate: water table within depth of 20 inches for short periods.
Severe: stone content excessive; high frost-action potential.	Severe: stone content excessive.	Severe: gravel content excessive; seasonal high water table; stone content excessive.	Severe: stone content excessive.	Severe: stone content excessive.	Severe: stone content excessive.
Severe: frequent flooding; seasonal high water table at surface; frost action potential high.	Severe: frequent flooding; seasonal high water table at surface.	Severe: frequent flooding; seasonal high water table at surface.	Severe: frequent flooding; water table above 20 inches for a month or more during picnic season.	Severe: frequent flooding; seasonal high water table at surface.	Severe: frequent flooding; water table above 20 inches for a month or more during season of use.
Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.
Slight	Slight	Moderate: slow permeability in fragipan; gentle slopes.	Slight	Slight	Slight.
Moderate: strong slopes.	Moderate: strong slopes.	Severe: strong slopes.	Moderate: strong slopes.	Moderate: strong slopes.	Slight.
Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Moderate: steep slopes; stone content moderately high.
Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundations for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Bath—Continued					
BgB	Moderate: stone content moderately high.	Moderate: stone content moderately high.	Moderate: slow permeability in fragipan; stone content moderately high; special design needed.	Moderate: depth to bedrock; gentle slopes.	Moderate: depth to bedrock; stone content moderately high.
BgD	Moderate if slopes are 8 to 15 percent; stone content moderately high. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent; stone content moderately high. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent; stone content moderately high. Severe if slopes are 15 to 25 percent.	Severe: strong and steep slopes.	Moderate: depth to bedrock; stone content moderately high; slopes of 15 to 25 percent.
BgE	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.
Braceville: BrA, BrB	Moderate: seasonal high water table at depth of 1½ to 3 feet.	Slight: seasonal high water table at depth of 1½ to 3 feet.	Moderate: seasonal high water table at depth of 1½ to 3 feet.	Severe: seasonal high water table at depth of 1½ to 3 feet.	Severe: seasonal high water table at depth of 1½ to 3 feet.
Carlisle: Ca	Severe: seasonal high water table at surface; frequent flooding; low bearing strength; severe subsidence.	Severe: seasonal high water table at surface; frequent flooding; low bearing strength; severe subsidence.	Severe: seasonal high water table at surface; frequent flooding.	Severe: seasonal high water table at surface; frequent flooding.	Severe: seasonal high water table at surface; frequent flooding.
Chenango: ChB	Slight	Slight	Slight: rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum.	Severe: rapid permeability in substratum; ground water pollution hazard.
ChD	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent; rapid permeability in substratum; ground water pollution hazard. Severe if slopes are 15 to 25 percent.	Severe: rapid permeability in substratum; slopes more than 8 percent.	Severe: rapid permeability in substratum; ground water pollution hazard.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Slight	Severe: stone content excessive.	Severe: stone content excessive.	Moderate: stone content moderately high.	Severe: stone content excessive.	Moderate: stone content moderately high.
Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Severe: stone content excessive.	Severe: stone content excessive.	Moderate: stone content moderately high; slopes of 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Severe: stone content excessive.	Moderate: stone content moderately high.
Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.
Moderate: seasonal high water table at depth of 1½ to 3 feet; moderate frost-action potential.	Moderate: seasonal high water table at depth of 1½ to 3 feet.	Severe: seasonal high water table at a depth of 1½ to 3 feet.	Slight	Slight	Slight.
Severe: seasonal high water table at surface; frequent flooding.	Severe: seasonal high water table at surface; frequent flooding.	Severe: seasonal high water table at surface; frequent flooding.	Severe: water table within 20 inches of surface for a month or more during season of use.	Severe: frequent flooding; water table within 20 inches of surface during season of use.	Severe: frequent flooding; seasonal high water table at surface; soil material high in organic matter.
Slight	Slight	Moderate: moderate gravel content.	Slight	Slight	Slight.
Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate: slopes of 8 to 15 percent. Severe: slopes of 15 to 25 percent.	Severe: strong and steep slopes.	Moderate: slopes of 8 to 15 percent. Severe: slopes of 15 to 25 percent.	Moderate: slopes of 8 to 15 percent. Severe: slopes of 15 to 25 percent.	Slight: slopes of 8 to 15 percent. Moderate: slopes of 15 to 25 percent.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundations for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Chenango—Continued					
CIC	Slight if slopes are 3 to 8 percent. Moderate if slopes are 8 to 15 percent.	Slight if slopes are 3 to 8 percent. Moderate if slopes are 8 to 15 percent.	Slight: rapid permeability in substratum; ground water pollution hazard; slopes of 3 to 8 percent. Moderate: slopes of 8 to 15 percent; rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum; slopes of 8 to 15 percent.	Severe: rapid permeability in substratum; ground water pollution hazard.
CID	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes; rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum; steep slopes.	Severe: rapid permeability in substratum; ground water pollution hazard.
Chippewa: CmB	Severe: seasonal high water table perched at depth of 0 to ½ foot.	Severe: seasonal high water table perched at depth of 0 to ½ foot.	Severe: seasonal high water table perched at depth of 0 to ½ foot; slow permeability in fragipan; extremely stony.	Severe: seasonal high water table perched at depth of 0 to ½ foot.	Severe: seasonal high water table perched at depth of 0 to ½ foot.
CnB	Severe: seasonal high water table perched at depth of 0 to ½ foot.	Severe: seasonal high water table perched at depth of 0 to ½ foot.	Severe: seasonal high water table perched at depth of 0 to ½ foot; slow permeability in fragipan.	Severe: seasonal high water table perched at depth of 0 to ½ foot.	Severe: seasonal high water table perched at depth of 0 to ½ foot.
Colonie:					
CoB	Slight	Slight	Slight: rapid permeability in subsoil and substratum; ground water pollution hazard.	Severe: rapid permeability in subsoil and substratum.	Severe: rapid permeability in subsoil and substratum; ground water pollution hazard.
CoC	Moderate: strong slopes.	Moderate: strong slopes.	Moderate: strong slopes; special design needed; ground water pollution hazard.	Severe: rapid permeability in subsoil and substratum; ground water pollution hazard.	Severe: rapid permeability in subsoil and substratum; ground water pollution hazard.
Fredon: FrA, FrB	Severe: seasonal high water table at depth of 0 to 1 foot.	Severe: seasonal high water table at depth of 0 to 1 foot.	Severe: seasonal high water table at depth of 0 to 1 foot.	Severe: seasonal high water table at depth of 0 to 1 foot.	Severe: seasonal high water table at depth of 0 to 1 foot.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Slight if slopes are 3 to 8 percent. Moderate if slopes are 8 to 15 percent.	Moderate: cobblestone content moderately high; slopes of 8 to 15 percent.	Severe: cobblestone content excessive; slopes of 8 to 15 percent.	Moderate: cobblestone content moderately high.	Moderate: cobblestone content moderately high.	Moderate: cobblestone content moderately high.
Severe: steep slopes.	Severe: steep slopes.	Severe: cobblestone content; steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Moderate: cobblestone content moderately high. Severe for very steep slopes.
Severe: seasonal high water table perched at depth of 0 to ½ foot; high frost-action potential.	Severe: seasonal high water table perched at depth of 0 to ½ foot; stone content excessive.	Severe: seasonal high water table perched at depth of 0 to ½ foot; stone content excessive.	Severe: water table within 20 inches of surface during season of use; stone content excessive.	Severe: water table within 20 inches of surface during season of use; stone content excessive.	Severe: seasonal high water table perched at depth of 0 to ½ foot; stone content excessive.
Severe: seasonal high water table perched at depth of 0 to ½ foot; high frost-action potential.	Severe: seasonal high water table perched at depth of 0 to ½ foot.	Severe: seasonal high water table perched at depth of 0 to ½ foot.	Severe: water table within 20 inches of surface during season of use.	Severe: water table within 20 inches of surface during season of use.	Severe: seasonal high water table perched at depth of 0 to ½ foot.
Moderate: moderate frost-action potential.	Severe: surface texture coarse; low available water capacity.	Moderate: gentle slopes; surface texture coarse; dusty when dry; fair trafficability.	Moderate: fair trafficability; dusty when dry.	Moderate: fair trafficability; dusty when dry.	Moderate: fair trafficability; dusty when dry.
Moderate: moderate frost-action potential; strong slopes.	Severe: surface texture coarse; low available water capacity; strong slopes.	Severe: strong slopes.	Moderate: fair trafficability; dusty when dry.	Moderate: fair trafficability; dusty when dry.	Moderate: fair trafficability; dusty when dry.
Severe: seasonal high water table at depth of 0 to 1 foot.	Severe: seasonal high water table at depth of 0 to 1 foot.	Severe: seasonal high water table at depth of 0 to 1 foot.	Severe: water table within 20 inches of surface during season of use.	Severe: water table within 20 inches of surface during season of use.	Severe: seasonal high water table at depth of 0 to 1 foot.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundations for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Halsey: Ha	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.
*Hazen: HfA, HfB	Slight	Slight	Slight: rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum; ground water pollution hazard.
HfD	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate: slopes of 8 to 15 percent; rapid permeability in substratum; ground water pollution hazard. Severe: slopes of 15 to 25 percent; rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum; ground water pollution hazard.
HgE For Palmyra part, see Palmyra series.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.
Hero: HkA, HkB	Moderate: seasonal high water table at depth of 1½ to 3 feet.	Slight: seasonal high water table at depth of 1½ to 3 feet.	Moderate: seasonal high water table at depth of 1½ to 3 feet.	Severe: seasonal high water table at depth of 1½ to 3 feet.	Severe: seasonal high water table at depth of 1½ to 3 feet.
Hibernia: HmB	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet.	Moderate: seasonal high water table perched at depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; slow permeability in fragipan.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet.
HnB	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet.	Moderate: seasonal high water table perched at depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; slow permeability in fragipan.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: water table within 20 inches of surface during season of use.	Severe: water table within 20 inches of surface during season of use.	Severe: seasonal high water table at surface.
Slight	Slight	Moderate: moderate gravel content.	Slight	Slight	Slight.
Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate: slopes of 8 to 15 percent. Severe: slopes of 15 to 25 percent.	Severe: gravel content excessive; strong and steep slopes.	Moderate: slopes of 8 to 15 percent. Severe: slopes of 15 to 25 percent.	Moderate: slopes of 8 to 15 percent. Severe: slopes of 15 to 25 percent.	Moderate: slopes of 15 to 25 percent.
Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.
Moderate: seasonal high water table at depth of 1½ to 3 feet; moderate frost-action potential.	Slight	Moderate: gravel content moderate; seasonal high water table at depth of 1½ to 3 feet.	Slight	Slight	Slight.
Severe: seasonal high water table perched at depth of ½ foot to 1½ feet.	Moderate: seasonal high water table perched at depth of ½ foot to 1½ feet.	Severe: seasonal high water table at depth of ½ to 1½ feet.	Moderate: water table within 20 inches of surface for short periods during season of use.	Severe: water table within 20 inches of surface during season of use.	Moderate: water table within 20 inches of surface during season of use.
Severe: seasonal high water table perched at depth of ½ foot to 1½ feet.	Severe: stone content excessive.	Severe: stone content excessive.	Moderate: water table within 20 inches of surface; for short periods during season of use; stone content moderately high.	Severe: stone content excessive.	Moderate: water table within 20 inches of surface during season of use; stony content moderately high.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundation for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Hibernia—Continued					
HnD	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; slopes of 15 to 25 percent.	Moderate: seasonal high water table perched at depth of ½ foot; to 1½ feet; stone content moderately high. Severe: slopes of 15 to 25 percent.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; slow permeability in fragipan; slopes of 15 to 25 percent.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; strong and steep slopes.	Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; slopes of 15 to 25 percent.
Hoosic:					
HoB	Slight	Slight	Slight: rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum.	Severe: rapid permeability in substratum; ground water pollution hazard.
HoD	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate: slopes of 8 to 15 percent; rapid permeability in substratum; ground water pollution hazard. Severe: slopes of 15 to 25 percent; rapid permeability in substratum; ground water pollution hazard.	Severe: strong and steep slopes; rapid permeability in substratum; ground water hazard.	Severe: rapid permeability in substratum; ground water pollution hazard.
Lackawanna:					
Mapped only with Swartswood soils. Part of SxB	Moderate: stone content moderately high; bedrock at a depth of more than 3½ feet.	Moderate: stone content moderately high.	Moderate: stone content moderately high; bedrock at a depth of more than 3½ feet.	Moderate: bedrock at a depth of more than 3½ feet; gentle slopes.	Severe: bedrock at a depth of 3½ feet.
Part of SxD	Moderate: stone content moderately high; bedrock at a depth of more than 3½ feet; slopes of 8 to 15 percent. Severe: slopes of 15 to 25 percent.	Moderate: stone content moderately high. Severe: very steep slopes.	Moderate: slopes of 8 to 15 percent; bedrock at a depth of more than 3½ feet. Severe: slopes of 15 to 25 percent.	Severe: strong and steep slopes.	Severe: bedrock at depth of 3½ feet; slopes of 15 to 25 percent.
Part of SxE	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.
Livingston: Lv	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Severe: seasonal high water table perched at depth of ½ foot to 1½ feet; slopes of 15 to 25 percent.	Severe: stone content excessive; slopes of 15 to 25 percent.	Severe: stone content excessive; strong and steep slopes.	Moderate: water table within 20 inches of surface for short periods during season of use; stone content moderately high; slopes of 8 to 15 percent. Severe: slopes of 15 to 25 percent.	Severe: stone content excessive; slopes of 15 to 25 percent.	Moderate: water table within 20 inches of surface during season of use; stone content moderately high; slopes of 15 to 25 percent.
Slight	Slight	Moderate: moderate gravel content; gentle slopes.	Slight	Slight	Slight.
Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Severe: strong and steep slopes.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 15 to 25 percent.
Slight	Severe: stone content excessive.	Severe: stone content excessive.	Moderate: stone content moderately high.	Severe: stone content excessive.	Moderate: stone content moderately high.
Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Severe: stone content excessive.	Severe: stone content excessive.	Moderate: stone content moderately high. Severe: slopes of 15 to 25 percent.	Severe: stone content excessive.	Moderate: stone content moderately high.
Severe: very steep slopes. Severe: seasonal high water table at surface.	Severe: very steep slopes. Severe: seasonal high water table at surface.	Severe: very steep slopes. Severe: seasonal high water table at surface.	Severe: very steep slopes. Severe: water table within 20 inches of surface during season of use.	Severe: very steep slopes. Severe: water table within 20 inches of surface during season of use.	Severe: very steep slopes. Severe: seasonal high water table at surface.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundation for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Lyons: Ly	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.
Lz	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.
Made land, sanitary land fill: Ma. Material too variable. Onsite investigation required.					
Middlebury: Md	Severe: occasional flood hazard; seasonal high water table at depth of 1 foot to 2½ feet.	Severe: occasional flood hazard; seasonal high water table at depth of 1 foot to 2½ feet.	Severe: occasional flood hazard; seasonal high water table at depth of 1 foot to 2½ feet.	Severe: occasional flood hazard; seasonal high water table at depth of 1 foot to 2½ feet.	Severe: occasional flood hazard; seasonal high water table at depth of 1 foot to 2½ feet.
Nassau: NaB, NaC	Severe: shale bedrock at depth of 1 foot to 1½ feet.	Moderate: shale bedrock at depth of 1 foot to 1½ feet.	Severe: pervious shale bedrock at depth of 1 foot to 1½ feet; limited filter material.	Severe: shale bedrock at depth of 1 foot to 1½ feet; NaC strong slopes.	Severe: shale bedrock at depth of 1 foot to 1½ feet.
NfD For Rock outcrop part of NfD, see Rock outcrop.	Severe: shale bedrock at depth of 1 foot to 1½ feet; steep slopes.	Severe: shale bedrock at depth of 1 foot to 1½ feet; steep slopes.	Severe: pervious shale bedrock at depth of 1 foot to 1½ feet; limited filter material; steep slopes.	Severe: shale bedrock at depth of 1 foot to 1½ feet; steep slopes.	Severe: shale bedrock at depth of 1 foot to 1½ feet.
NfE For Rock outcrop part of NfE, see Rock outcrop.	Severe: shale bedrock at depth of 1 foot to 1½ feet; very steep slopes.	Severe: shale bedrock at depth of 1 foot to 1½ feet; very steep slopes.	Severe: pervious shale bedrock at depth of 1 foot to 1½ feet; very steep slopes.	Severe: shale bedrock at depth of 1 foot to 1½ feet; very steep slopes.	Severe: shale bedrock at depth of 1 foot to 1½ feet; very steep slopes.
Ng For Rock outcrop part of Ng, see Rock outcrop.	Severe: shale bedrock at depth of 1 foot to 1½ feet; extremely stony.	Severe: shale bedrock at depth of 1 foot to 1½ feet; extremely stony.	Severe: pervious shale bedrock at depth of 1 foot to 1½ feet; limited material; extremely stony.	Severe: shale bedrock at depth of 1 foot to 1½ feet; strong to steep slopes.	Severe: shale bedrock at depth of 1 foot to 1½ feet; extremely stony.
Norwich: NhA, NoA	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Severe: seasonal high water table at surface; high frost-action potential.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: water table within 20 inches of surface during season of use.	Severe: water table within 20 inches of surface during season of use.	Severe: seasonal high water table at surface.
Severe: seasonal high water table at surface; high frost-action potential.	Severe: seasonal high water table at surface; stone content excessive.	Severe: seasonal high water table at surface; stone content excessive.	Severe: water table within 20 inches. of surface during season of use.	Severe: water table within 20 inches. of surface during season of use.	Severe: seasonal high water table at surface.
Severe: occasional flood hazard; seasonal high water table at depth of 1 foot to 2½ feet.	Severe: occasional flood hazard; seasonal high water table at depth of 1 foot to 2½ feet.	Severe: occasional flood hazard; seasonal high water table at depth of 1 foot to 2½ feet.	Moderate: occasional flooding during season of use.	Moderate: occasional flooding during season of use.	Moderate: occasional flooding during season of use.
Severe: shale bedrock at depth of 1 foot to 1½ feet.	Severe: shale bedrock at depth of 1 foot to 1½ feet.	Severe: shale bedrock at depth of 1 foot to 1½ feet.	Moderate: shale content moderately high.	Moderate: shale content moderately high, strong slopes in NaC.	Moderate: shale content moderately high.
Severe: shale bedrock at depth of 1 foot to 1½ feet.	Severe: shale bedrock at depth of 1 foot to 1½ feet.	Severe: shale bedrock at depth of 1 foot to 1½ feet.	Severe: steep slopes.	Severe: steep slopes.	Moderate: shale content moderately high; steep slopes.
Severe: shale bedrock at depth of 1 foot to 1½ feet; very steep slopes.	Severe: shale bedrock at depth of 1 foot to 1½ feet; very steep slopes.	Severe: shale bedrock at depth of 1 foot to 1½ feet; very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.
Severe: shale bedrock at depth of 1 foot to 1½ feet.	Severe: shale bedrock at depth of 1 foot to 1½ feet; extremely stony.	Severe: shale bedrock at depth of 1 foot to 1½ feet; extremely stony.	Severe: extremely stony, steep slopes in places.	Severe: extremely stony, steep slopes in places.	Severe: extremely stony.
Severe: seasonal high water table at surface; high frost-action potential.	Severe: seasonal high water table at surface; NoA excessively stony.	Severe: seasonal high water table at surface; NoA excessively stony.	Severe: water table within 20 inches of surface during season of use.	Severe: water table within 20 inches of surface during season of use.	Severe: seasonal high water table at surface.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundation for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Oquaga:					
OmB	Severe: bedrock at depth of 2 to 3½ feet; stone content excessive.	Severe: stone content excessive.	Severe: bedrock at depth of 2 to 3½ feet; stone content excessive.	Severe: bedrock at depth of 2 to 3½ feet.	Severe: bedrock at depth of 2 to 3½ feet; ground water pollution hazard.
OmD	Severe: bedrock at depth of 2 to 3½ feet; stone content excessive; slopes of 15 to 25 percent.	Severe: stone content excessive; slopes of 15 to 25 percent.	Severe: bedrock at depth of 2 to 3½ feet; stone content excessive; slopes of 15 to 25 percent.	Severe: bedrock at depth of 2 to 3½ feet; strong and steep slopes.	Severe: bedrock at depth of 2 to 3½ feet; ground water pollution hazard.
OrD For Rock outcrop part of OrD, see Rock outcrop.	Severe: bedrock at depth of 2 to 3½ feet; steep slopes.	Severe: steep slopes.	Severe: bedrock at depth of 2 to 3½ feet; steep slopes.	Severe: bedrock at depth of 2 to 3½ feet; steep slopes.	Severe: bedrock at depth of 2 to 3½ feet; ground water pollution hazard.
Otisville:					
OtC	Slight if slopes are 3 to 8 percent. Moderate if slopes are 8 to 15 percent.	Slight if slopes are 3 to 8 percent. Moderate if slopes are 8 to 15 percent.	Slight: rapid permeability in subsoil; ground water pollution hazard. Moderate if slopes are 8 to 15 percent.	Severe: rapid permeability in subsoil; ground water pollution hazard; slopes of 8 to 15 percent.	Severe: rapid permeability in subsoil; ground water pollution hazard.
OtD	Severe: steep or very steep slopes.	Severe: steep or very steep slopes.	Severe: steep or very steep slopes; rapid permeability in subsoil; ground water pollution hazard.	Severe: rapid permeability in subsoil; ground water pollution hazard; steep or very steep slopes.	Severe: rapid permeability in subsoil; ground water pollution hazard.
Palmyra:					
PaA, PaB	Slight	Slight	Slight: rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum; ground water pollution hazard.
PaD	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent; rapid permeability in substratum; ground water pollution hazard. Severe if slopes are 15 to 25 percent; rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum; ground water pollution hazard; 8 to 25 percent slopes.	Severe: rapid permeability in substratum; ground water pollution hazard.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Moderate: bedrock at depth of 2 to 3½ feet; stone content moderately high.	Severe: stone content excessive; bedrock at depth of 2 to 3½ feet.	Severe: stone content excessive.	Severe: stone content excessive.	Severe: stone content excessive.	Severe: stone content excessive.
Moderate: bedrock at depth of 2 to 3½ feet; stone content moderately high. Severe: slopes of 15 to 25 percent.	Severe: stone content excessive; bedrock at depth of 2 to 3½ feet; slopes of 15 to 25 percent.	Severe: stone content excessive; strong and steep slopes.	Severe: stone content excessive; slopes of 15 to 25 percent.	Severe: stone content excessive; slopes of 15 to 25 percent.	Severe: stone content excessive.
Severe: steep slopes.	Severe: stone content excessive; steep slopes.	Severe: stone content excessive; steep slopes.	Severe: steep slopes.	Severe: stone content excessive; steep slopes.	Moderate: steep slopes; stone content moderately high.
Slight if slopes are 3 to 8 percent. Moderate if slopes are 8 to 15 percent.	Severe: surface texture coarse; low available water capacity; difficult to vegetate.	Severe: surface texture coarse; poor trafficability; difficult to vegetate.	Moderate: surface texture coarse; gravel content moderate.	Moderate: gravel content moderate; surface texture coarse.	Moderate: surface texture coarse; gravel content moderate.
Severe: steep or very steep slopes.	Severe: surface texture coarse; low available water capacity; difficult to vegetate; steep or very steep slopes.	Severe: surface texture coarse; poor trafficability; difficult to vegetate; steep or very steep slopes.	Severe: steep or very steep slopes.	Severe: steep or very steep slopes.	Moderate: surface texture coarse; gravel content moderate.
Slight	Slight	Moderate: moderate gravel content.	Slight	Slight	Slight.
Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Severe if slopes are 8 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Slight if slopes are 8 to 15 percent. Moderate if slopes are 15 to 25 percent.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundation for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Pits, sand and gravel: Pt. Material too variable. Onsite investigation required.					
Pompton: PvA	Severe: seasonal high water table at depth of 1 foot to 2 feet.	Moderate: seasonal high water table at depth of 1 foot to 2 feet.	Severe: seasonal high water table at depth of 1 foot to 2 feet.	Severe: seasonal high water table at depth of 1 foot to 2 feet.	Severe: seasonal high water table at depth of 1 foot to 2 feet.
Preakness: Pw	Severe: seasonal high water table at surface; subject to occasional stream overflow.	Severe: seasonal high water table at surface; subject to occasional stream overflow.	Severe: seasonal high water table at surface; subject to occasional stream overflow.	Severe: seasonal high water table at surface; subject to occasional stream overflow.	Severe: seasonal high water table at surface; subject to occasional stream overflow.
Raynham: RaB	Severe: seasonal high water table within a depth of 1½ feet.	Severe: seasonal high water table within a depth of 1½ feet.	Severe: seasonal high water table within a depth of 1½ feet; moderate to moderately slow permeability in subsoil.	Severe: seasonal high water table within a depth of 1½ feet.	Severe: seasonal high water table within a depth of 1½ feet.
Riverhead: RhB	Slight	Slight	Slight: rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum; ground water pollution hazard.	Severe: rapid permeability in substratum; ground water pollution hazard.
RhC	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate: rapid permeability in substratum; slopes of 8 to 15 percent; ground water pollution hazard. Severe: slopes of 15 to 25 percent.	Severe: rapid permeability in substratum; strong and steep slopes.	Severe: rapid permeability in substratum; ground water pollution hazard.
Rockaway: RoB	Slight: seasonal water table perched over fragipan for short periods.	Slight	Moderate: deep ditches may be needed; lateral seepage over fragipan in places.	Moderate: gentle slopes.	Severe: bedrock at depth of 4 feet or more.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Severe: seasonal high water table at depth of 1 foot to 2 feet.	Moderate: seasonal high water table at depth of 1 foot to 2 feet.	Severe: seasonal high water table at depth of 1 foot to 2 feet.	Moderate water table within 20 inches of surface for short periods during season of use.	Moderate: water table within 20 inches of surface for short periods during season of use.	Moderate: seasonal high water table at depth of 1 foot to 2 feet.
Severe: seasonal high water table at surface; subject to occasional stream overflow; high frost-action potential.	Severe: seasonal high water table at surface; subject to occasional stream overflow.	Severe: seasonal high water table at surface; subject to occasional stream overflow.	Severe: water table within 20 inches of surface for month or more during season of use.	Severe: water table within 20 inches of surface for month or more during season of use.	Severe: seasonal high water table at surface.
Severe: seasonal high water table within a depth of 1½ feet; high frost-action potential.	Severe: seasonal high water table within a depth of 1½ feet.	Severe: seasonal high water table within a depth of 1½ feet.	Severe: water table within 20 inches of surface during season of use.	Severe: water table within 20 inches of surface during season of use.	Severe: seasonal high water table within a depth of 1½ feet.
Slight	Slight	Moderate: gentle slopes.	Slight	Slight	Slight.
Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Severe: strong and steep slopes.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Slight if slopes are 8 to 15 percent. Moderate if slopes are 15 to 25 percent.
Moderate: in places seasonal water table perched over fragipan; moderate frost-action potential.	Slight	Moderate: gravel content moderate; gentle slopes.	Slight	Slight	Slight.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundation for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Rockaway—Continued					
RoC	Moderate: strong slopes; seasonal water table perched over fragipan; lateral seepage.	Moderate: strong slopes.	Moderate: deep ditches may be needed; lateral seepage over fragipan in places; strong slopes may require special design and careful installation.	Severe: strong slopes.	Severe: bedrock at depth of 4 feet.
RoD	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.
RpD	Moderate: seasonal water table perched over fragipan may seep laterally; stone content moderately high; slopes of 5 to 15 percent. Severe: slopes of 15 to 25 percent.	Moderate: slopes of 5 to 15 percent; stone content moderately high. Severe: slopes of 15 to 25 percent.	Moderate: deep ditches may be needed; lateral seepage over fragipan; slopes of 5 to 15 percent; stone content moderately high. Severe: slopes of 15 to 25 percent.	Severe: strong and steep slopes.	Severe: bedrock at depth of 4 feet; slopes of 15 to 25 percent.
RpE	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.
RrD For Rock outcrop part of RrD, see Rock outcrop.	Severe: steep slopes; stony.	Severe: steep slopes; stony.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.
Rock outcrop: RsF, RtE, RvE. Severe limitations for all uses.					
Sloan: Sm For Wayland part of Sm, see Wayland series.	Severe: frequent flood hazard; seasonal high water table at surface.	Severe: frequent flood hazard; seasonal high water table at surface.	Severe: frequent flood hazard; seasonal high water table at surface.	Severe: frequent flood hazard; seasonal high water table at surface.	Severe: frequent flood hazard; seasonal high water table at surface.
Swamp: Sp. Material too variable. On-site investigation required.					
Swartswood:					
SwB	Slight	Slight	Moderate: moderately slow permeability in subsoil; bedrock at depth of 4 feet or more; special design for deep ditches needed.	Moderate: gentle slopes; gravel content moderately high.	Severe: bedrock at depth of 4 feet or more.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Moderate: in places seasonal water table perched over fragipan; moderate frost-action potential; strong slopes.	Moderate: strong slopes.	Severe: strong slopes.	Moderate: strong slopes.	Moderate: strong slopes.	Slight.
Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Moderate: steep slopes.
Moderate: seasonal water table perched over fragipan; moderate frost-action potential; slopes of 5 to 15 percent.	Severe: stone content excessive; slopes of 15 to 25 percent.	Severe: stone content excessive; strong and steep slopes.	Moderate: stone content moderately high; slopes of 5 to 15 percent.	Severe: stone content excessive; slopes of 15 to 25 percent.	Moderate: stone content moderately high.
Severe: slopes of 15 to 25 percent.					
Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.
Severe: steep slopes.	Severe: steep slopes; stony.	Severe: steep slopes; excessively stony.	Severe: steep slopes; stony.	Severe: steep slopes; stony.	Severe: steep slopes; stony.
Severe: frequent flood hazard; seasonal high water table at surface.	Severe: frequent flood hazard; seasonal high water table at surface.	Severe: frequent flood hazard; seasonal high water table at surface.	Severe: frequent flood hazard; water table within 20 inches of surface for a month or more during season of use.	Severe: frequent flood hazard; water table within 20 inches of surface for a month or more during season of use.	Severe: frequent flood hazard; seasonal high water table at surface.
Slight	Slight	Moderate: gravel content moderately high; gentle slopes.	Slight	Slight	Slight.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundation for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Swartswood—Continued					
SwC	Moderate: strong slopes.	Moderate: strong slopes.	Moderate: moderately slow permeability in subsoil; bedrock at depth of 4 feet or more; special design for deep ditches needed.	Severe: strong slopes.	Severe: bedrock at depth of 4 feet or more.
SwD	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: bedrock at depth of 4 feet.
SxB For Lackawanna part of SxB, see Lackawanna series.	Moderate: stone content moderately high.	Moderate: stone content moderately high.	Moderate: stone content moderately high; bedrock at depth of 4 feet; special design for deep ditches needed.	Moderate: bedrock at depth of 4 feet; gentle slopes.	Severe: bedrock at depth of 4 feet.
SxD For Lackawanna part of SxD, see Lackawanna series.	Moderate: stone content moderately high; bedrock at depth of 4 feet; slopes of 8 to 15 percent. Severe: slopes of 15 to 25 percent.	Moderate: stone content moderately high; slopes of 8 to 15 percent. Severe: slopes of 15 to 25 percent.	Moderate: slopes of 8 to 15 percent; bedrock at depth of 4 feet; special design for deep ditches needed. Severe: slopes of 15 to 25 percent.	Severe: strong and steep slopes.	Severe: bedrock at depth of 4 feet; slopes of 15 to 25 percent.
SxE For Lackawanna part of SxE, see Lackawanna series.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.
Unadilla: UnA, UnB	Slight	Slight	Slight	Moderate: moderate permeability in subsoil and substratum; UnB gentle slopes.	Slight
Vallois:					
VaB	Moderate: bedrock at depth of 4 feet.	Slight	Moderate: bedrock at depth of 4 feet.	Severe: bedrock at depth of 4 feet; moderate to moderately rapid permeability in substratum.	Severe: moderate to moderately rapid permeability in substratum.
VaC	Moderate: bedrock at depth of 4 to 5 feet in places; strong slopes.	Moderate: strong slopes.	Moderate: bedrock at depth of 4 to 5 feet in places; strong slopes.	Severe: strong slopes.	Severe: moderate to moderately rapid permeability in substratum.
VaD	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: moderate to moderately rapid permeability in substratum.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Moderate: strong slopes.	Moderate: strong slopes.	Severe: strong slopes.	Moderate: strong slopes.	Moderate: strong slopes.	Slight.
Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Moderate: steep slopes.
Slight	Severe: stone content excessive.	Severe: stone content excessive.	Moderate: stone content moderately high.	Severe: stone content excessive.	Moderate: stone content moderately high.
Moderate if slopes are 8 to 15 percent. Severe if slopes are 15 to 25 percent.	Severe: stone content excessive.	Severe: stone content excessive.	Moderate: stone content moderately high. Severe: slopes of 15 to 25 percent.	Severe: stone content excessive.	Moderate: stone content moderately high.
Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes.	Severe: very steep slopes; stone content excessive.	Severe: very steep slopes.
Slight	Slight	Slight for UnA. Moderate for UnB: slope.	Slight	Slight	Slight.
Moderate: moderate frost action potential.	Slight	Moderate: shale content moderately high.	Slight	Slight	Slight.
Moderate: strong slopes; moderate frost action potential.	Moderate: strong slopes.	Severe: strong slopes.	Moderate: strong slopes.	Moderate: strong slopes.	Slight.
Severe: steep slopes.	Severe: steep slopes.	Severe: shale content excessive; steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Moderate: steep slopes.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundation for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Wallkill: Wa	Severe: subject to occasional flood hazard; seasonal high water table at surface.	Severe: subject to occasional flood hazard; seasonal high water table at surface.	Severe: subject to occasional flood hazard; seasonal high water table at surface.	Severe: subject to occasional flood hazard; seasonal high water table at surface.	Severe: subject to occasional flood hazard; seasonal high water table at surface.
Washington: WhB	Slight: may be cavernous in places.	Slight: may be cavernous in places.	Moderate: bedrock at depth of 5 feet or more; may be cavernous in places; ground water pollution hazard.	Moderate: bedrock at depth of 5 feet or more; moderate permeability in subsoil.	Severe: bedrock at depth of 5 feet or more; may be cavernous in places; ground water pollution hazard.
WhC	Moderate: strong slopes.	Moderate: strong slopes.	Moderate: strong slopes; special design needed.	Severe: strong slopes.	Severe: bedrock at depth of 5 feet or more; may be cavernous in places; ground water pollution hazard.
WhD	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: bedrock at depth of 5 feet or more; may be cavernous; ground water pollution hazard.
WkC	Moderate: stone content moderate; slopes of 8 to 15 percent.	Moderate: stone content moderate; slopes of 8 to 15 percent.	Moderate: stone content moderate; slopes of 8 to 15 percent.	Moderate: bedrock at depth of 5 feet or more; moderate permeability in subsoil. Severe: slopes of 15 to 25 percent.	Severe: bedrock at depth of 5 feet or more; may be cavernous; ground water pollution hazard.
WkD	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: bedrock at depth of 5 feet or more; may be cavernous; ground water pollution hazard.
WlC For Wassaic part of WlC, see Wassaic soils.	Moderate: strong slopes.	Moderate: strong slopes.	Moderate: strong slopes; special design needed.	Severe: strong slopes.	Severe: bedrock at depth of 5 feet or more; may be cavernous; ground water pollution hazard.
WlD For Wassaic part of WlD, see Wassaic series.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: bedrock at depth of 5 feet or more; may be cavernous; ground water pollution hazard.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Severe: subject to occasional flood hazard; seasonal high water table at surface.	Severe: subject to occasional flood hazard; seasonal high water table at surface.	Severe: water table within 20 inches of surface during season of use.	Severe: water table within 20 inches of surface during season of use.	Severe: subject to occasional flood hazard; water table within 20 inches of surface during season of use.	Severe: subject to occasional flood hazard; seasonal high water table at surface.
Moderate: moderate frost-action potential.	Slight	Moderate: gentle slopes.	Slight	Slight	Slight.
Moderate: moderate frost-action potential.	Moderate: strong slopes.	Severe: strong slopes.	Moderate: strong slopes.	Moderate: strong slopes.	Slight.
Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Moderate: steep slopes.
Moderate: moderate frost-action potential; slopes of 8 to 15 percent.	Severe: stone content excessive.	Severe: stone content excessive; slopes of 8 to 15 percent.	Moderate: stone content moderate.	Severe: stone content excessive.	Moderate: stone content moderate.
Severe: steep slopes.	Severe: steep slopes.	Severe: stone content excessive; steep slopes.	Severe: steep slopes.	Severe: stone content excessive; steep slopes.	Moderate: stone content moderate; steep slopes.
Moderate: moderate frost-action potential.	Moderate: strong slopes.	Severe: strong slopes.	Moderate: strong slopes.	Moderate: strong slopes.	Slight.
Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Moderate: steep slopes.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundation for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Wassaic:					
WmC	Severe: bedrock at depth of 1½ to 3½ feet.	Moderate: bedrock at depth of 1½ to 3½ feet.	Severe: bedrock at depth of 1½ to 3½ feet.	Severe: bedrock at depth of 1½ to 3½ feet; strong slopes.	Severe: bedrock at depth of 1½ to 3½ feet.
WmD	Severe: bedrock at depth of 1½ to 3½ feet; steep slopes.	Severe: steep slopes.	Severe: bedrock at depth of 1½ to 3½ feet; steep slopes.	Severe: bedrock at depth of 1½ to 3½ feet; steep slopes.	Severe: bedrock at depth of 1½ to 3½ feet.
WnD For Rock outcrop part of WnD, see Rock outcrop.	Severe: bedrock at depth of 1½ to 3½ feet; steep slopes.	Severe: steep slopes.	Severe: bedrock at depth of 1½ to 3½ feet; steep slopes.	Severe: bedrock at depth of 1½ to 3½ feet; steep slopes.	Severe: bedrock at depth of 1½ to 3½ feet.
Wayland Mapped only with Sloan soils.	Severe: frequent flood hazard; seasonal high water table within 1 foot of surface.	Severe: frequent flood hazard; seasonal high water table within 1 foot of surface.	Severe: frequent flood hazard; seasonal high water table within 1 foot of surface.	Severe: frequent flood hazard; seasonal high water table within 1 foot of surface.	Severe: frequent flood hazard; seasonal high water table within 1 foot of surface.
Whitman: Wo	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.
Wooster:					
WsB	Moderate: bedrock at depth of 3½ feet or more.	Slight	Moderate: moderately slow permeability in subsoil; special design needed; bedrock at depth of 3½ feet or more.	Severe: bedrock at depth of 3½ feet or more.	Severe: bedrock at depth of 3½ feet or more.
WsC	Moderate: strong slopes where depth to bedrock is 3½ feet or more.	Moderate: strong slopes.	Moderate: moderately slow permeability in subsoil; special design needed; bedrock at depth of 3½ feet or more; strong slopes.	Severe: strong slopes.	Severe: bedrock at depth of 3½ feet or more.
WsD, WsE	Severe: steep and very steep slopes.	Severe: steep and very steep slopes.	Severe: steep and very steep slopes.	Severe: steep and very steep slopes.	Severe: steep and very steep slopes.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Moderate: bedrock at depth of 1½ to 3½ feet.	Moderate to severe: bedrock at depth of 1½ to 3½ feet.	Severe: bedrock at depth of 1½ to 3½ feet; strong slopes.	Moderate: strong slopes.	Moderate: strong slopes.	Slight.
Severe: steep slopes.	Severe: steep slopes.	Severe: bedrock at depth of 1½ to 3½ feet; steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Moderate: steep slopes.
Severe: steep slopes.	Severe: steep slopes.	Severe: bedrock at depth of 1½ to 3½ feet; steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Moderate: steep slopes.
Severe: frequent flood hazard; seasonal high water table within 1 foot of surface.	Severe: frequent flood hazard; seasonal high water table within 1 foot of surface.	Severe: frequent flood hazard; seasonal high water table within 1 foot of surface.	Severe: frequent flood hazard; water table within 1 foot of surface for a month or more during season of use.	Severe: frequent flood hazard; water table within 1 foot of surface for a month or more during season of use.	Severe: frequent flood hazard; seasonal high water table within 1 foot of surface.
Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.
Slight	Slight	Moderate: gentle slopes.	Slight	Slight	Slight.
Moderate: strong slopes.	Moderate: strong slopes.	Severe: strong slopes.	Moderate: strong slopes.	Moderate: strong slopes.	Slight.
Severe: steep and very steep slopes.	Severe: steep and very steep slopes.	Severe: steep and very steep slopes.	Severe: steep and very steep slopes.	Severe: steep and very steep slopes.	Moderate: WsD steep slopes. Severe: WsE very steep slopes.

TABLE 11.—*Soil limitations to be considered*

Soil series and map symbols	Degree and kind of soil limitations for—				
	Foundation for dwellings—		Septic tank absorption fields	Sewage lagoons	Sanitary landfills
	With basements	Without basements			
Wurtsboro:					
WtB, WtC	Severe: seasonal high water table perched at depth of 1½ to 2½ feet.	Moderate: seasonal high water table perched at depth of 1½ to 2½ feet.	Severe: seasonal high water table perched at depth of 1½ to 2½ feet.	Severe: seasonal high water table perched at depth of 1½ to 2½ feet.	Severe: seasonal high water table perched at depth of 1½ to 2½ feet.
WuB, WuC	Severe: seasonal high water table perched at depth of 1½ to 2½ feet.	Moderate: seasonal high water table perched at depth of 1½ to 2½ feet; stone content moderate.	Severe: seasonal high water table perched at depth of 1½ to 2½ feet.	Severe: seasonal high water table perched at depth of 1½ to 2½ feet.	Severe: seasonal high water table perched at depth of 1½ to 2½ feet.

Plant and animal life

Living organisms are important in soil formation. Plants and animals furnish organic matter to the soil and bring nutrients from lower layers to upper layers. When the organic matter becomes part of the soil, it plays a dominant role in determining color, and during decomposition it produces organic acids that accelerate leaching and weathering processes. Bacteria and fungi are active in the decomposition of organic matter, the release of plant nutrients, and the formation of soil structure. In Sussex County, the native forests have had more influence on soil formation than any other living organism. Man, however, has greatly influenced the surface layer where he has cleared the forests, removed stones and boulders, and plowed the land. He has added lime and fertilizers, mixed some of the soil horizons, and has moved soil materials from place to place.

Parent material

Parent material is the unconsolidated mass from which soils are formed. It determines the mineral and chemical composition of soils and influences the rate of soil-forming process.

In Sussex County, soils formed in glacial till, glacial outwash, recent stream alluvium, organic materials (*13*, *14*), and from rock materials weathering in place. The glacial materials (fig. 9) were left after the glaciers melted 10,000 to 15,000 years ago. Alluvial and organic materials are of more recent origin and are still accumulating today. Soils formed from glacial till are the most extensive and have a wide range of characteristics. Firm substrata are commonly present. Whitman, Albia, Wurtsboro, and Swartswood soils are examples. Soils formed in glacial outwash deposits are generally loamy and are commonly underlain by stratified sand and gravel. Examples are Chenango, Hazen, and Atherton soils. Soils along major streams are formed in recent alluvial materials. They are medium textured and have little soil development. Examples are Wayland, Sloan, and Middlebury soils. Carlisle muck formed in organic material. The relation of the soils to parent materials, their origin, textures, and natural drainage classes are shown in table 12.

Topography

The shape of the land surface, commonly called the lay of the land; the slope; and the position in relation to the water table have had great influence on the formation of soils in the county. Soils that form in sloping areas where runoff is moderate to rapid generally are well drained, have an unmottled bright-colored subsoil, and in most places are leached to greater depths than wetter soils in the same general area. In more gently sloping areas where runoff is slower, a greater number of soils show some evidence of wetness, such as mottling in the subsoil, for short periods. In level areas or slight depressions where the water table is at or near the surface for long periods, the soils show evidence of wetness to a marked degree. They have a thick, dark-colored organic surface layer and a strongly mottled or grayish subsoil. The permeability of the soil material, as well as the length, steepness, and configuration of the slopes, influence the kind of soil that forms from place to place. Local differences in soils are largely the result of differences in parent material and topography.

Time

The formation of soils requires time for changes to take place in the parent materials, and this is usually a long time when measured in years. The soils of Sussex County formed in the period since glaciation. Evidence of this limited time can be seen in the soils.

in town and country planning—Continued

Degree and kind of soil limitations for—Continued					
Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites, trailers, and tents	Paths and trails
Severe: seasonal high water table perched at depth of 1½ to 2½ feet; high frost-action potential.	Moderate: seasonal high water table perched at depth of 1½ to 2½ feet.	Moderate: seasonal high water table perched at depth of 1½ to 2½ feet.	Slight for WtB. Moderate for WtC.	Slight: water table below 20 inches during season of use.	Slight.
Severe: seasonal high water table perched at depth of 1½ to 2½ feet; high frost-action potential.	Severe: stone content excessive.	Severe: stone content excessive.	Slight: water table below a depth of 20 inches during season of use.	Severe: stone content excessive.	Slight.

***Figure 9.*—Glacial deposit of partially rounded stones and boulders.**

TABLE 12.—*Soil series arranged according to origin and lithology, dominant soil texture and other characteristics, and natural drainage*

Origin and lithology, texture, and other characteristics	Natural drainage				
	Excessively drained and well drained	Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
SOILS FORMED IN ALLUVIUM					
Moderately coarse texture	----------	Middlebury	Middlebury	----------	
Medium texture	----------	----------	----------	Wayland	Sloan.
Mixed texture	----------	----------	----------	----------	Alluvial land, wet.
Medium texture over organic	----------	----------	----------	----------	Wallkill.
SOILS FORMED IN GLACIAL OUTWASH					
Coarse texture:					
Dominantly sandstone and quartzite.	Colonie	----------	----------	----------	
Dominantly granitic material.	Otisville	----------	----------	----------	
Moderately coarse texture:					
Dominantly sandstone, slate, and siltstone.	Hoosic, Chenango	Braceville	----------	Atherton	Atherton.
Dominantly granitic material.	Riverhead	----------	Pompton	Preakness	Preakness.
Dominantly sandstone, shale, and limestone.	Hazen	Hero	----------	Fredon	Halsey.
Medium texture:					
Dominantly sandstone, slate, and siltstone.	Unadilla	Braceville	----------	Atherton	Atherton.
Dominantly sandstone, shale, and limestone.	Palmyra	Hero	----------	Fredon	Halsey.
SOILS FORMED IN GLACIAL LAKE SEDIMENTS					
Medium and fine texture	----------	----------	Raynham	----------	Livingston.
SOILS FORMED IN GLACIAL TILL OR THIN GLACIAL TILL					
Limestone, shale, and granitic material.					
Moderately deep	Wassaic	----------	----------	----------	
Deep, no fragipan	Washington	----------	----------	Lyons	Lyons.
Deep, fragipan	Wooster	----------	----------	----------	
Granitic material	Rockaway	----------	Hibernia	----------	Whitman.
Slate, sandstone, and shale:					
Deep	Bath, Valois	----------	Albia	Chippewa	Norwich.
Shallow	Nassau	----------	----------	----------	
Sandstone, quartzite, and shale:					
Deep	Swartswood, Lackawanna.	Wurtsboro	----------	----------	Norwich.
Moderately deep	Oquaga	----------	----------	----------	
SOILS FORMED IN ORGANIC MATERIAL.	----------	----------	----------	----------	Carlisle.

Soils formed on low bottoms, subject to varying degrees of overflow, can receive new sediment with each flood. These soils have only weak structure and little color variation between horizons. An example is Sloan soils. Soils that have well-defined horizons, such as Washington soils, have been forming for longer periods than, for example, Wayland soils.

Major Soil Horizons

The results of the soil-forming factors can be distinguished by the different layers, or soil horizons, seen in a soil profile. The soil profile extends from the surface of the soil downward to materials that are little altered by the soil-forming processes.

Most soils contain three major horizons called A, B, and C (*9*). These major horizons may be further subdivided by the use of subscripts and letters to indicate changes within one horizon. An example would be the B2t horizon, which represents a layer within the B horizon, of translocated clay illuviated from the A horizon.

The A horizon is the surface layer. It is the layer that has the largest accumulation of organic matter and also the layer of maximum leaching or eluviation of clay and iron. The A1 and Ap horizons have the largest accumulation of organic matter. When considerable leaching has taken place, an A2 horizon forms. The A2 horizon of some soils in Sussex County shows brownish colors resulting from oxidation of iron.

The B horizon underlies the A horizon and is commonly called the subsoil. It is the horizon of maximum accumulation, or illuviation of clay, iron, aluminum, or other compounds, leached from the A horizon. In some soils, the B horizon is formed by alteration in place rather than from illuviation. The alteration may be due to oxidation and reduction of iron or the weathering of clay minerals. The B horizon is generally firmer, has blocky or prismatic structure, and is generally lighter colored than the A horizon but darker than the C horizon. Most young soils do not have a B horizon.

The C horizon is below the A or the B horizon. It consists of materials that are little altered by the soil-forming processes, but may be modified by weathering.

Processes of Soil Formation

Several processes are involved in the formation of soil horizons in the soils of Sussex County. These include the accumulation of organic matter, the leaching of soluble salts, reduction and translocation of iron, the formation of soil structure, and some translocation and loss of clay minerals, aluminum, silica, and iron. These processes are continually taking place and generally at the same time throughout the profile. These processes are measured in thousands of years.

The accumulation of organic matter takes place with the decomposition of plant residue. This process darkens the surface layer and helps form the A1 horizon. Replacement of organic matter, once it has been lost, takes a long time.

Most of the soils in Sussex County have a distinct subsoil horizon. It is believed that some of the lime and other soluble salts are leached before translocation of iron and clay takes place. Such factors as the kinds of salts originally present, the depth to which the soil solution percolates, and the texture of the soil profile all affect leaching.

Well drained and moderately well drained soils in Sussex County have a yellowish-brown or reddish-brown subsoil, mainly because the sand and silt grains have thin coatings of iron oxides. In some soils, Lackawanna soils, for example, the colors are inherited from the reddish glacial materials in which they formed. Weak to moderate development of subangular blocky structure has taken place, but the subsoil contains the same or slightly more clay than the overlying surface horizon.

The reduction and transfer of iron, a process called gleying, is associated mainly with the wetter, more poorly drained soils. Poorly drained to very poorly drained soils, such as the Halsey, Whitman, and Lyons soils, have a subsoil and underlying material that are grayish colored, indicating reduction and transfer of iron. Moderately well drained to somewhat poorly drained soils have yellowish-brown, reddish-brown, and gray mottles indicating the segregation of iron.

A fragipan has formed in the subsoil of many moderately well drained and somewhat poorly drained soils. These horizons are very firm and brittle when moist and hard when dry. Soil particles are tightly packed so that bulk density is high and pore space is low. Genesis of these horizons is not fully understood, but studies show that the soil shrinks and swells in alternating wet and dry periods. This may account for the tight packing of soil particles and also a gross polygonal pattern of cracks in the fragipan. Clay, silica, and oxides of aluminum are the most likely cementing agents that cause brittleness and hardness.

Classification of the Soils

The purpose of soil classification is to help us remember the significant characteristics of soils, assemble our knowledge about the soils, see their relationships to one another and to the whole environment, and develop principles relating to their behavior and their response to manipulation. First through classification and then through the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The current system of soil classification (*7*, *10*) was adopted by the Cooperative Soil Survey in 1965. It is a comprehensive system, designed to accommodate all soils. In this system classes of soils are defined in terms of observable or measurable properties. The properties chosen are primarily those that result in the grouping of soils of similar genesis, or mode of origin. Genesis does not, however, appear in the definitions of the classes.

The current system of classification has six categories. Beginning with the most inclusive, the categories are the order, the suborder, the great group, the subgroup, the family, and the series. Table 13 shows the classification of the soils of Sussex County according to this system. Brief descriptions of the six categories follow.

TABLE 13.—*Soil series classified according to current system of classification*

Series	Family	Subgroup	Order
Albia	Fine-loamy, mixed, mesic	Aeric Fragiaqualfs	Alfisols.
Alluvial land, wet		Fluvaquents and Aquolls	Entisols and Mollisols.
Atherton	Fine-loamy, mixed, nonacid, mesic	Aeric Haplaquepts	Inceptisols.
Bath	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols.
Braceville	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols.
Carlisle	Euic, mesic	Typic Medisaprists	Histosols.
Chenango	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Chippewa	Fine-loamy, mixed, mesic	Typic Fragiaquepts	Inceptisols.
Colonie	Mixed, mesic	Alfic Udipsamments	Entisols.
Fredon	Coarse-loamy over sandy or sandy-skeletal, mixed, nonacid, mesic.	Aeric Haplaquepts	Inceptisols.
Halsey	Coarse-loamy over sandy or sandy-skeletal, mixed, nonacid, mesic.	Mollic Haplaquepts	Inceptisols.
Hazen	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic.	Mollic Hapludalfs	Alfisols.
Hero	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic.	Aquic Eutrochrepts	Inceptisols.
Hibernia	Coarse-loamy, mixed, mesic	Aquic Fragiudults	Ultisols.
Hoosic	Sandy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Lackawanna	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols.
Livingston	Very fine, illitic, nonacid, mesic	Mollic Haplaquepts	Inceptisols.
Lyons	Fine-loamy, mixed, nonacid, mesic	Mollic Haplaquepts	Inceptisols.
Middlebury	Coarse-loamy, mixed, mesic	Fluvaquentic Eutrochrepts	Inceptisols.
Nassau	Loamy-skeletal, mixed, mesic	Lithic Dystrochrepts	Inceptisols.
Norwich	Fine-loamy, mixed, mesic	Typic Fragiaquepts	Inceptisols.
Oquaga	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Otisville	Sandy-skeletal, mixed, mesic	Typic Udorthents	Entisols.
Palmyra	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Glossoboric Hapludalfs	Alfisols.
Pompton	Coarse-loamy, mixed, mesic	Aquic Dystrochrepts	Inceptisols.
Preakness	Coarse-loamy, mixed, acid, mesic	Typic Humaquepts	Inceptisols.
Raynham	Coarse-silty, mixed, nonacid, mesic	Aeric Haplaquepts	Inceptisols.
Riverhead	Coarse-loamy, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Rockaway	Coarse-loamy, mixed, mesic	Typic Fragiudults	Ultisols.
Sloan	Fine-loamy, mixed, mesic	Fluvaquentic Haplaquolls	Mollisols.
Swamp		Aquents and Aquepts	Entisols and Inceptisols.
Swartswood	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols.
Unadilla	Coarse-silty, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Valois	Coarse-loamy, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Wallkill	Fine-loamy, mixed, nonacid, mesic	Thapto-Histic Fluvaquents	Entisols.
Washington[1]	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Wassaic	Fine-loamy, mixed, mesic	Glossoboric Hapludalfs	Alfisols.
Wayland	Fine-silty, mixed, nonacid, mesic	Mollic Fluvaquents	Entisols.
Whitman	Coarse-loamy, mixed, mesic	Typic Fragiaquepts	Inceptisols.
Wooster	Fine-loamy, mixed, mesic	Typic Fragiudalfs	Alfisols.
Wurtsboro	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols.

[1] Washington soils are taxadjuncts to the Washington series. They have lower chromas in the C horizon and slightly less clay in the argillic horizon than are defined as the range for the Washington series.

Order.—Ten soil orders are recognized: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate orders are those that tend to give broad climatic groupings of soils. Two exceptions to this generalization are the Entisols and the Histosols, both of which occur in many different climates. Six of the ten orders are represented in Sussex County: Alfisols, Entisols, Histosols, Mollisols, Ultisols, and Inceptisols.

Suborder.—Each order is divided into suborders, mainly on the basis of soil characteristics that result in grouping soils according to genetic similarity. The climatic range is narrower than that of the order. The properties used are mainly those that reflect either the presence or absence of waterlogging or differences in climate or vegetation.

Great group.—Each suborder is divided into great groups on the basis of similarity in the kind and sequence of the major horizons and in major soil properties. The horizons considered are those in which clay, iron, or humus have accumulated and those in which pans that interfere with the growth of roots and the movement of water have formed. The properties are soil temperature, chemical composition (mainly content of calcium, magnesium, sodium, and potassium), and the like.

Subgroup.—Each great group is divided into subgroups, one that represents the central (typic) concept of the group, and others, called intergrades, that have one or more properties of another great group, suborder, or order.

Family.—Families are established within each subgroup, primarily on the basis of properties important to

the growth of plants or properties significant in engineering. Texture, mineral composition, reaction, soil temperature, permeability, thickness of horizons, and consistence are among the properties considered.

Series.—A series is a group of soils that have horizons similar in all important characteristics, except for texture of the surface layer, and similar in arrangement in the profile. (See the section "How This Survey Was Made.")

General Nature of the County

General information on physiography, water supply, climate, and farming and land use in Sussex County is given in the paragraphs that follow.

Physiography and Drainage

The Appalachian Province, (*4*) one of the great physiographic divisions of the Nation, encompasses Sussex County. Two of the Province's four major divisions cross Sussex County in a northeast to southwest direction: the Appalachian Valley and the Appalachian Mountain, known in New Jersey as the Highlands.

A large part of Sussex County is in the Appalachian Valley. The eastern part of the valley is the broad Kittatinny Valley and the western part is the narrow valley of the upper Delaware. The two valleys are separated by the bold, even-crested ridge of Kittatinny Mountain, which is one of the ridges of the Appalachian Valley belt, but reaches a greater altitude than the Highlands east of the valley. The plains and bottom lands of the Kittatinny Valley are between 400 to 600 feet above sea level, and its hills and ridges rise to elevations of 800 to 1,000 feet. The Kittatinny Mountain generally is 1,600 to 1,800 feet high and attains a maximum elevation of 1,804 feet at High Point, the highest in the State.

The Highlands, a rough belt on the eastern side of Sussex County, consist of several broad, rounded or flat topped ridges that rise 400 to 600 feet above the low lands on either side. They are separated by deep and generally narrow valleys that range from 500 to 800 feet above sea level. The larger topographical features of the Highlands, like those of the Appalachian Valley, show a marked northeast-southwest trend. Their maximum elevation is 1,496 feet midway between Canistear and Vernon. Bearfort Mountain reaches 1,491 feet, and several points on Wawayanda and Hamburg Mountains are more than 1,400 feet above sea level. The Highlands descend gradually to the Ramapo Mountain on the southeastern border, where maximum elevation is 1,171 feet, and to the Musconetcong Mountain at the southwest, where a miximum altitude is 987 feet.

Roughly one half of Sussex County is drained by the Delaware River and its tributaries, Flat Brook, Mill Brook, and Paulins Kill and Pe Quest River. The other large watershed in Sussex County is the Wallkill River and its tributaries, Clove Brook and Papakating and Pochuck Creeks. A small area on the eastern border of the county is drained by a tributary of the Pequannock River and the southeastern corner of the county is drained by Lubbers Run, part of the headwaters of the Musconetcong River.

Water Supply

In most areas of Sussex County water is obtained from individually dug or drilled wells. Some towns have their own water supply. Some are partly supplied by private companies, through community wells, and the rest is supplied by individual wells. Most lake communities have individual wells. Ponds, streams, developed springs, and domestic wells furnish water for livestock.

The Highlands-Appalachian Valley has the least favorable conditions of any in the State for reliable ground water supplies in sizable quantities.

The geologic formations in this province form very poor aquifers. Pockets containing unconsolidated sand and gravel of glacial age are sources of fair yields of ground water, but these pockets are largely undefined and of limited capacity. The Survey of New Jersey Water Resources Development (*8*) characterizes ground water resources in the Highlands-Appalachian Province as being "primary of local interest and importance as potable supplies for small municipalities and farms."

Climate [4]

The climate of Sussex County is continental but humid and temperate. It is only slightly influenced by the ocean. The data in tables 14 and 15 are from the cooperative weather station at Newton.

Summer temperatures seldom exceed 100° F., but readings in the middle or upper 90's occur frequently. Winter temperatures are generally not below 10° F. for long perods, but are low enough that agricultural drainage tile must be placed below a depth of 30 inches for protection against freezing.

The average annual precipitation ranges from about 43 to 49 inches and the monthly averages in table 14 show that precipitation is well distributed over the year. Nearly every year, however, has periods when rainfall is not sufficient for high-value crops. Rainfall is heaviest during July and August. Much of this rainfall in summer comes during thunderstorms, and about 32 storms occur annually. Between 15 and 22 inches of rain fell over the county in August 1955, during two hurricanes and some thunderstorms.

The average length of the growing season in the county is about 154 days. The average date of the last killing freeze in spring is May 4th, and that of the first in fall is October 5th. Probabilities for the last damaging cold temperatures in spring and the first in fall are listed in table 15.

Winter temperatures are not low enough to keep the ground frozen throughout the winter every year. Sometimes rainfall during winter warms the soils enough to thaw them. Heavy rainfall on partially thawed soils is highly erosive. Hail does not occur frequently, but it can be destructive to high-value crops.

[4] Prepared by DONALD V. DUNLAP, climatologist for New Jersey; National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

TABLE 14.—*Temperature and precipitation*

[All data from Newton, N. J. Elevation 650 feet]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average total	One year in 10 will have—		Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover of 1 inch or more
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F	°F	°F	°F	Inches	Inches	Inches	Number	Inches
January	35	18	54	−6	3.0	0.8	3.9	18	5
February	36	18	53	−1	2.6	1.7	4.0	12	5
March	46	27	63	13	3.5	1.9	5.5	7	5
April	60	36	80	25	3.8	2.3	6.5	1	3
May	71	47	86	32	4.0	1.0	5.1	0	0
June	79	55	91	41	4.3	2.0	5.7	0	0
July	84	60	94	47	4.9	1.5	9.1	0	0
August	82	58	91	43	4.5	1.4	10.2	0	0
September	75	52	91	34	4.0	1.9	6.0	0	0
October	64	41	81	28	3.4	1.0	5.3	(1)	1
November	50	32	66	19	3.6	2.1	5.5	1	3
December	38	21	54	2	3.2	0.9	5.4	9	4
Year	60	39	[2]97	[3]−9	44.8	29.6	51.0	48	5

[1] Less than 0.5 day.
[2] Average annual highest temperature.
[3] Average annual lowest temperature.

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

[All data from Newton, Sussex County, N. J.]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	March 31	April 14	April 24	May 1	May 15
2 years in 10 later than	March 22	April 8	April 21	April 28	May 11
5 years in 10 later than	March 15	March 23	April 6	April 20	May 4
Fall:					
1 year in 10 earlier than	November 15	October 27	October 19	October 6	September 27
2 years in 10 earlier than	November 20	November 6	October 27	October 14	October 2
5 years in 10 earlier than	November 30	November 13	November 3	October 20	October 5

Farming and Land Use

The 1969 agricultural census shows that about 30 percent, or 98,312 acres, of Sussex County is farms. This includes 54,717 acres in crops, 18,686 acres of pasture, and 24,120 acres of woodland. The dairy farm is the chief type of farm. Only small acreages are beef cattle, vegetable, and fruit farms.

The number of farms has decreased steadily from 1,273 in 1940 to 1,089 in 1950, 525 in 1964, and 519 in 1969. The average size of farms has increased from 143 acres in 1900, to 150 acres in 1950, and to 205 acres in 1964. It decreased to 189 acres in 1969.

The last agricultural census shows that hay was the principal crop. Hay was grown on 19,000 acres, corn on about 8,500 acres, silage on about 7,000 acres, and grain on the remaining acreage.

The number of dairy cows remained fairly constant from the early part of this century until the early 1960's. In the 1960's the number of dairy animals declined steadily, while the number of beef animals increased slightly. This increase is not sufficient to affect overall land use in the county.

Large areas of Sussex County are owned by the State of New Jersey and the Federal Government. The land is in State forests, State parks, fish and game areas, and a national park.

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Glossary

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

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation exchange capacity.

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 (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

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.

Coarse fragments. Mineral or rock particles more than 2 millimeters in diameter.

Coarse-textured soil. Sand and loamy sand.

Cobblestone. A rounded or partly rounded fragment of rock, 3 to 10 inches in diameter.

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

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

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

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

Excessively drained soils are commonly very porous and rapidly permeable and have a low available water capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Eluviation. The movement of material from one place to another within the soil, in either true solution or colloidal suspension. Soil horizons that have lost material through eluviation are said to be eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Fragipan. A loamy, brittle subsurface horizon that is very low in organic-matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Glacial drift (geology). Rock material transported by glacial ice and then deposited; also includes the assorted and unassorted materials deposited by streams flowing from glaciers.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice; the deposits are stratified and occur in the form of kames, eskers, deltas, and outwash plains.

Gneiss. A coarse-grained metamorphic rock in which granular minerals alternate with bands of prismatic minerals.

Gravelly soil material. From 15 to 50 percent of material by volume, consists of rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Hue. One of the three variables of color. The dominant spectral (rainbow) color; it is related to the dominant wavelength of the light. See Munsell notation.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Illuvation. The accumulation of material in a soil horizon through the deposition of suspended material and organic matter removed from horizons above. Since part of the fine clay in the B horizon (or subsoil) of many soils has moved into the B horizon from the A horizon above, the B horizon is called an illuvial horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed by lowering of the water level or elevation of the land.

Land classification. The classification of units of land for the purpose of showing their relative suitabilities for some specific use.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state. In engineering, a high liquid limit indicates that the soil has a high content of clay and a low capacity for supporting loads.

Mapping unit. Areas of soil of the same kind outlined on the soil map and identified by a symbol.

Medium-textured soil. Soil of very fine sandy loam, loam, silt loam, or silt texture.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are these: Terminal, lateral, medial, ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical mineralogical, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Neutral soil. In practice, a soil having a pH value between 6.6 and 7.3. Strictly speaking a soil that has a pH value of 7.0.

Organic matter. A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Percolation. The downward movement of water through the soil.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *slow, moderately slow, moderate, moderately rapid,* and *rapid.*

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

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

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

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

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

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

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. 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. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Sedimentary rock. A rock composed of particles deposited from suspension in water. The chief sedimentary rocks are conglomerate, from gravel; sandstone, from sand; shale, from clay; and limestone, from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sands have been consolidated into sandstone.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Shale. A sedimentary rock formed by the hardening of clay deposits.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slate. A fine-grained metamorphic rock possessing well-developed cleavage along closely spaced parallel planes.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

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

Stones. Rock fragments greater than 10 inches in diameter if rounded, and greater than 15 inches along the longer axis if flat.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 6 to 11 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Value (color). One of three variables of color. Value increases as the relative intensity of reflected light increases. See Munsell notation.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Water table, perched. The upper surface of a body of free ground water that is separated from an underlying body of ground water by unsaturated material.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which it belongs. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Estimated yields, table 2, page 47.
Woodland, table 4, page 50.
Wildlife, table 6, page 55.
Engineering, tables 7, 8, and 9, pages 58 through 81.
Landscape plantings, table 10, page 84.
Town and country planning, table 11, page 86.

Map symbol	Mapping unit	Described on page	Capability unit		Woodland group
			Symbol	Page	Symbol
AlB	Albia gravelly loam, 3 to 8 percent slopes	8	IIIw-28	43	4w1
AlC	Albia gravelly loam, 8 to 15 percent slopes	8	IIIe-28	43	4w1
AmB	Albia extremely stony loam, 3 to 8 percent slopes	8	VIIs-45	46	5x1
Ar	Alluvial land, wet	9	VIw-46	45	5w1
At	Atherton loam	9	IIIw-36	43	4w1
BaB	Bath loam, 3 to 8 percent slopes	10	IIe-3	40	3o1
BaC	Bath loam, 8 to 15 percent slopes	10	IIIe-3	42	3o1
BfD	Bath gravelly loam, 15 to 25 percent slopes	10	IVe-3	43	3r1
BfE	Bath gravelly loam, 25 to 40 percent slopes	10	VIe-3	45	3r1
BgB	Bath very stony loam, 3 to 8 percent slopes	10	VIs-19	45	3o1
BgD	Bath very stony loam, 8 to 25 percent slopes	10	VIs-19	45	3r1
BgE	Bath very stony loam, 25 to 40 percent slopes	10	VIIs-21	46	3r1
BrA	Braceville gravelly sandy loam, 0 to 3 percent slopes	11	IIw-24	41	3o1
BrB	Braceville gravelly sandy loam, 3 to 8 percent slopes	11	IIw-24	41	3o1
Ca	Carlisle muck	12	IIIw-41	43	5w1
ChB	Chenango gravelly fine sandy loam, 3 to 8 percent slopes	12	IIs-7	41	2o1
ChD	Chenango gravelly fine sandy loam, 8 to 25 percent slopes	12	IVe-15	44	2r1
ClC	Chenango cobbly sandy loam, 3 to 15 percent slopes	13	VIe-13	45	2o1
ClD	Chenango cobbly sandy loam, 15 to 35 percent slopes	13	VIe-13	45	2r1
CmB	Chippewa extremely stony loam, 0 to 8 percent slopes	13	VIIs-45	46	5x1
CnB	Chippewa silt loam, 3 to 8 percent slopes	14	IVw-44	44	5w1
CoB	Colonie loamy fine sand, 3 to 8 percent slopes	14	IVs-12	44	4s1
CoC	Colonie loamy fine sand, 8 to 15 percent slopes	14	VIIs-12	45	4s1
FrA	Fredon loam, 0 to 3 percent slopes	15	IIIw-36	43	4w1
FrB	Fredon loam, 3 to 8 percent slopes	15	IIIw-36	43	4w1
Ha	Halsey loam	16	IIIw-36	43	5w1
HfA	Hazen gravelly loam, 0 to 3 percent slopes	16	I-6	40	3o1
HfB	Hazen gravelly loam, 3 to 8 percent slopes	16	IIe-6	40	3o1
HfD	Hazen gravelly loam, 8 to 25 percent slopes	16	IVe-11	44	3r1
HgE	Hazen and Palmyra gravelly sandy loams, 25 to 45 percent slopes	16	VIIe-10	45	3r1
HkA	Hero loam, 0 to 3 percent slopes	17	IIw-25	41	3o1
HkB	Hero loam, 3 to 8 percent slopes	17	IIw-25	41	3o1
HmB	Hibernia gravelly loam, 3 to 8 percent slopes	18	IIIw-28	43	2w1
HnB	Hibernia very stony loam, 3 to 8 percent slopes	18	VIs-19	45	2w1
HnD	Hibernia very stony loam, 8 to 25 percent slopes	18	VIs-19	45	2r1
HoB	Hoosic gravelly loam, 3 to 8 percent slopes	19	IIs-7	41	3o1
HoD	Hoosic gravelly loam, 8 to 25 percent slopes	19	IVe-15	44	3r1
Lv	Livingston silty clay loam	20	IVw-44	44	---
Ly	Lyons silt loam	20	IVw-44	44	5w1
Lz	Lyons very stony silt loam	20	VIIs-45	46	5w1
Ma	Made land, sanitary land fill	20	-------	--	---
Md	Middlebury loam	21	IIw-32	41	1o1
NaB	Nassau rocky silt loam, 3 to 8 percent slopes	21	IIIe-15	42	5d1
NaC	Nassau rocky silt loam, 8 to 15 percent slopes	21	IVe-15	44	5d1
NfD	Nassau-Rock outcrop complex, 15 to 25 percent slopes	21	VIs-15	45	5x1
NfE	Nassau-Rock outcrop complex, 25 to 45 percent slopes	22	VIIs-21	46	5x1
Ng	Nassau-Rock outcrop complex, extremely stony	22	VIIs-21	46	5x1

Map symbol	Mapping unit	Described on page	Capability unit		Woodland group
			Symbol	Page	Symbol
NhA	Norwich silt loam, 0 to 3 percent slopes	23	IVw-44	44	5w1
NoA	Norwich very stony silt loam, 0 to 3 percent slopes	23	VIIs-45	46	5w1
OmB	Oquaga extremely stony loam, 3 to 8 percent slopes	24	VIIs-21	46	3x1
OmD	Oquaga extremely stony loam, 8 to 25 percent slopes	24	VIIs-21	46	3x1
OrD	Oquaga-Rock outcrop association, moderately steep	24	VIIs-21	46	3x1
OtC	Otisville gravelly loamy sand, 3 to 15 percent slopes	25	VIIs-12	45	4s1
OtD	Otisville gravelly loamy sand, 15 to 35 percent slopes	25	VIIs-12	45	4s1
PaA	Palmyra gravelly fine sandy loam, 0 to 3 percent slopes	25	I-6	40	2o1
PaB	Palmyra gravelly fine sandy loam, 3 to 8 percent slopes	25	IIe-6	40	2o1
PaD	Palmyra gravelly fine sandy loam, 8 to 25 percent slopes	26	IVe-11	44	2f1
Pt	Pits, sand and gravel	26	------	--	---
PvA	Pompton fine sandy loam, 0 to 3 percent slopes	26	IIw-25	41	2w1
Pw	Preakness sandy loam	27	IVw-44	44	4w1
RaB	Raynham silt loam, 0 to 5 percent slopes	27	IIIw-36	43	4w1
RhB	Riverhead sandy loam, 3 to 8 percent slopes	28	IIe-7	41	3o1
RhC	Riverhead sandy loam, 8 to 25 percent slopes	28	IVe-15	44	3r1
RoB	Rockaway gravelly loam, 3 to 8 percent slopes	28	IIe-3	40	3o1
RoC	Rockaway gravelly loam, 8 to 15 percent slopes	29	IIIe-3	42	3o1
RoD	Rockaway gravelly loam, 15 to 25 percent slopes	29	IVe-3	43	3r1
RpD	Rockaway very stony loam, 5 to 25 percent slopes	29	VIs-19	45	3r1
RpE	Rockaway very stony loam, 25 to 40 percent slopes	29	VIIs-21	46	3r1
RrD	Rockaway-Rock outcrop association, sloping and moderately steep	29	VIIs-21	46	3x1
RsF	Rock outcrop-Nassau association, very steep	29	VIIIs-23	46	5x1
RtE	Rock outcrop-Oquaga association, steep	29	VIIIs-23	46	3x1
RvE	Rock outcrop-Rockaway association, steep	29	VIIIs-23	46	3x1
Sm	Sloan and Wayland silt loams	30	VIw-46	45	4w1
Sp	Swamp	30	VIIIw-37	46	5w1
SwB	Swartswood gravelly loam, 3 to 8 percent slopes	31	IIe-3	40	3o1
SwC	Swartswood gravelly loam, 8 to 15 percent slopes	31	IIIe-3	42	3o1
SwD	Swartswood gravelly loam, 15 to 25 percent slopes	31	IVe-3	43	3r1
SxB	Swartswood and Lackawanna very stony soils, 3 to 8 percent slopes	31	VIs-19	45	3o1
SxD	Swartswood and Lackawanna very stony soils, 8 to 25 percent slopes	31	VIs-19	45	3r1
SxE	Swartswood and Lackawanna very stony soils, 25 to 35 percent slopes	31	VIIs-21	46	3r1
UnA	Unadilla very fine sandy loam, 0 to 3 percent slopes	32	I-6	40	3o1
UnB	Unadilla very fine sandy loam, 3 to 8 percent slopes	32	IIe-6	41	3o1
VaB	Valois shaly loam, 3 to 8 percent slopes	32	IIe-3	41	3o1
VaC	Valois shaly loam, 8 to 15 percent slopes	33	IIIe-3	42	3o1
VaD	Valois shaly loam, 15 to 25 percent slopes	33	IVe-3	43	3r1
Wa	Wallkill silt loam	33	IIIw-41	43	5w1
WhB	Washington loam, 3 to 8 percent slopes	34	IIe-3	40	1o1
WhC	Washington loam, 8 to 15 percent slopes	34	IIIe-3	42	1o1
WhD	Washington loam, 15 to 25 percent slopes	34	IVe-3	43	1r1
WkC	Washington very stony loam, 3 to 15 percent slopes	34	VIs-19	45	1o1
WkD	Washington very stony loam, 15 to 25 percent slopes	34	VIIs-21	46	1r1
WlC	Washington-Wassaic complex, 3 to 15 percent slopes	34	IIIe-18	42	1o1
WlD	Washington-Wassaic complex, 15 to 25 percent slopes	34	IVe-11	44	1r1
WmC	Wassaic silt loam, 3 to 15 percent slopes	35	IIIe-18	42	2o1
WmD	Wassaic silt loam, 15 to 30 percent slopes	35	IVe-11	44	2r1
WnD	Wassaic-Rock outcrop association, moderately steep	35	VIIs-21	46	3x1
Wo	Whitman extremely stony sandy loam	36	VIIs-45	46	5w1
WsB	Wooster loam, 3 to 8 percent slopes	37	IIe-3	40	2o1
WsC	Wooster loam, 8 to 15 percent slopes	37	IIIe-3	42	2o1
WsD	Wooster loam, 15 to 25 percent slopes	37	IVe-3	43	2r1

Map symbol	Mapping unit	Described on page	Capability unit		Woodland group
			Symbol	Page	Symbol
WsE	Wooster loam, 25 to 35 percent slopes	37	VIe-3	45	2r1
WtB	Wurtsboro gravelly loam, 3 to 8 percent slopes	38	IIw-24	41	3o1
WtC	Wurtsboro gravelly loam, 8 to 15 percent slopes	38	IIIe-28	43	3o1
WuB	Wurtsboro very stony loam, 0 to 8 percent slopes	38	VIs-19	45	3o1
WuC	Wurtsboro very stony loam, 8 to 20 percent slopes	38	VIs-19	45	3r1

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