Series 1961, No. 42

Issued April 1966

SOIL SURVEY

Camden County New Jersey

OUR SOIL * OUR STRENGTH

This is the last report of the 1961 series.

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
NEW JERSERY AGRICULTURAL EXPERIMENT STATION

HOW TO USE THIS SOIL SURVEY REPORT

THIS SOIL SURVEY of Camden County contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

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

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. 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 in the report. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability unit, woodland group, urban group, or any other group in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. 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 of the soils for agriculture mainly in the descriptions of the soils and in the discussions of the capability units.

Foresters and others interested in woodland can refer to the section "Use of Soils for Woodland." In that section the soils of the county are placed in groups according to their suitability for trees, and management of each group is discussed.

Game managers, sportsmen, and others concerned with wildlife will find information about the main kinds of wildlife and their food and cover in the section "Use of Soils for Wildlife."

Community planners and others concerned with suburban development can read about the soil characteristics that affect the choice of homesites, industrial sites, schools, and parks in the section "Soils in Urban Development."

Engineers and builders will find in the section "Engineering Applications" tables that give engineering descriptions of the soils in the county; that name soil features affecting engineering practices and structures; and that rate the soils according to their suitability for several kinds of engineering work.

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

Students, teachers, and others will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Camden 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 section "General Information about the County."

* * * * *

Fieldwork for this survey was completed in 1961. Unless otherwise indicated, all statements in this report refer to conditions in the county at the time the survey was in progress. This survey of Camden County was made as part of the technical assistance furnished by the Soil Conservation Service to the Camden County Soil Conservation District.

U.S. GOVERNMENT PRINTING OFFICE: 1966

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402

Contents

Series 1961, No. 42

Issued April 1966

SOIL SURVEY OF CAMDEN COUNTY, NEW JERSEY

REPORT BY MARCO MARKLEY, SOIL CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

SOILS SURVEYED BY MARCO MARKLEY AND JOHN KROHN, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE COLLEGE OF AGRICULTURE AND THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION

CAMDEN COUNTY is in the southern part of New Jersey on the Atlantic Coastal Plain (fig. 1). It is opposite the city of Philadelphia, along the navigable Delaware River, which provides excellent port facilities for shipbuilding and other industries. It extends to the southeast from the Delaware River. Its total area is 141,400 acres, or about 221 square miles. Its average width is about 12 miles, and its average length is about 25 miles.

In 1960 the population in Camden County was 392,035, and the average density was more than 1,800 persons per square mile. More than 117,000 people lived in the city of Camden, the county seat. Much of the remaining population is concentrated in the western one-third of the county within 15 miles of the Delaware River. At present about 40 percent of the land in the county is in forest and 18 percent[1] is in farmland. The principal crops grown are vegetables and nursery crops, sweetpotatoes, corn, alfalfa, and tree fruits. About 42 percent of the land is in urban and suburban use; this figure includes idle areas that obviously will be developed for nonfarm use.

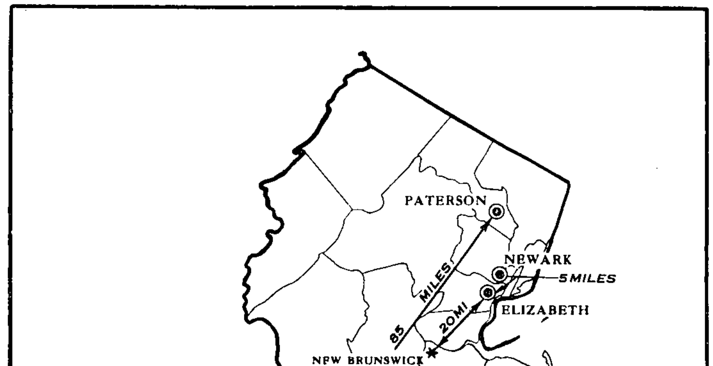

Figure 1.—**Location of Camden County in New Jersey.**

How This Soil Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Camden County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of geologic materials; 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 (fig. 2); it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. For successful use of this report, it is necessary to know the kinds of groupings most used in a local soil classification.

[1] This estimate is based on a 2 percent sample and is considerably higher than the amount reported in the 1960 agricultural census.

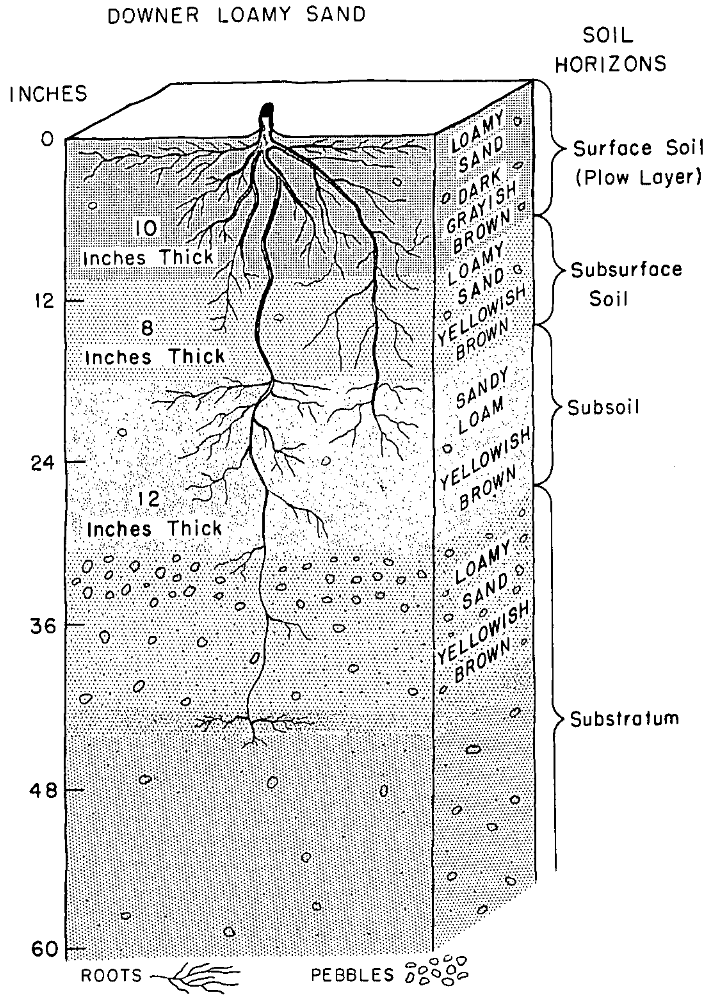

Figure 2.—**A typical profile of Downer loamy sand.**

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. Downer and Freehold, 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 go with their behavior in the natural landscape. Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Freehold fine sandy loam and Freehold loamy fine sand are two soil types in the Freehold series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Freehold fine sandy loam, 0 to 2 percent slopes, is one of several phases of Freehold fine sandy loam, a soil type that ranges from nearly level to strongly sloping.

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 greatly help in drawing soil boundaries accurately. In areas where soil boundaries could be located reliably and where detailed information was needed, the mapping was in considerable detail. In large wooded areas, however, where the need for detail was less and where soil boundaries were more difficult to determine, the mapping was more generalized. Mapping was also less detailed in urban areas where few observations could be made of the soils and where the soils had been altered greatly. The soil map in the back of this report 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 management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size, that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Aura-Downer loamy sands. The soil scientists may also show as one mapping unit two or more soils if the differences between them are too small to justify separation. Such a mapping unit is called an undifferentiated soil group. For example, Woodstown and Klej loamy sands. Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water or during construction that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Loamy alluvial land or Sand and gravel pits, and are called land types rather than soils.

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 soils 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 soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, managers of woodland, engineers, urban developers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports. The soil scientists set up trial groups based on the yield and practice tables and other data and test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

While a survey is in progress, and after some areas have been mapped, however, many changes occur. In this county, highway construction has left borrow pits in fields and woodlands and made fills in low, wet areas. Also, some areas that were fields when the aerial photographs at the back of the report were made are now covered by houses.

In some townships urban development has extended beyond the public sewage lines. These townships require that percolation tests be made of the soils at all homesites. The soil survey report can be used to assist in the planning of sewage systems. For example, the soil map shows areas of soils that have rapid permeability of the substratum where septic fields function well and where few percolation tests are needed. Also, this soil survey indicates areas that have slow permeability, those areas where percolation tests are needed to determine whether the soil is suitable for septic fields and how the fields should be designed. In addition, the report shows areas where drainage is so poor and permeability is so slow that the soils are generally not suitable for septic systems.

General Soil Map

The general soil map at the back of this report shows, in color, the soil associations in Camden 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 farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The eight soil associations in Camden County are shown on the general soil map at the back of this report and are described in the following pages.

1. Aura-Downer association: Gently sloping gravelly and sandy soils

This soil association occurs in irregularly shaped areas at elevations between 120 and 180 feet. It occupies the divide between the water flowing west into the Delaware River and the water flowing east into the Atlantic Ocean. The association includes Sicklerville, West Berlin, Williamstown Junction, the eastern part of Berlin, and the western part of Chesilhurst.

Most soils in the association are well drained. The soil material formed from geologic formations locally called Bridgeton and Cohansey.

The dominant soils in this association are the Aura and the Downer. The Aura soils are in slightly higher positions in the landscape than Downer soils. The Aura soils have a sandy loam or loamy sand surface layer and a reddish, coarse sandy loam subsoil containing some quartz gravel. The subsoil is so firm that root growth is restricted. Downer soils also have a sandy loam or loamy sand surface layer, but their subsoil is not so red nor so firm as that in the Aura soils.

Minor soils in this association are the Woodstown, Dragston, Fallsington, Pocomoke, Sandy alluvial land, Loamy alluvial land, and Muck. These soils are in moderately low to low positions where a high water table and flooding are problems. Deep drainage is needed if these soils are to be used for urban areas.

Sweetpotatoes and peaches are the most extensively grown crops in this association. In some places sweetpotatoes are grown between rows of trees in young orchards (fig. 3). The Aura soils are a source of much gravel and subbase material for building roads.

***Figure 3.*—Sweetpotatoes interplanted in young peach orchard.**

2. Downer-Woodstown-Dragston association: Gently sloping, grayish-brown sandy soils

This association consists mostly of sand and gravel deposited by streams or rivers. It occurs in several widely separated areas. One strip, 1 to 2 miles wide, lies immediately east of the Delaware River at elevations ranging from 5 to 100 feet above sea level. This strip includes the western part of Gloucester City, most of the city of Camden, all of East Camden, and the northern part of Pennsauken Township around Industrial Park.

Other areas of this association are east of and just below the divide, which is a section of high ground across the county. Elevations range from 60 to 120 feet. These areas include the communities of Berlin, Atco, and Waterford.

The soils in this association formed from materials of the Cape May, Pennsauken, Cohansey, and Bridgeton geologic formations.

The dominant soils in this association are the Downer, Woodstown, and Dragston, all of which are sandy. Downer soils are well drained, but they are droughty because they are sandy and shallow. Woodstown and Dragston soils have a high water table.

Minor soils in this association are the Fallsington, Pocomoke, and Klej.

In the strip of this association that lies within 5 miles of the Delaware River, nearly all the land is used for industry, commerce, residences, or recreation. In this part farmland occupies less than 5 percent of the acreage and is in isolated parcels. This land is rapidly being converted to urban use.

In areas of this association east of the divide, about 50 percent of the acreage has been cleared. Included in the cleared acreage are some commercial and residential areas, which are mostly small. The farms are generally of small or medium size, and they produce mainly vegetables, fruits, or poultry. Sweetpotatoes, tomatoes, peaches, and apples are the most important crops. Wood products of this association include pine for pulpwood from the uplands and white-cedar from the swamps. The soils in this association are not highly fertile. Areas could be cleared, however, if needed, and made to produce more than the soils now farmed. Irrigation and well-planned application of lime and fertilizer would be needed.

This association is well suited to most urban uses. Deep drainage, however, is needed in the Woodstown and Dragston soils to keep basements dry.

3. Freehold-Holmdel-Collington association: Gently to strongly sloping soils from greensand

This soil association is a band 4 to 6 miles wide and is roughly parallel to the Delaware River. It is adjacent to the Howell-Urban land association. It includes Runnemede, Barrington, Haddon Heights, and Haddonfield and many subdivisions, such as the Barclay Farms and Kingston Estates.

Generally, slopes in this association are gentle, but immediately adjacent to streams they are strong to steep. The soils are at elevations ranging from 40 to 120 feet. The slope generally is toward the Delaware River. The parent materials of soils in this association are mostly fine sand but include some silt and clay. All of the materials contain glauconite. The soil materials formed from geologic formations locally called the Englishtown, Marshalltown, and Mt. Laurel-Wenonah.

The dominant soils in the association are the Freehold, Holmdel, and Collington. Freehold and Collington soils are well drained. Holmdel soils are moderately well drained to somewhat poorly drained and have a high water table late in winter and during prolonged wet periods.

Shrewsbury soils are the minor soils in the association.

The soils in this association are fertile, and nearly all the gentle slopes have been cleared for farming. Now more than half of the acreage is in urban uses, and the rest is rapidly being converted from farmland and woodland to urban uses. Deep drainage is needed on Holmdel soils to prevent flooding and to allow septic fields to operate. If Shrewsbury soils are used in urban development, deep drainage is needed to lower the high water table.

Septic fields are generally satisfactory in this association, except where the soils are underlain by a clayey layer. The steep slopes adjacent to streams are suitable for use as parks, such as the Pennypacker Park along the Cooper River in Haddonfield.

4. Howell-Urban land association: Gently sloping, brown silty and clayey soils

This soil association is a band 1 to 3 miles wide and is roughly parallel to the Delaware River. It includes parts of Bellmawr, Northmont, Audubon Park, Oaklyn, Collingswood, and Merchantville. The soils are gently sloping and occupy elevations that range from 20 to nearly 100 feet. The parent materials are silty and clayey marine deposits as much as 110 feet thick. Locally these deposits are called the Merchantville and Woodbury clays. Runoff is high because water soaks into these materials very slowly.

Dominant in this association are the Howell soils and Urban-Moderately wet land complex. The Howell soils occupy the higher elevations and are well drained or moderately well drained. Urban-Moderately wet land complex occupies the lower positions in the landscape.

Minor soils in this association are the Freehold, Holmdel, and Downer.

Nearly all of this association is used as sites for industry, commerce, residences, recreation, and other urban projects. Because the soils are slowly permeable, they are generally not suitable as disposal fields for septic systems. Urban-Moderately wet land complex is low and subject to flooding. If basements are constructed on this land, deep drainage is needed.

5. Lakewood-Lakehurst-Lakeland association: Level to steep, gray sandy soils

The strongly sloping to steep areas of this association occur in a wavy strip at relatively high elevations; the nearly level areas occur adjacent to the major east-flowing streams just above the border of swamps. The association consists of deep sandy soils, most of which have a bleached, gray surface layer.

The parent material of soils in this association is sand. Part of the western area is from the Kirkwood geologic formation and is dominantly fine sand; the rest of the association is from the Cohansey formation and is dominantly medium and coarse sand. Soils on high elevations are well drained, but those on the lower sites have a high water table.

The dominant soils in this association are the Lakewood, Lakehurst, and Lakeland, named in order of extent. Because they are so droughty and so infertile, less than 10 percent of their acreage has been cleared for farming. The Lakewood and the Lakeland soils are excessively drained, but the Lakehurst soils have a fluctuating water table. Septic fields work well in Lakewood and Lakeland soils but are hampered by a high water table in the Lakehurst soils. The soils are suitable for building sites, but droughtiness and low natural fertility are problems in establishing and maintaining plants for landscaping and lawn grasses. Some of the areas are too steep for residences of the customary design and construction.

Minor soils in this association are Leon sand, St. Johns sand, Sandy alluvial land, and Muck. All these soils have a high water table, which makes them unsuitable for most urban uses.

6. Muck-Alluvial land association: Wet soils mainly along streams

This soil association occurs in nearly level areas adjacent to all the major streams in the county. The soils are frequently flooded.

Along the streams flowing westward, the dominant soils are Sandy alluvial land and Loamy alluvial land. These soils are on narrow flood plains. Most of the acreage is in woodland, but small areas have been converted to parks and other recreational use. Because of a high water table and flood hazard, these areas are not suitable for building sites.

Along the streams flowing eastward, the slopes are more gentle. The dominant soils along these streams are Muck, Sandy alluvial land, Leon sand, and St. Johns sand. Most of their acreage is in woodland made up of white-cedar or pine. The Muck and Sandy alluvial land are not suitable for farming, except for such special crops as cranberries and blueberries. St. Johns sand and Leon sand are well suited to blueberries, provided water-level control is established.

Minor soils in this association are the Fallsington and Pocomoke, which occur in places near the headwaters of streams.

7. Marlton-Kresson association: Gently sloping to steep, olive clay soils

This soil association is in a narrow, wavy strip 1/4 mile to 1 1/2 miles wide. It extends across the county from near Lakeland toward Marlton in Burlington County. The Marlton soil was named for the community of Marlton. The association occupies parts of Blenheim, Hi-Nella, Somerdale, Magnolia, Osage, and Ashland. The area is at elevations ranging from about 40 feet to about 90 feet. Slopes range from nearly level to steep.

The parent material of the soils in this association is from the Hornerstown geologic formation. This formation consists of highly glauconitic marine deposits of sandy loam and clay in alternate layers. Near the surface, the material is olive colored. The association is pitted by excavations of the highly glauconitic underlying material, locally called marl. This material was used in early times as fertilizer.

The dominant soils in the association are the Marlton and the Kresson. The Marlton soils are well drained or moderately well drained and occupy high and intermediate elevations. The Kresson soils are somewhat poorly drained and are in relatively low positions where a high water table and flooding are problems.

The soils in this association are fertile, but they are hard to work because of their high content of clay. Because the association is narrow and has a wavy boundary, it has no particular type of farming. Corn, small grain, forage crops, and tomatoes are commonly grown. Septic fields on Marlton soils generally need to be of special design; they are unsatisfactory on Kresson soils because of flooding and a high water table.

8. Westphalia-Nixonton-Barclay association: Nearly level to steep, fine sandy soils

This soil association, a wide wavy strip parallel to the Delaware River, is 1 mile to 5 miles wide and is upslope from the Marlton-Kresson association. It includes parts of the communities of Lakeland, Clementon, Lindenwold, Kirkwood, Gibbsboro, Glendale, and Kresson. The association slopes westward toward the Delaware River, and the slopes range from nearly level to steep. Elevations range from 40 feet to about 120 feet.

The dominant soils in the association are the Westphalia, Nixonton, and Barclay. Westphalia soils make up about 70 percent of the acreage and Barclay soils about 10 percent. Minor soils make up the rest. All of these soils formed in thick beds of fine sand in a geologic formation locally called the Kirkwood. The Westphalia soils occur at high elevations and are well drained. Downslope from them are the Nixonton and the Barclay soils. Nixonton soils are moderately well drained, and the Barclay soils are somewhat poorly drained. Inadequately drained soils occur far up the slope in this association.

Minor soils in this association are the Pasquotank, Weeksville, Sandy alluvial land, and Loamy alluvial land. These soils are all poorly drained or very poorly drained because they are in low positions where there is a high or perched water table, flooding, or both.

The soils in this association are moderately fertile. Most of the gently sloping soils have been cleared for farming and are used mainly for fruit and vegetables. Small steep areas and some wet areas are still in woodland consisting of yellow-poplar and holly.

Because the soils in this association are made up of uniformly fine sand, they have unusual characteristics that limit their use. Permeability of the subsoil is slow. Capillary movement of water is moderate. When the soils are saturated, they have low shear strength and flow readily. This makes ditchbanks very erodible and allows vertical cuts to collapse readily. A special design of foundations is needed if these soils are to be used for buildings.

Septic fields generally are satisfactory on Westphalia soils, but drainage is needed if Nixonton and Barclay soils are to be used for septic systems.

Descriptions of the Soils

This section describes the soil series (group of soils) and single soils (mapping units) of Camden County. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

The procedure in this section is first to describe the soil series, and then the mapping units in that series. Thus, to get full information of any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in "How this Soil Survey was Made," a few of the mapping units are not members of soil series. Loamy alluvial land, Clay pits, and other miscellaneous land types do not belong to a soil series but, nevertheless, are listed along with the soil series.

A soil symbol in parentheses follows each mapping unit and identifies that unit on the detailed soil map.

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

Soil	Area	Extent
	Acres	*Percent*
Aura loamy sand, 0 to 2 percent slopes	400	0.3
Aura loamy sand, 2 to 5 percent slopes	3,000	2.1
Aura sandy loam, 0 to 2 percent slopes	1,100	.8
Aura sandy loam, 2 to 5 percent slopes	3,000	2.1
Aura-Downer loamy sands, 0 to 5 percent slopes	1,700	1.2
Aura-Downer sandy loams, 0 to 5 percent slopes	1,200	.8
Aura-Urban land complex	250	.2
Clay pits	100	(1)
Colemantown loam	200	.1
Collington fine sandy loam, 0 to 2 percent slopes	800	.6
Collington fine sandy loam, 2 to 5 percent slopes	600	.4
Downer loamy sand, 0 to 5 percent slopes	18,000	12.8
Downer loamy sand, clayey substratum, 0 to 5 percent slopes	300	.2
Downer sandy loam, 0 to 2 percent slopes	800	.6
Downer sandy loam, 2 to 5 percent slopes	900	.6
Downer soils, 5 to 10 percent slopes	1,000	.7
Downer-Aura complex, 5 to 10 percent slopes	400	.3
Fallsington sandy loam	1,300	.9
Freehold fine sandy loam, 0 to 2 percent slopes	1,000	.7
Freehold fine sandy loam, 2 to 5 percent slopes	2,500	1.8
Freehold fine sandy loam, 5 to 10 percent slopes	700	.5
Freehold loamy fine sand, 0 to 5 percent slopes	2,000	1.4
Freehold loamy fine sand, 5 to 10 percent slopes	300	.2
Freehold sand, thick surface variant, 0 to 5 percent slopes	500	.4
Freehold soils, 15 to 30 percent slopes	400	.3
Freehold and Collington soils, 10 to 15 percent slopes	400	.3
Freehold and Downer-Urban land complex, gently sloping	13,000	9.2
Freehold and Downer-Urban land complex, sloping	300	.2
Freehold and Downer, clayey substrata, -Urban land complex	1,300	.9
Holmdel fine sandy loam, 0 to 3 percent slopes	3,000	2.1
Holmdel loamy fine sand, 0 to 3 percent slopes	300	.2
Holmdel, clayey substratum, -Urban land complex	400	.3
Holmdel-Urban land complex	1,000	.7
Howell-Urban land complex, gently sloping	1,300	.9
Howell-Urban land complex, sloping	100	(1)
Klej loamy sand, 0 to 2 percent slopes	300	.2
Kresson sandy loam, 0 to 3 percent slopes	250	.2
Lakehurst sand, 0 to 3 percent slopes	2,350	1.6
Lakehurst-Lakewood association, 0 to 5 percent slopes	3,400	2.4
Lakeland fine sand, firm substratum, 0 to 5 percent slopes	2,300	1.6
Lakeland sand, 0 to 5 percent slopes	1,500	1.1
Lakeland sand, water table, 0 to 2 percent slopes	500	.4
Lakewood fine sand, 0 to 5 percent slopes	1,000	.7
Lakewood fine sand, 5 to 10 percent slopes	500	.4
Lakewood fine sand, 10 to 25 percent slopes	200	.1

Soil	Area	Extent
	Acres	*Percent*
Lakewood sand, 0 to 5 percent slopes	8,000	5.7
Lakewood sand, 5 to 10 percent slopes	700	.5
Lakewood and Lakeland sands, 10 to 30 percent slopes	2,000	1.4
Leon sand	3,000	2.1
Leon-St. Johns sands	3,500	2.5
Loamy alluvial land	2,300	1.6
Made land	1,500	1.0
Marlton sandy loam, 0 to 2 percent slopes	300	.2
Marlton sandy loam, 2 to 5 percent slopes	300	.2
Marlton soils, 5 to 10 percent slopes, severely eroded	100	(1)
Marlton and Kresson-Urban land complex	800	.6
Matawan loamy sand, 0 to 5 percent slopes	250	.2
Matawan sandy loam, 0 to 2 percent slopes	300	.2
Matawan sandy loam, 2 to 5 percent slopes	150	.1
Moderately wet land	400	.3
Muck	6,700	4.8
Nixonton and Barclay fine sandy loams, 0 to 3 percent slopes	450	.3
Nixonton and Barclay loamy fine sands, 0 to 5 percent slopes	350	.3
Pasquotank fine sandy loam	2,000	1.4
Pasquotank and Weeksville-Urban land complex	700	.5
Pocomoke sandy loam	800	.6
St. Johns sand	1,000	.7
St. Johns sand, clayey substratum	500	.4
Sand and gravel pits	1,500	1.0
Sandy alluvial land	2,000	1.4
Shrewsbury fine sandy loam	1,000	.7
Shrewsbury-Urban land complex	250	.2
Tidal marsh-Made land complex	300	.2
Urban-Moderately wet land complex	1,000	.7
Weeksville fine sandy loam	300	.2
Westphalia fine sandy loam, 0 to 5 percent slopes	700	.5
Westphalia loamy fine sand, 0 to 5 percent slopes	800	.6
Westphalia loamy fine sand, 5 to 10 percent slopes	300	.2
Westphalia soils, 10 to 20 percent slopes	350	.3
Westphalia soils, 10 to 20 percent slopes, severely eroded	150	.1
Westphalia and Nixonton-Urban land complex	4,000	2.9
Woodstown and Dragston sandy loams, 0 to 3 percent slopes	800	.6
Woodstown and Klej loamy sands, 0 to 3 percent slopes	2,300	1.6
Woodstown and Klej loamy sands, clayey substrata, 0 to 3 percent slopes	300	.2
Unmapped city of Camden	13,400	9.5
Total	141,400	100.0

[1] Less than 0.1 percent.

Listed at the end of the description of a mapping unit are the capability unit, the woodland suitability group, and the urban group in which that kind of soil has been placed. Some mapping units have been placed only in urban groups. The pages on which the capability unit, and woodland suitability group are described can be found readily by referring to the "Guide to Mapping Units, Capability Units, and Woodland Groups," at the back of the report.

Soil scientists, teachers, engineers, foresters, and others who want more detailed information about the soils should turn to the section "Formation and Classification of Soils." Many terms used in the soil descriptions and in other sections of the report are defined in the Glossary.

Aura Series

The Aura series consists of dark grayish-brown, well-drained, sandy soils in high positions. The soils are nearly level to gently sloping. In the upper 2 feet, they contain variable amounts of quartzose gravel (fig. 4). The lower part of the subsoil is firm, reddish coarse sandy clay loam that restricts root growth.

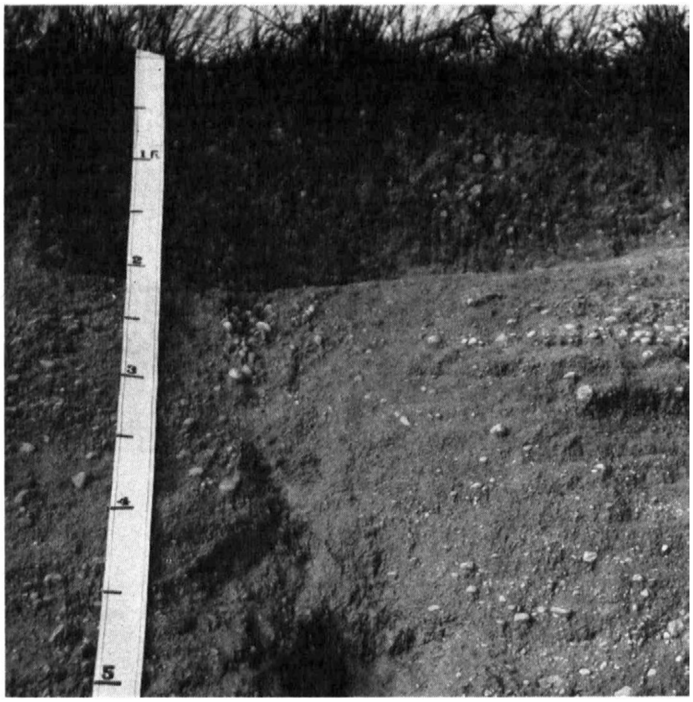

Figure 4.—**Profile of Aura soil that contains a considerable amount of gravel.**

The natural vegetation consists of mixed oak trees and lowbush blueberries and other shrubs. Pines, however, have seeded in abandoned fields where seed trees are nearby.

In a typical profile of a cultivated Aura soil the surface layer is dark grayish-brown sandy loam about 10 inches thick; the subsurface layer is yellowish-brown sandy loam about 5 inches thick. The upper part of the subsoil is yellowish-brown sandy loam about 9 inches thick, and the lower part is firm, yellowish-red sandy clay loam 16 to 30 inches thick. Below the subsoil is loose, sandier material. The firm subsoil layer is hard when moist and very hard when dry.

The depth to the firm layer averages 24 inches but ranges from 18 to 30 inches. Generally, the subsoil texture ranges from heavy sandy loam to sandy clay, but it is most commonly sandy clay loam. However, small pockets of more sandy deposits occur within these soils.

The Aura soils naturally are extremely acid, but some farmed fields have been limed heavily and are now less acid. A traffic pan forms readily if heavy tillage implements are used. Because water moves slowly through the subsurface layer and subsoil, runoff is more rapid, and the hazard of erosion is greater than the gentle slopes would suggest. Irrigation water should be applied slowly. The quantity of water available for plants is low because the average penetration by roots is only about 2 feet. Irrigation water that reaches a depth of more than 2 feet is largely wasted. Land smoothing is somewhat restricted because deep excavations would expose the firm, compact subsoil.

The Aura soils are most extensive on the divide near Sicklerville, but they occur in small areas throughout the eastern part of the county. They generally occur beside the Downer and Woodstown soils. Aura soils are redder and firmer than the Downer soils. Also, they do not have mottling, which is common in the Woodstown soils.

Because Aura soils are well drained and are in high positions where air drainage is good, they are frequently used for fruit production. These soils are also suitable for vegetables. The Aura sandy loams are suitable for general crops. Aura soils contain more gravel than any other soils in the county, but the gravel in the surface layer hinders cultivation only in places. Crops of high value are normally irrigated.

(AmA) **Aura loamy sand, 0 to 2 percent slopes.**—The surface and subsurface layers of this soil total about 18 inches in thickness. These layers are made up of loose loamy sand instead of the sandy loam described as typical of the Aura series. Small areas of Downer soils are included with this soil in mapping.

The soil is easy to cultivate, but it is subject to blowing, and crops on it are subject to sandblasting. It is droughty and is generally irrigated if used for crops of high value. If this soil is used for homesites it should be planted to drought-resistant grasses and regularly watered and fertilized. (Capability unit IIIs-10; woodland suitability group 3; urban group 3)

(AmB) **Aura loamy sand, 2 to 5 percent slopes.**—The total thickness of the surface and subsurface layers is about 12 inches. Small areas of Downer soils are included with this soil in mapping. Also included are small areas with slopes steeper than 5 percent.

This soil is easy to cultivate, but it is less productive and is more droughty than the Aura sandy loams. Also, it is subject to wind erosion. (Capability unit IIIs-10; woodland suitability group 3; urban group 3)

(ArA) **Aura sandy loam, 0 to 2 percent slopes.**—The profile of this soil is the one described as typical of the Aura series. Small areas of Downer soils are commonly included with this soil in mapping. Also included are small areas of Woodstown sandy loam.

This soil is suited to fruits, vegetables, and general crops. If the soil is irrigated, water must be applied slowly, as the soil is moderately to slowly permeable. A compact lower subsoil inhibits root penetration. If the areas of Woodstown sandy loam are used for crops of high value, they may require drainage. (Capability unit IIs-9; woodland suitability group 3; urban group 3)

(ArB) **Aura sandy loam, 2 to 5 percent slopes.**—This soil is similar to Aura sandy loam, 0 to 2 percent slopes, but it is more sloping and thus is subject to runoff and erosion. The surface layer is several inches thinner than that of the less sloping soil, and in small eroded areas plowing has mixed some of the stickier reddish subsoil into the surface layer. Small areas of Downer soils are included with this soil in mapping.

This soil is suited to fruits, vegetables, and general corps. Use of contour tillage, cover crops, and an occasional sod crop in the cropping sequence helps to control erosion and to maintain a porous plow layer. (Capability unit IIs-9; woodland suitability group 3; urban group 3)

(AtB) **Aura-Downer loamy sands, 0 to 5 percent slopes.**—About half of this complex is Aura loamy sand, and the rest is Downer loamy sand and other soils. These soils occur in such an intricate pattern that they cannot easily be mapped separately.

The Aura soils generally are in slightly higher positions than Downer soils. The same crops can be grown on both soils, and yields are about the same. Land smoothing, however, is severely limited on the Aura soils, because their firm lower subsoil restricts root penetration and slows permeability.

The characteristics and qualities of a typical Downer soil are described under the Downer series.

If possible, septic fields should be on the more permeable Downer soils. Percolation tests are helpful in locating the more permeable areas. (Capability unit IIIs-10, Aura loamy sand part; capability unit IIs-6, Downer loamy sand part; woodland suitability group 3; urban group 3, Aura loamy sand part; urban group 2, Downer loamy sand part)

(AvB) **Aura-Downer sandy loams, 0 to 5 percent slopes.**—About 60 percent of this complex is Aura sandy loam, and about 40 percent is Downer sandy loam and other soils. In Camden County these soils occur in such an intricate pattern that they cannot easily be mapped separately at the scale used.

The Aura soils occupy higher positions than the Downer soils. The same crops can be grown on both soils, and yields are about the same. Land smoothing is difficult on the Aura soils but commonly is not difficult on the Downer soils.

The characteristics and qualities of a typical Downer soil are described under the Downer series.

If possible, septic fields should be on the more permeable Downer soils. Percolation tests can be made to locate these areas. (Capability unit IIs-9; woodland suitability group 3; urban group 3, Aura sandy loam part; urban group 2, Downer sandy loam part)

(Ax) **Aura-Urban land complex.**—This mapping unit contains mostly Aura soils that are used for urban or suburban purposes. The slope is generally less than 5 percent. Residences or commercial buildings are in most areas, though some areas are vacant. A normal soil profile is described for the Aura series, but between 30 and 40 percent of the soil in this mapping unit has been disturbed by construction. (Urban group 3)

Barclay Series

In the Barclay series are dark grayish-brown, somewhat poorly drained, sandy soils in low positions. They developed in deposits of uniformly fine sand. The soils are gently sloping, and runoff is slow.

The natural vegetation is southern red oak, white oak, pin oak, willow oak, yellow-poplar, beech, holly, and scattered sweetgum. Lowbush blueberry is the most common shrub.

In a typical profile of a cultivated Barclay soil, the surface layer is dark grayish-brown fine sandy loam about 10 inches thick. It is underlain by a light brownish-gray, mottled subsurface layer that extends to a depth of 16 inches. The subsoil is mottled light olive-brown very fine sandy loam. Below a depth of 25 to 30 inches is stratified fine sandy loam and loamy fine sand that is generally light brownish gray, grayish brown, or yellowish brown.

The Barclay soils are naturally extremely acid, but some farmed fields have been limed heavily and are now less acid. In winter in their natural undrained condition, the soils contain a perched water table that reaches to within 16 inches of the surface. The water table in summer, however, is below a depth of 5 feet. Unless drained, these soils are somewhat restricted in use. The soils are slowly permeable, and the capillary movement of water is moderate. The banks of drainage ditches slough severely when the soils are saturated. If tile drains are used, special precautions are needed to prevent fine sand from entering and clogging the drains.

Barclay soils occupy higher positions than the sandy Pasquotank soils and are not so gray as those soils. They are distinguished from the Nixonton soils by mottling in the subsurface layer or in the upper part of the subsoil.

If adequately drained, these soils are well suited to general farm crops and to vegetables of high value. They do not warm early enough in spring for early vegetables.

In Camden County, Barclay soils are mapped only in an undifferentiated unit with the Nixonton soils.

(Ca) Clay Pits

This mapping unit consists of clay pits now in use and others that have been abandoned. The clay is used primarily for making bricks. The pits vary in size, shape, and depth. Most abandoned pits fill with water if they are in relatively low positions. For example, Virginia Lake near Tansboro is at an elevation of 137 feet. Less than one-fourth mile north of Tansboro, however, the pits at elevations above 170 feet contain little water.

Included in mapped areas of this unit are spoil banks consisting of overburden adjacent to large pits.

Clay generally is excavated for brickmaking only where the deposits are extensive and thick. Thus, in some places, Clay pits indicate the kind of underlying material in the vicinity of the pits.

Colemantown Series

The Colemantown series consists of mottled dark-gray, poorly drained, loamy soils underlain by a prominently mottled, olive sandy clay subsoil. The substratum is stratified sandier material. Because these soils are nearly level or gently sloping, runoff is slow. In places the soils are ponded. The Colemantown soils contain a large amount of glauconite.

The natural vegetation consists of pin, swamp white, and willow oaks and scattered sweetgum trees. But sweetgum forms a pure, early stand in fields that have been left idle. Shrubs of dentate viburnum and spicebush generally form a dense stand.

In a typical profile of Colemantown soils, the surface layer is mottled very dark gray and dark reddish-brown loam about 10 inches thick; the subsoil is prominently mottled sandy clay that has blocky structure. The substratum consists of stratified, friable sandy loam and sandy clay. These layers have a dark-olive color because they contain large amounts of glauconite.

The Colemantown soils occupy a low position in the landscape and therefore are likely to receive deposits of sandy material from adjacent soils.

The Colemantown soils occur mostly beside the Kresson and Marlton soils. The surface soil of the Colemantown soils is darker colored and mottling is closer to the surface than in the Kresson or Marlton soils.

(Cm) **Colemantown loam.**—This is the only Colemantown soil mapped in the county.

In places, small areas of sandy loam are included. In some places, the color of the surface layer is nearly black. Also, in places the texture of the subsoil is sandy clay loam.

Colemantown loam naturally is extremely acid, but some farmed fields have been heavily limed and are now less acid. The water table in winter is near the surface, or the soil is ponded unless drained. In summer the water table is 3 or more feet below the surface. Normally, water is held high in the soil by the sandy clay subsoil, but in places free water also occurs in the sandier substratum. In places water in the substratum is under pressure and rises to the surface if the subsoil is punctured. If Colemantown soil is to be farmed, it must first be drained. Surface drainage is needed for growing any crop, and subsoil drainage is needed for most special crops.

If it is adequately drained, this soil is suitable for general crops, hay, and pasture. It warms slowly in spring, and dries out slowly after wetting. Because of the relatively high clay content of the surface layer, this soil is difficult to work. Permeability is too slow for the general use of tile to remove surface water. The soil is moderately productive after drainage.

Because the soil occupies a low position in the landscape, crops on it are subject to severe frost damage. The loam surface soil is subject to severe frost heaving. (Capability unit IIIw–18; woodland suitability group 4; urban group 9)

Collington Series

The Collington series consists of dark grayish-brown, well-drained soils. They have a medium textured or moderately fine textured subsoil in which glauconite is evident. The subsoil is distinctly more clayey than the surface layer. The soils are mostly nearly level to gently sloping and are on divides in high positions.

The natural vegetation consists of hardwoods, mostly red oak, beech, and yellow-poplar.

A typical profile of a cultivated Collington soil has a dark grayish-brown, fine sandy loam plow layer about 9 inches thick; a brown, fine sandy loam subsurface layer about 4 inches thick; and a brown or olive-brown, fine sandy clay loam subsoil about 20 inches thick. The subsoil overlies stratified loamy sand and sandy loam that extends to a depth of 60 inches. The layers of loamy sand and sandy loam range from strong brown to olive brown in color.

The colors in the subsoil are redder in soils that formed in high positions where oxidation is favorable and in soils that formed from reddish parent material. Rounded quartz pebbles occur in places, especially in the substratum, but they are not found everywhere. In some places the soils are underlain by highly glauconitic sandy clay.

The Collington soils naturally are extremely acid, but some fields have been heavily limed and are now less acid. The soils are moderately fertile and are moderately to slowly permeable. They are easy to work and respond well to fertilization.

The Collington soils are in the greensand area in soil association 3. They commonly occur beside the Freehold, Holmdel, and Marlton soils. A uniformly colored subsoil distinguishes the Collington soils from the Holmdel soils, which have a mottled subsoil. The subsoil of the Collington soils is not so olive colored nor so clayey as the subsoil of Marlton soils, but it is more olive colored and has a higher content of glauconite than the subsoil of the Freehold soils.

The Collington soils are well suited to most vegetables of high value, and these crops are generally irrigated. These soils are also suited to hay, pasture, and general crops.

(CoA) **Collington fine sandy loam, 0 to 2 percent slopes.**—There is little erosion on this nearly level soil. Nearly all areas are farmed. Annual cover crops or deep-rooted crops help to maintain a porous plow layer. Small circular areas of Holmdel soils in depressions are included in mapped areas of this soil, and these areas may require drainage.

This soil is well suited to most urban uses, and much of the acreage is being converted to those uses. Establishing a lawn and landscaping generally do not involve any unusual problems. Except where there are underlying clayey layers, there should be no basement seepage or septic field problems. (Capability unit I–5; woodland suitability group 1; urban group 1)

(CoB) **Collington fine sandy loam, 2 to 5 percent slopes.**—This soil is susceptible to erosion if it is farmed. In some fields, sheet erosion has reduced the thickness of the surface layer to 8 inches or less. If these eroded areas are plowed, the more clayey and sticky subsoil is mixed with the friable surface layer.

If vegetables are grown on this soil, use contour farming and plant annual cover crops to help reduce erosion. If general crops are grown, use alternate contour strips of hay crops. In apple orchards use a complete cover of sod; and in peach orchards use alternate strips of sod. (Capability unit IIe–5; woodland suitability group 1; urban group 1)

Downer Series

The Downer series consists of dark grayish-brown, well-drained soils that have a yellowish-brown subsoil containing only a little more clay than the surface layer. These soils are nearly level to gently sloping and occur on divides and below the divides. The natural vegetation consists mostly of pine and oak.

In a typical profile of a cultivated Downer soil, the surface layer is dark grayish-brown, loose loamy sand about 10 inches thick; the subsurface layer is yellowish-brown, loose loamy sand about 8 inches thick; the subsoil is yellowish-brown sandy loam about 12 inches thick; and the substratum is stratified, loose loamy sand. Quartz gravel, although conspicuous in places, is rarely abundant and is not a typical component of the Downer soils.

In places the Downer soils are as shallow as 20 to 24 inches to loose sand. The shallow areas are droughty. In some places the substratum contains a considerable amount of gravel, and in other places it has clayey layers. The areas containing clayey layers are not so droughty as the more sandy areas.

The Downer soils are naturally extremely acid, but some farmed fields have been heavily limed and are now less acid, even to a depth of 3 to 5 feet. These soils are moderately permeable to rapidly permeable. Excess water drains away easily, and the soils can be worked soon after rains. The soils have low natural fertility and low available moisture holding capacity.

If the soils are used for crops of high value, they generally need to be irrigated. They are too droughty, however, for good yields of hay and pasture. They warm early enough in spring for early vegetables. They are also suitable for fruit production.

(DoA) **Downer loamy sand, 0 to 5 percent slopes.**—Generally, the total thickness of the surface and subsurface layers of this soil is about 18 inches. The surface layer is loose and is subject to blowing. Included in areas mapped as this soil are small areas of Aura soils and a few of Matawan soils.

The water-holding capacity of this soil is low. Movement of water through this soil is moderate to rapid. It is too low for good yields of hay and pasture. The soil is suited, however, to sweetpotatoes and early vegetables. Irrigation is needed if summer vegetables are grown. If the soil is used for homesites, it should be seeded to drought-resistant lawn grasses and fertilized and watered regularly. (Capability unit IIs–6; woodland suitability group 3; urban group 2)

(DrA) **Downer loamy sand, clayey substratum, 0 to 5 percent slopes.**—The profile of this soil is like that described as typical of the Downer soils except that clay or sandy clay layers occur at a depth between 30 and 60 inches. Even though the clayey layers are thin and are only a small part of the substratum, they reduce the permeability of the soil from rapid to moderate. This soil also holds excess water longer and holds more moisture available for deep-rooted plants than Downer loamy sand, 0 to 5 percent slopes.

In places the underlying clayey layers reduce permeability enough to cause a temporary perched water table. If the soil is used for urban purposes, this water table may cause basement seepage and septic field problems unless special precautions are taken. (Capability unit IIs-6; woodland suitability group 1; urban group 2)

(DsA) **Downer sandy loam, 0 to 2 percent slopes.**—The total thickness of the surface and subsurface layers of this soil is about 12 inches; the thickness of the subsoil is about 12 inches. In places, however, the total thickness of the surface and subsurface layers and the subsoil is only 20 inches. Because the soil is moderately coarse textured and is shallow to loose sand, it holds little water. Plants on this soil need to be irrigated and fertilized frequently. (Capability unit I–5; woodland suitability group 3; urban group 2)

(DsB) **Downer sandy loam, 2 to 5 percent slopes.**—The content of gravel in this soil varies but is greater where the soil adjoins the Aura soils. In some eroded fields, plowing has mixed some of the subsoil with the plow layer. Small areas of Aura soils are included in mapped areas of this soil.

This soil is subject to erosion if farmed. Contour planting and cover crops help to reduce erosion. (Capability unit IIe–5; woodland suitability group 3; urban group 2)

(DtC) **Downer soils, 5 to 10 percent slopes.**—This mapping unit consists of areas (dominantly Downer soils) that have loamy sand and sandy loam surface soils. The dominant texture, however, is loamy sand. The surface soil ranges from 6 to 16 inches in thickness and averages about 10 inches.

The erosion hazard is severe if these sandy soils are farmed. Contour farming, diversion terraces, and cover crops can be used to reduce the erosion hazard. (Capability unit IIIe–6; woodland suitability group 3; urban group 4)

(DxC) **Downer-Aura complex, 5 to 10 percent slopes.**—The Downer soils predominate in this complex, but they are so intermingled with areas of Aura soils that the two soils cannot feasibly be mapped separately at the scale used. A typical profile of an Aura soil is described for the Aura series

The soils in this complex are subject to erosion if plowed. Contour plowing and diversion terraces help to reduce the erosion hazard. No special farm management is needed, because these soils occur together.

If septic fields are used on this soil complex, they should be on the more permeable Downer soils, if possible. A percolation test at the site is helpful in determining the best location. (Capability unit IIIe–6; woodland suitability group 3; urban group 4)

Dragston Series

The Dragston series consists of very dark grayish-brown, somewhat poorly drained soils that formed in moderately coarse textured material. Mottles are generally distinct or prominent in the subsoil but are less distinct and fewer in the subsurface layer. Dragston soils are in the eastern part of the county in relatively low positions and have slopes of less than 1 percent.

The natural vegetation consists of white, red, and black oaks and, in places, yellow-poplar, sweetgum, pitch pine, and beech.

In a typical profile of a cultivated Dragston soil, the plow layer is very dark grayish-brown sandy loam about 10 inches thick. The subsoil is mottled yellowish-brown or light olive-brown sandy loam that is slightly more clayey than the surface layer. At a depth of 30 inches is a layer of grayish-brown, loose coarse sand and various amounts of rounded quartzose gravel.

In places the solum of Dragston soils is only 24 inches thick. Also, in some places the substratum contains layers that are finer than sand. Some areas of this soil are more brightly colored than normal. The texture of the subsoil ranges from sandy loam to sandy clay loam, but sandy loam is dominant.

The Dragston soils are extremely acid, but some farmed fields have been heavily limed and now are less acid, even to a depth of several feet. In their natural state, these soils have a subsoil that is saturated in winter by a high water table. The wet subsoil delays farming operations in spring and restricts the kinds of crops that can be grown. Most farmed areas, however, have now been artificially drained. Permeability is moderate to a depth of 30 inches and is rapid below that depth, unless a clay layer is present. Deep clay layers (below 60 inches) normally cause the water table to be high. Underground drains work satisfactorily in most places.

The Dragston soils occur beside the Woodstown, Fallsington, Aura, and Downer soils. Mottling in the subsoil distinguishes them from the Downer and Aura soils. They are not so gray as the Fallsington soils, but they are grayer than the Woodstown soils and have mottles that are more distinct and nearer the surface.

If they are adequately drained, the soils are suited to vegetables and to general farm crops. Most areas have been cleared for farming.

In Camden County, Dragston soils are mapped only in an undifferentiated group, Woodstown and Dragston sandy loams, 0 to 3 percent slopes. The Woodstown soils are described under the Woodstown series.

Fallsington Series

The Fallsington series consists of grayish-colored, poorly drained, moderately coarse textured soils that are generally prominently mottled. They are in the southeastern part of the county in low positions and have slopes of less than 1 percent. Runoff is slow, and some areas are ponded.

The natural vegetation consists of pin, willow, and swamp white oaks and red maple. If seed trees are nearby, idle fields are rapidly seeded to pitch pine. There is generally a dense undergrowth of highbush blueberry, sheep laurel, gallberry, sweet pepperbush, and other shrubs.

A representative profile of Fallsington sandy loam has a dark-gray plow layer about 10 inches thick. The subsoil is grayish-brown sandy loam that is mottled with dark yellowish brown and has slightly more clay than the plow layer. It extends to a depth of about 24 inches. The underlying material is loose, light brownish-gray coarse loamy sand.

The subsoil ranges from sandy loam to sandy clay loam in texture. In places it extends to a depth of 30 to 36 inches. It ranges from gray to yellowish brown in color. In places the substratum has brighter colors. Rounded quartzose pebbles are common in the underlying material. The content ranges from 0 to 5 percent, by volume. Also in some areas the underlying material contains discontinuous lenses of clay, but it was not feasible to map these areas separately.

In their natural state, the Fallsington soils are extremely acid, but some farmed fields have been limed and are now less acid. Also, these soils are almost constantly wet. In winter the water table is near the surface; in summer it is about 2 feet below the surface. The soils are moderately permeable. Generally, tile drains or open ditches can be used to lower the water table. Because of the loose material in the substratum, deep ditches, especially in shallow soils, require careful management to prevent ditchbanks from caving in.

The Fallsington soils occur beside the Pocomoke, Woodstown, and Dragston soils. They are grayer than the Woodstown and Dragston soils. They are not so dark in the surface layer as the Pocomoke soils.

Without drainage, the Fallsington soils are not suitable for any kind of farming. If drained, they are suitable for blueberries and for annual vegetables that can withstand short periods of subsoil saturation. They are also suitable for general crops and pasture. The soils generally cannot be drained well enough to produce high-value perennial crops, such as asparagus, fruit, or alfalfa. They are generally suitable as sites for ponds that are supplied by groundwater.

(Fd) **Fallsington sandy loam.**—A profile of this soil is described for the Fallsington series. Small areas of Pocomoke sandy loam, Dragston sandy loam, and small areas of Fallsington loam are included with this soil in mapping.

In some circular depressions, clay layers occur between a depth of 30 and 60 inches from the surface. In these areas groundwater recharge may be slow if groundwater ponds are constructed. (Capability unit IIIw-21; woodland suitability group 4; urban group 9)

Freehold Series

The Freehold series consists of dark grayish-brown, well-drained, sandy soils that are low in glauconite. They occur in high positions in the western part of the county. Their subsoil is dark yellowish brown or brown. The substratum is stratified material that is mostly loamy sand but that also contains thin layers of sandy loam and clayey material. The finer material generally has a reddish color derived from iron coatings. Generally, the soils contain little quartzose gravel.

The natural vegetation consists mostly of red oak, beech, and yellow-poplar.

A typical profile of Freehold soil has a dark grayish-brown fine sandy loam plow layer 9 inches thick; a yellowish-brown fine sandy loam subsurface layer 6 inches thick; a dark yellowish-brown sandy clay loam subsoil 20 inches thick; and underlying layers of mostly stratified loamy sand and sandy loam. The underlying layers range in color from light olive brown to strong brown in places where the sand grains are coated with iron. There are thin ironstone sheets in some lower layers.

The subsoil ranges from fine sandy loam to sandy clay loam in texture. In high positions where oxidation takes place readily, the colors of the subsoil are somewhat redder than those in the typical Freehold soil. The thickness of the solum ranges from 30 to 42 inches. As a rule, Freehold soils contain little gravel (fig. 5).

The Freehold soils naturally are extremely acid, but some farmed fields have been limed and are now less acid. The soils are moderately fertile, moderately permeable, and have a moderate to good water-holding capacity.

Freehold soils occur beside the Holmdel, Shrewsbury, and Collington soils. They lack the mottling common in Holmdel and Shrewsbury soils. They contain less glauconite than Collington soils.

Nearly all the Freehold soils that have favorable slopes have been cleared for farming. They are highly prized for growing fruit, high-value vegetables, and nursery crops, as well as general crops of corn, small grain, hay, and soybeans.

(FfA) **Freehold fine sandy loam, 0 to 2 percent slopes.**—A profile of this soil is described as typical of the Freehold series. Included with this soil in mapping are small areas of Holmdel soils in depressions. These areas may need drainage if crops of high value are to be grown. Also included are areas that contain remnants of more recently deposited material. This material is redder and contains more gravel and less glauconite than normal for Freehold soils, and the sand is generally coarser. The same crops can be grown on this material, but the soil is less fertile and more droughty.

This soil is highly favorable to farming, as there is little erosion hazard and only minor problems of drainage in small areas. The use of cover crops or sod crops is needed to maintain a large amount of organic matter and a porous plow layer.

In places this soil is underlain by clay between a depth of 30 and 60 inches. The clay may cause the layer above to be saturated for brief periods. If this soil is used for a homesite, the clayey layer could cause basement seepage and restrict the use of the soil as a septic field. (Capability unit I–5; woodland suitability group 1; urban group 1)

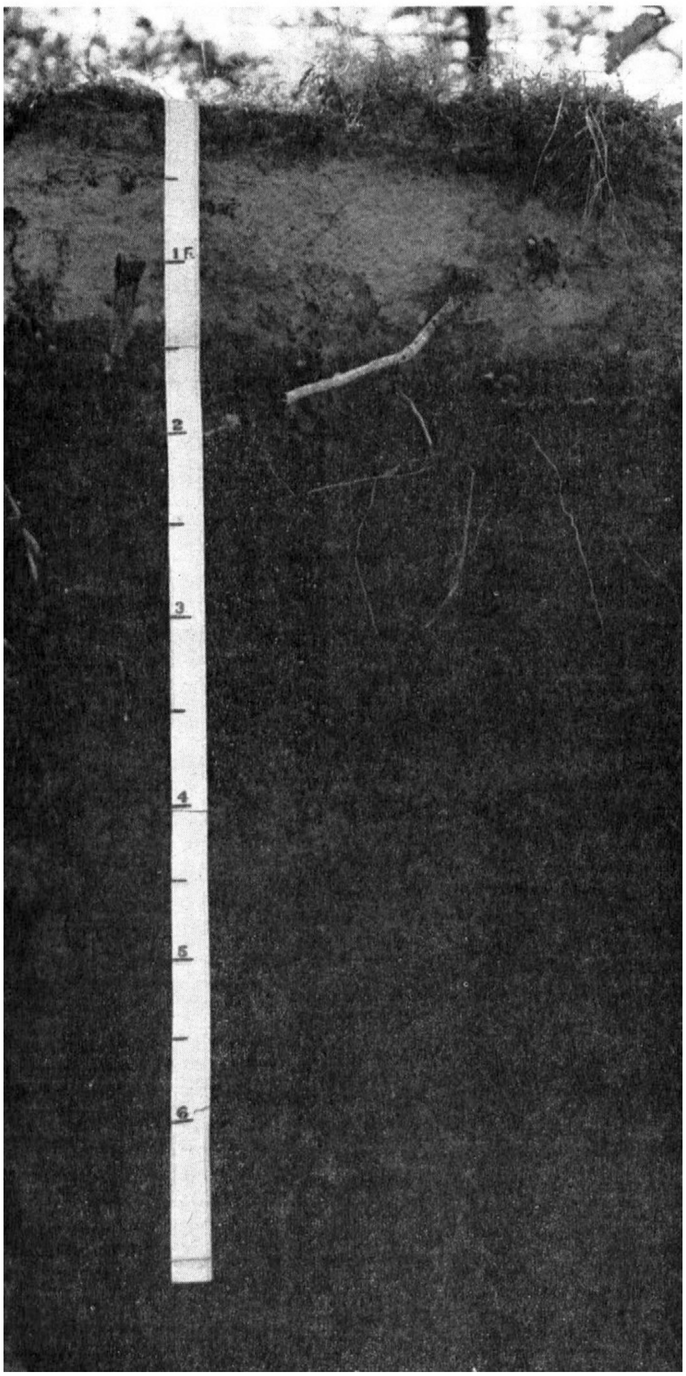

***Figure 5.*—A profile of Freehold loamy fine sand showing the loose surface layer.**

(FfB) **Freehold fine sandy loam, 2 to 5 percent slopes.**—Because this soil is more sloping than Freehold fine sandy loam, 0 to 2 percent slopes, runoff is more rapid and organic-matter content is more difficult to maintain. Unless erosion is controlled, it limits crop production. Contour planting, cover crops, and sod crops can be used to reduce the erosion hazard.

This soil is well suited to most urban uses. If underlying clay layers are present, however, they may cause basement seepage and slight problems in septic fields. (Capability unit IIe–5; woodland suitability group 1; urban group 1)

(FfC) **Freehold fine sandy loam, 5 to 10 percent slopes.**—Runoff is rapid on this sloping and strongly sloping soil. If not controlled, erosion is a serious hazard in plowed fields. In some fields erosion has removed part of the surface layer and has cut gullies. Yields of these fields are low, and soil management is more difficult. Contour planting, cover crops, and diversion terraces are practices that help to reduce the erosion hazard in cropped areas. In pasture land and in woodland, however, erosion is not a problem.

If this soil is used for homesites, erosion is a problem in establishing lawns. In some areas sodding may be required. The slope of this soil should be considered in the design of septic fields. (Capability unit IIIe–6; woodland suitability group 1; urban group 4)

(FhB) **Freehold loamy fine sand, 0 to 5 percent slopes.**—The total thickness of the surface and subsurface layers of this soil is about 18 inches. The surface layer is loose and therefore is subject to wind erosion. The subsoil contains considerably more clay than the surface soil. Because of the clay content, the subsoil is moderately permeable and has moderate available moisture holding capacity. This soil generally contains little or no gravel. Some areas that have a surface layer of sand are included with this soil in mapping.

This soil warms readily in spring and is well suited to early crops. Most crops of high value grown on this soil are irrigated. Because most slopes are short, there is little hazard of water erosion. Some erosion control practices may be needed on long slopes. Cover crops, wind stripcrops, and privet windbreaks can be used to reduce wind erosion

If this soil is used for homesites, drought-resistant grasses should be grown in lawns, and water and fertilizer should be regularly applied. (Capability unit IIs–6; woodland suitability group 1; urban group 2)

(FhC) **Freehold loamy fine sand, 5 to 10 percent slopes.**—This soil is like Freehold loamy fine sand, 0 to 5 percent slopes. It has stronger slopes than that soil, runoff is more rapid, and cultivated areas are more likely to have gullies and a thinner surface layer. This soil is more droughty than the less sloping Freehold loamy fine sand. Water erosion is more of a problem on this soil than wind erosion. Contour farming can be used to reduce water erosion.

If this soil is used for homesites, erosion is a problem in establishing a lawn. In some places sodding may be needed. Drought-resistant grasses should be grown, and water and fertilizer should be applied regularly to lawns and landscape plants. The slope should be considered in designing a septic field on this soil. (Capability unit IIIe–6; woodland suitability group 1; urban group 4)

(FnB) **Freehold sand, thick surface variant, 0 to 5 percent slopes.**—The total thickness of the surface and subsurface layers of this soil exceeds 30 inches. These layers are made up of loose sand. Because of the extreme thickness of the sand, this soil has little in common with the other Freehold soils. The sand makes it less fertile and and more droughty than the other Freehold soils. It is also more likely to be eroded by wind. The subsoil, however, contains enough clay to prevent rapid percolation of water and the leaching of added fertilizer. This clayey layer is about 1 foot thick and is underlain by loamy sand.

This soil is best suited to peach trees, apple trees, and grapevines, and other deep-rooted perennial plants. It is too sandy and droughty for pasture.

If this soil is used for homesites, the establishment of lawn grasses and landscape plants is severely limited, as the soil is droughty and infertile. Drought-resistant grasses or warm-climate grasses can be established by using plugs. Deep-rooted landscape plants are needed. Water and fertilizers should be applied frequently. (Capability unit IIIs–7; woodland suitability group 3; urban group 2)

(FsE) **Freehold soils, 15 to 30 percent slopes.**—These soils are chiefly in narrow bands on steep banks adjacent to streams. Nearly all the acreage is forested. Because of steepness and erosion, alternate layers of geologic deposits that have not been greatly altered by the soil-forming processes are exposed at the surface. The deposits are mainly sandy, though in places they are finer textured. Seeps occur if the sand lies over finer material. Runoff is rapid. Because of the erosion hazard, it would be better if these soils were not cleared for farming.

These soils generally occur near streams and have been developed in places as part of a park. (Capability unit VIe–5; woodland suitability group 1; urban group 11)

(FtD) **Freehold and Collington soils, 10 to 15 percent slopes.**—This group is composed mostly of Freehold fine sandy loam and Freehold loamy fine sand, but it also contains Collington soils of the same textures. In places, however, the soils are underlain by clayey deposits that cause seeps. Because the slopes are steep, runoff is rapid.

Small areas have been cleared for farming. The erosion hazard is very high in cultivated fields, and contour planting, hay strips, or diversion terraces are needed. In a few fields gullies have formed. In areas used for pasture and woodland, however, the erosion hazard is only slight. (Capability unit IVe–6; woodland suitability group 1; urban group 11)

(FxB) **Freehold and Downer-Urban land complex, gently sloping**—This mapping unit consists of Freehold and Downer soils in urban areas where it was impractical to map each soil separately. The Freehold soils are more extensive than the Downer soils. The slope ranges from 0 to 5 percent.

The soils in this complex are in urban or suburban use. Most areas are residential, but some are commercial, and some are idle. In the older developed areas where construction was mainly of single units, disturbance of the soil was restricted to the immediate location of the unit. In the newer areas, the disturbance has affected the entire area through stockpiling of surface soil, grading or leveling the area, excavating for foundations, and then replacing the surface soil after construction was finished. (Urban group 1, Freehold and Urban land parts; urban group 2, Downer part)

(FxC) **Freehold and Downer-Urban land complex, sloping.**—Except for stronger slopes, this complex is similar to Freehold and Downer-Urban land complex, gently sloping. The slope ranges from 5 to 15 percent.

Erosion of the soils in this complex is a problem. Also, the septic fields are more difficult to install on these soils than on the less sloping soils, and they do not function so well. (Urban group 4)

(Fy) **Freehold and Downer, clayey substrata,-Urban land complex.**—This unit contains either Freehold or Downer soils; the two seldom occur together in one area. Generally these soils are gently sloping (0 to 5 percent), but some steeper areas are included in mapping.

The Freehold and Downer soils in this unit are similar to the ones described as typical of their respective series, except that they have underlying layers of clay or sandy clay between a depth of 30 and 60 inches. The clayey layers range from 3 to 24 inches in thickness. They reduce the permeability of the substratum and thereby trap water in wet seasons. Thus basement seepage may be a problem for buildings on this unit. Drainage to a depth below 4 feet is needed on land in this unit that is used for a septic field. (Urban group 1, Freehold and Urban land parts; urban group 2, Downer part)

Holmdel Series

The Holmdel series consists of dark grayish-brown, moderately well drained to somewhat poorly drained soils that have a mottled yellowish-brown or light olive-brown subsoil and a stratified substratum. The soils contain a small amount of glauconite. They are on slopes where the water table rises into the subsoil in winter but drops to a depth of 3 feet or more in summer. These soils are in the western part of the county.

The natural vegetation consists mostly of red, scarlet, and white oaks, yellow-poplar, beech, and hickory. In the somewhat poorly drained areas, however, pin oak, willow oak, and sweetgum predominate. The natural shrubs are viburnum and spicebush.

A typical profile of Holmdel soil has a dark grayish-brown, fine sandy loam plow layer 10 inches thick, and a yellowish-brown or light olive-brown, prominently mottled, fine sandy loam subsoil about 24 inches thick. The subsoil is slightly more clayey than the surface layer. Below the subsoil is mostly stratified, olive-colored loamy sand and sandy loam extending to a depth of 60 inches.

In moderately well drained areas, mottling is in the lower part of the subsoil only, but in the somewhat poorly drained areas, it is in the upper part. The subsoil ranges from sandy loam to sandy clay loam in texture, though the sandy loam is more common. In places the subsoil is not so thick as that in the typical profile described. The texture and color of the stratified material varies widely from place to place. Normally, rounded quartzose gravel is not common in Holmdel soils. In places the soils have a pale subsurface layer between the plow layer and the subsoil.

The Holmdel soils naturally are extremely acid, but some farmed fields have been heavily limed and are now less acid. The soils are generally permeable enough to be drained efficiently by tile.

The Holmdel soils occur beside the Freehold, Collington, and Shrewsbury soils. Mottling in the subsoil distinguishes Holmdel soils from the Freehold and the Collington soils. A predominantly brown subsoil distinguishes Holmdel soils from the Shrewsbury soils, which have a grayish subsoil.

The high water table that rises into the subsoil in winter and in spring limits the use of the Holmdel soils. If they are adequately drained, these soils are suitable for vegetable crops of high value and for general farm crops.

(HdA) **Holmdel fine sandy loam, 0 to 3 percent slopes.**—This soil is slow to warm in spring. Because it contains mostly fine sand, capillary action is moderate.

If adequately drained, this soil is suitable for vegetables of high value. In high positions where it can be drained and where frost is not a great hazard, it is suitable for fruit trees. If this soil is used for homesites, deep drainage is needed to prevent serious septic field problems and basement seepage. (Capability unit IIw–14; woodland suitability group 1; urban group 7)

(HfA) **Holmdel loamy fine sand, 0 to 3 percent slopes.**—This soil has a loose, sandy surface layer about 16 inches thick. Otherwise, it is similar to the soil described as typical of the Holmdel series. Because this soil has a loose surface layer, it warms early in spring and is subject to blowing. It is less fertile and more droughty than the soil described for this series. In most places this soil is moderately well drained.

If adequately drained, this soil is suited to early vegetables of high value, to fruit, and to a lesser degree, to general crops. If this soil is used for homesites, deep drainage is needed to prevent severe septic field problems and basement seepage. (Capability unit IIw–15; woodland suitability group 1; urban group 7)

(Hm) **Holmdel, clayey substratum, -Urban land complex.**—Except that it has clayey layers between a depth of 30 and 60 inches, the Holmdel soil in this unit has a profile similar to the one described as typical of the Holmdel series. The clayey layers are slowly permeable. The unit occupies mostly gentle slopes (0 to 3 percent), but some areas with steeper slopes were included in mapping.

Because all of this unit has been developed for urban uses, the normal sequence of soil layers has been disturbed. In the older developed areas, the disturbance has been restricted to areas immediately adjacent to the buildings; but in the newly developed areas, it has been more extensive and more severe because of land leveling.

The land in this mapping unit naturally has a seasonally high water table. If the clayey layers are thin and are punctured, and if the underlying material is not saturated, the water may drain away. Drainage deeper than 4 feet, however, is needed if the land is to be used for a septic field. (Urban group 7)

(Hn) **Holmdel-Urban land complex.**—This mapping unit occupies nearly level areas. Slopes range from 0 to 3 percent. The unit consists mostly of Holmdel soils, but some areas of Woodstown soils in urban and suburban areas were included in mapping.

Most areas of this unit are occupied by commercial or private buildings. During construction there was much mixing of the soil materials. Originally, the water table extended into the subsoil in winter. If this land is used for buildings, deep drainage is needed to prevent septic field problems and basement seepage. (Urban group 7)

Howell Series

The Howell series consists of thick, yellowish-brown, silty clay soils that are well drained to moderately well drained and contain a small amount of glauconite. They are nearly level to strongly sloping and are on divides, lower slopes, and stream bluffs in the western part of the county. They developed in beds of thick, marine silty clay.

The native vegetation consists of red, scarlet, and white oaks, beech, and scattered ash, sweetgum, hickory, and yellow-poplar. In places, yellow-poplar occurs in nearly pure stands. Natural shrubs include dentate viburnum and spicebush.

A typical profile of a cultivated Howell soil has a yellowish-brown, loamy surface soil about 10 inches thick and a yellowish-brown, heavy loam or clay loam subsoil about 22 inches thick. The subsoil is underlain by mottled, firm silty clay.

Mica is common in the lower horizons. The lower part of the subsoil is mottled, especially where the soil is in low positions. Also, in the low positions, the substratum contains thin sandy layers, presumably because there has been more mixing of the marine deposits. These underlying deposits are dense, dark gray to black, and very thick; and they contain thin ironstone sheets in cracks.

The Howell soils naturally are extremely acid, but in some places they have been heavily limed and now are less acid. They are slowly permeable, and runoff is very rapid after intense rainfall. Permeability is too slow for the effective use of tile drains in most places. In high positions the soils are nearly well drained and hold a perched water table for only short periods. In the lower positions, water moves laterally through the soils in places where they are sloping and causes seeps, if excavations are made.

The Howell soils occur mostly beside the Freehold soils and Moderately wet land. They have better natural drainage than Moderately wet land, as evidenced by mottling in only the lower layers.

Howell soils are moderately productive and have a high water-holding capacity. They are subject to severe frost heaving. Nearly all areas of Howell soils are being developed for urban purposes.

(HoB) **Howell-Urban land complex, gently sloping.**—The soils and land types in this mapping unit have properties similar to Howell soils, except in areas where urban use and construction have removed or disturbed the original soil. Most areas of this unit are in urban use.

Normally, the soils of this unit do not need irrigation. Water is needed on areas used for golf courses or industrial lawns but it should be applied slowly. Because the moderately fine textured soils are slowly permeable, they should be graded carefully to prevent ponding. Shallow ditches can be used to remove water quickly from the surface. If tile drains are installed, the trench should be backfilled with permeable material to allow surface water to get down into the tile rapidly.

Where deep cuts are made, seeps may occur. After excavation for basements and construction of buildings, much clayey subsoil material is generally left on the surface. Large amounts of organic matter can be applied to make the material more workable.

Because of the slow permeability of the subsoil and substratum, the soils and land types of this unit are severely limited for use as a septic field and are somewhat limited for buildings because of basement seepage. (Urban group 8)

(HoC) **Howell-Urban land complex, sloping.**—The soils and land types in this mapping unit have properties similar to the Howell soils, except for steeper slopes and the usual disturbance of soil layers caused by urban development and use.

Runoff is rapid. Unless precautions are taken, erosion is a problem when this unit is used for building sites. Permeability is slow, and in places seepage is a problem. Also, frost heaving is severe. (Urban group 4)

Klej Series

The Klej series consists of deep, loose, grayish-brown, sandy soils. The depth to the water table fluctuates from 16 to 60 inches or more. The soils are moderately well drained to somewhat poorly drained. They are nearly level soils in intermediate positions generally just above the border of swamps. They occur in the eastern part of the county.

The natural vegetation is a mixed pine and oak forest. In areas where wildfire has been severe, the vegetation has changed to pitch pine, scrub oak, and blackjack oak.

A typical profile of a cultivated Klej soil has a very dark grayish-brown, loamy sand plow layer about 10 inches thick; a light yellowish-brown, loose loamy sand layer 6 inches thick; a yellowish-brown, faintly mottled, loose loamy sand layer 14 inches thick; and brown loamy sand or sand extending to a depth of 60 inches.

The somewhat poorly drained Klej soils have a slightly darker surface layer than that described for the typical profile. Generally, they are more distinctly mottled, and the depth to mottling may be less than the 16 inches.

The lower horizon of Klej soils (below 30 inches) may be brown, grayish brown, or yellowish brown, and mottling may range from none to distinct. In places clayey layers occur between a depth of 30 and 60 inches. The content of quartzose gravel varies, but normally it is not high.

The Klej soils naturally are extremely acid, but some farmed fields have been heavily limed and now are less acid. The acidity of these sandy soils can be changed readily. Permeability is rapid or very rapid. The water in the soil is held up by deep underlying clayey layers. Because the sand is mostly of medium and coarse size, little water rises from the water table through capillary action.

The Klej soils, in winter, normally have a water table between a depth of 16 and 20 inches, and in summer it is from 3 to 5 feet or more from the surface. Some areas have been drained, and in these areas the water table is not so high and does not remain high for long periods.

The soils can hold little water available for plants. Plant roots, however, can reach water in most places. Because the soils are rapidly permeable, drainage ditches and tile lines can be spaced widely.

Klej soils occur beside the Lakeland and Leon soils. They can be distinguished from Lakeland soils by the mottling between a depth of 16 and 30 inches. They can be distinguished from the Leon soils by their yellowish-brown subsoil.

The Klej soils have a low content of organic matter and clay. Their productivity is low, but they are easy to work. They are suited to sweetpotatoes, tomatoes, peppers, eggplant, peaches, and grapes. Drainage may not be needed in all places, especially if general crops are grown. If high-value fruit and vegetables are to be grown, however, the risk of having a saturated soil in extremely wet periods should not be taken. Saturation can be prevented by underdrains.

(KmA) **Klej loamy sand, 0 to 2 percent slopes.**—This soil has the profile described as typical of the Klej series. Some areas have clayey layers at a depth of 30 to 60 inches, but such areas occur in erratic patterns and cannot be mapped separately at the scale used.

If used for homesites, this soil is of moderately limited use for septic fields because it has a high water table. In places deep ditches can be used to lower the water table. (Capability unit IIIw-16; woodland suitability group 3; urban group 10)

Kresson Series

The Kresson series consists of nearly level, somewhat poorly drained, brownish, sandy soils that have a prominently mottled, olive-colored, sandy clay subsoil and a sandier substratum, which is seasonally saturated by a high water table. The olive color is caused by the high content (more than 40 percent) of glauconite. These nearly level soils are in the western part of the county in low positions where runoff is slow. In places water is ponded.

The natural vegetation consists of hardwoods, mainly oaks. Viburnum and spicebush are common shrubs. Many areas that have been left idle grow up in sweetgum.

A typical profile of a cultivated Kresson soil has a very dark grayish-brown, sandy loam surface layer about 10 inches thick. Below the surface layer there is a dark-olive, prominently mottled, firm, blocky, sandy clay subsoil about 22 inches thick. Below the subsoil are alternating layers of dark-olive sandy loam and sandy clay. These layers are highly glauconitic and are friable.

In some areas the substratum is sandy clay, but in most places it is sandier material. Because the soils are in low positions, they receive deposits from higher soils.

The Kresson soils naturally are extremely acid, but some farmed fields have been heavily limed and now are less acid. The water table in winter is at a depth of about 2 feet, but in summer it is below 3 or 4 feet.

The Kresson soils occur beside the Colemantown and Marlton soils. Kresson soils are mottled nearer the surface than the Marlton soils and lack the grayish surface layer of Colemantown soils.

If they are adequately drained, Kresson soils are suitable for general farm crops and some high-value small fruits and annual vegetables.

(KrA) **Kresson sandy loam, 0 to 3 percent slopes.**—In places the sandy loam surface layer is thicker than that described for the Kresson series because of deposits washed from adjacent soils. Most areas are nearly level.

This soil must be drained before it can be farmed. Because the subsoil has slow permeability, tile is unsatisfactory for removing surface water. Normally, a combination of deep and shallow ditches is needed to provide adequate drainage. A deep ditch is needed to draw down the water from the sandy substratum, and the shallow ditches are needed to provide outlets for surface water. In places, however, the water in the sandy substratum is under pressure.

If adequately drained, this soil is suited to general crops and some high-value annual vegetables and small fruit. The low areas in which this soil occurs are natural frost pockets. The available moisture capacity for plants is moderate. If the soil is irrigated, the rate of applying water must be slow enough for the subsoil to absorb the water. If this soil is used for homesites, there may be problems of basement seepage and moderate limitations for use as a septic field. (Capability unit IIIw–11; woodland suitability group 2; urban group 7)

Lakehurst Series

The Lakehurst series consists of deep, loose, moderately well drained to somewhat poorly drained, sandy soils. These soils have a bleached layer near the surface and a water table that fluctuates between a depth of 20 and 60 inches or more. The soils are nearly level to gently sloping and generally are adjacent to the border of swamps.

The natural vegetation consists mostly of pines. Pitch, shortleaf, and Virginia pines and scattered black oaks and white oaks normally make up the stand. Lowbush blueberry is the most common shrub. Scattered sheep laurel and gallberry are on the somewhat poorly drained Lakehurst soils. Where wildfire has been severe, the vegetation that has survived is pitch pine, scrub oak, and blackjack oak.

A typical profile of a Lakehurst soil has dark-gray loose sand over light-gray loose sand to a depth of about 11 inches; a 2-inch brown layer, weakly cemented in places; and underlying yellowish-brown, mottled sand that becomes paler with increasing depth. The thickness of the bleached subsurface layer ranges from 6 to 24 inches, and that of the brown layer from 2 to 6 inches. In some places, however, the brown layer is absent. The content of rounded quartzose gravel varies, but normally it is not large.

In winter the water table is within 2 or 3 feet of the surface, but it is below a depth of 5 feet in summer. The soils are extremely acid. They are droughty because they are composed mainly of sand, and little water rises from the water table through capillary action. Also, they are infertile because the surface layer is strongly leached. Added fertilizer leaches readily.

The Lakehurst soils occur mostly beside the Lakewood and Leon soils. Mottling of the subsoil distinguishes Lakehurst soils from the Lakewood soils. A yellowish-brown subsoil distinguishes the Lakehurst from the Leon soils.

Lakehurst soils are so infertile and so droughty that it is not generally economical to farm them. Ground water, however, is within reach of tree roots, and the soils are capable of producing a satisfactory pine forest. If the soils are used for building sites, the seasonally high water table may cause basement seepage and also may limit the use of the soils for septic fields.

(LaA) **Lakehurst sand, 0 to 3 percent slopes.**—In most places the sand in this soil is medium or coarse, though in some places it is mostly fine. The bleached layer near the surface generally ranges from 6 to 12 inches in thickness, but in some areas it ranges from 12 to 24 inches (fig. 6).

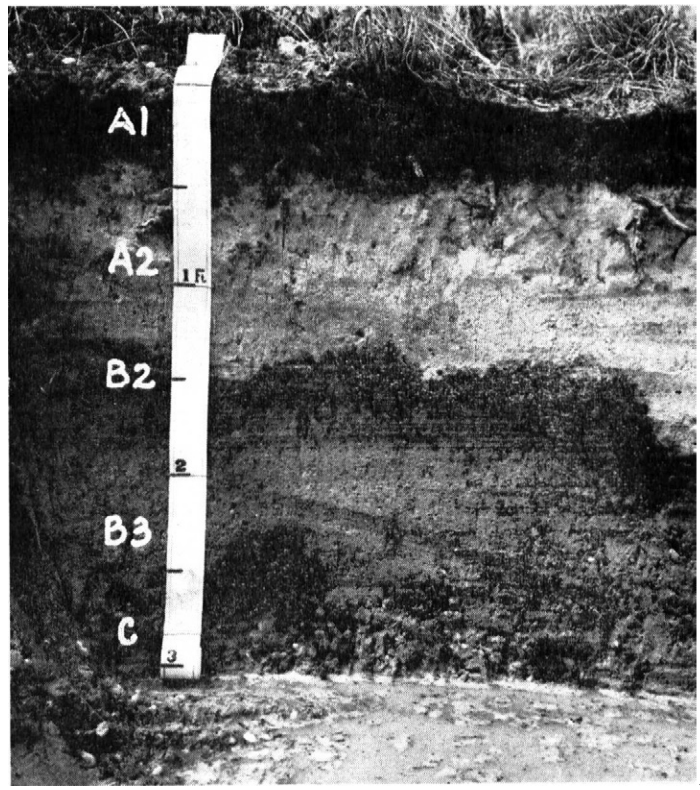

Figure 6.—**Profile of Lakehurst sand showing the thick, bleached, gray layer near the surface, with a wavy to irregular lower boundary, and a thin discontinuous B2 horizon. The height of the water table in winter is also shown.**

On the soils that have a thick bleached layer, forests noticeably have less densely stocked stands, and growth appears stunted. The thick, bleached layer severely limits the establishment of lawn grasses and landscape plants. In a few places there are layers of clay or sandy clay between a depth of 30 and 60 inches.

Because of poor fertility and droughtiness, this soil is not suitable for cultivation. It is most suitable for the production of pulpwood, or as a source of food and cover for wildlife, or for water conservation and recreation areas. (Capability unit IVw–17; woodland suitability group 6; urban group 10)

(LbA) **Lakehurst-Lakewood association, 0 to 5 percent slopes.**—This unit contains areas of both Lakehurst sand and Lakewood sand so intricately mixed that they cannot be mapped separately at the scale used. The Lakehurst soils are dominant in the complex. Lakewood soils occur in the higher positions. Neither soil, however, is suitable for crops.

The nearness of the water table to the surface is reflected in the more rapid growth of pine trees on the Lakehurst soils. When this unit is used for building sites, the seasonally high water table in the Lakehurst soils may cause basement seepage and problems in septic fields. (Capability unit IVw-17, Lakehurst part; capability unit VIIs-8, Lakewood part; woodland suitability group 6; urban group 10, Lakehurst part; urban group 5, Lakewood part)

Lakeland Series

The Lakeland series consists of deep, loose, excessively drained, sandy soils. They are nearly level to strongly sloping. In places they occur as dunes.

The natural vegetation is a forest of mixed pine and oak. Lowbush blueberry is the most common shrub.

A typical profile of a cultivated Lakeland soil has a very dark grayish-brown plow layer about 10 inches thick that is underlain by yellowish-brown, loose sand extending to a depth of 60 inches. The sand becomes paler with increasing depth.

In most places the loose sand extends to a depth of 60 inches. Where it does not extend to that depth, the soil is mapped as Lakeland fine sand, firm substratum. Various amounts of rounded quartzose pebbles occur with the sand in places.

Lakeland soils are infertile and droughty. Their organic-matter content is low. If they are cleared, these soils are subject to blowing, and crops on them are subject to sandblasting. Permeability is very rapid, and added fertilizer leaches readily.

The Lakeland soils occur beside the Lakewood, Klej, or Downer soils. The bleached layer in Lakeland soils is not so gray nor so thick as that in the Lakewood soils. Lakeland soils lack the faint mottling of the Klej soils. They are sandier than the Downer soils.

Because Lakeland soils hold only a small amount of water, crops on them must be irrigated often. Only crops that can withstand the unfavorable conditions are suitable for these soils.

(LcB) **Lakeland fine sand, firm substratum, 0 to 5 percent slopes.**—This soil is on high divides. The fine sand extends to a depth of 30 or 40 inches. It is underlain by firm, reddish gravelly sandy loam to sandy clay loam to a depth of 60 inches or more. Consistence of the lower layer ranges from slightly firm to very firm. This layer contains enough fine material to hold more water and more fertility for plant roots above the firm layer than is normal for Lakeland soils. Roots of annual plants generally do not penetrate the firm layer.

Because this soil occurs primarily in small, isolated areas adjacent to soils less suitable for farming, it is not used extensively as cropland. Some areas contain pits where sand and gravel have been excavated.

This soil is suitable for sweetpotatoes, peaches, squash, and pumpkins. It is a little less droughty than the deeper Lakeland sand. It is also suitable for woodland and wildlife and for recreation and building areas. This soil is moderately limited for septic fields because of the firm substratum. (Capability unit IIIs-7; woodland suitability group 6; urban group 3)

(LdA) **Lakeland sand, 0 to 5 percent slopes.**—A profile of this soil is described as typical of the Lakeland series. As a rule the surface texture is sand, but small areas of loamy sand are included with this soil in mapping. Also in places small areas of Downer, Lakewood, and Klej soils are included.

Sweetpotatoes, peaches, grapes, squash, and pumpkins are the most common crops on these soils. Irrigation is needed almost every year because the soils become too dry. The soils warm early in spring and are so hot at times that peppers and tomatoes are scalded. As yields are generally low, this soil is not used extensively for any crops except sweetpotatoes and peaches. Wind erosion and sandblasting are problems on this soil. The soil and the crops can be protected by windbreaks and by wind stripcropping. Woodland, wildlife habitats, or recreation areas are generally the best uses for this soil. If the soil is used for homesites, grasses that resist drought and tolerate low fertility should be used for lawns. In addition, water should be applied regularly. (Capability unit IVs-7; woodland suitability group 6; urban group 5)

(LeA) **Lakeland sand, water table, 0 to 2 percent slopes.**—This soil occurs in nearly level areas where the water table in winter is between depths of 30 and 60 inches. In summer the water table is a foot or more lower, depending on the position of the site. The high water table in these sandy soils is beneficial for deep-rooted perennial crops, and no attempt is made to lower it. It is not near enough to the surface in summer, however, to hamper the production of crops.

The soils are suited to sweetpotatoes, peaches, and grapes. Although the soil is droughty, it is not too droughty for perennial crops, for wildlife food plants, and for trees.

If the soil is used for a homesite, there may be a moderate problem of basement seepage and moderate limitation on use as a septic field.

Grasses that resist drought and tolerate low fertility should be used for establishing lawns. (Capability unit IIIs-7; woodland suitability group 6; urban group 10)

Lakewood Series

The Lakewood series consists of nearly level to strongly sloping, deep, excessively drained, sandy soils that have a bleached, light-gray subsurface layer 6 inches thick or more. These soils are so poorly suited to farming that most areas have remained in pine woodland, particularly where wildfires have been severe. The vegetation that has survived the wildfires includes pitch pine, blackjack and scrub oaks, and lowbush blueberry.

A typical profile of a forested Lakewood soil consists of a dark-gray surface layer of loose sand about 3 inches thick; a layer of bleached, light-gray sand 7 inches thick; a wavy layer of dark yellowish-brown sand 1 inch thick that contains concretions; and a subsoil and substratum of loose, yellowish-brown sand extending to a depth of 60 inches. Dark streaks occur in old root channels.

The bleached layer ranges from 6 to 13 inches in thickness. The sand is predominantly of quartz. The size is mostly medium and coarse, though in some areas it is fine. In some places, Lakewood soils have quartzose pebbles on the surface and in the surface layer, but the pebbles are not numerous. In a few places the subsoil contains hard, cemented, dark reddish-brown or yellowish concretions.

Lakewood soils are extremely acid throughout, are low in natural fertility, and are droughty.

North and east of Gibbsboro and Berlin the Lakewood soils are at elevations of about 150 feet and are not intermingled with wet soils. In the southeastern part of the county, along Sleeper Branch, they are at lower elevations, about 60 feet, and are intermingled with the poorly drained Leon soils and the dark, very poorly drained St. Johns soils. In this area the dominantly forested Lakewood soils are grayer and more strongly bleached than those Lakeland soils that have been cleared and farmed.

Less than 1 percent of the total acreage of Lakewood soils in Camden County is cultivated. Most of the acreage is in woodlands that consist of poor quality, drought-resistant, fire-tolerant trees, chiefly pitch pine.

(LfB) **Lakewood fine sand, 0 to 5 percent slopes.**—This soil has a profile like that of Lakewood sand, 0 to 5 percent slopes, but it is finer textured at all depths. In places the subsoil is very fine sandy loam. In these places the soil is not droughty. In some parts of the county, small areas of Lakewood sand were included with this soil in mapping.

Except for a few acres that are cultivated, this soil is in woodland. Because of extremely low natural fertility and droughtiness, it is not suitable for cultivation or pasture.

Permeability is moderately rapid, and the soil is somewhat less droughty than Lakewood sand. Because the sand grains in the soil are of uniform size, special design for foundations may be needed. (Capability unit VIIs–8; woodland suitability group 6; urban group 5)

(LfC) **Lakewood fine sand, 5 to 10 percent slopes.**—Except for stronger slopes, this soil is similar to Lakewood fine sand, 0 to 5 percent slopes. Permeability is moderately rapid.

If this soil is used for homesites, erosion is a problem, and the slope needs to be considered in the design of septic fields. Because the grain size of the sand is uniform, foundations on this soil, especially for large buildings, may require special design. (Capability unit VIIs–8; woodland suitability group 6; urban group 6)

(LfD) **Lakewood fine sand, 10 to 25 percent slopes.**—This soil has steeper slopes and is more likely to contain ironstone, but it is otherwise similar to Lakewood fine sand, 0 to 5 percent slopes. In most places the fine sand continues to a depth of 5 feet or more with no marked change. The steepness of slopes limits the suitability of this soil for homesites and causes problems in designing septic fields. Erosion also is a problem. (Capability unit VIIs–8; woodland suitability group 6; urban group 11)

(LgB) **Lakewood sand, 0 to 5 percent slopes.**—A profile of this soil is described as typical of the Lakewood series. It is the most extensive Lakewood soil in Camden County, and practically all the acreage is in woodland. Small areas of Lakeland and Downer soils were included with this soil in mapping. Also, some small areas steeper than 5 percent, especially along the drainageways, were included because they were too narrow to be mapped separately.

This soil is too droughty and infertile for cultivated crops or for pasture, but it can be used for growing pulpwood. Also, the woodlands serve as a habitat for many of the deer in the county. If this soil is used for a homesite, lawn grasses that resist drought and tolerate low-fertility should be used. In addition, water should be applied regularly. (Capability unit VIIs–8; woodland suitability group 6; urban group 5)

(LgC) **Lakewood sand, 5 to 10 percent slopes.**—The profile of this soil is like the one described for the Lakewood series. This soil is mostly in the central part of the county, north and east of Gibbsboro and Berlin, at elevations of about 150 feet. Much of it occurs in long bands along streams or drainageways and has short slopes. Included in mapped areas are some soils as steep as 25 percent and a few small areas that have gravel on the surface.

All areas of this soil except those that have been cleared for recreational or urban use are wooded. The total acreage of this soil is not large, and the individual areas are small and irregular.

If this soil is used for a homesite, lawn grasses that resist drought and tolerate low fertility should be grown. Erosion is a problem because of steepness. If septic fields are planned, the slope should be considered in the design. Erosion is a problem in the landscaping of urban and recreational areas. (Capability unit VIIs–8; woodland suitability group 6; urban group 6)

(LhE) **Lakewood and Lakeland sands, 10 to 30 percent slopes.**—This mapping unit contains moderately steep to steep Lakewood and Lakeland soils on the top of knolls and along deeply cut streams and drainageways. The knolls are at the higher elevations, between 150 and 220 feet. They contain ironstone that formerly was quarried and used for building stone. The ironstone occurs as shattered slabs as much as a foot thick. The beds have a total thickness of several feet. Near the knolls, the color of the subsoil ranges from brown to red.

If the soils are used for homesites, the slopes limit the possible location of buildings and septic fields. Also, erosion is a problem. (Capability unit VIIs–8; woodland suitability group 6; urban group 11)

Leon Series

Soils of the Leon series consist of poorly drained gray sand, brown sand, and gray sand in successive layers. The layers of gray sand are loose, and in most places, the layer of brown sand is firm enough to be a hardpan. These soils are in the eastern part of the county. They occupy level areas bordering swamps or are in isolated, circular depressions where the water table is constantly high.

The natural vegetation is pitch pine. Shrubs generally include highbush blueberry, sheep laurel, gallberry, and greenbrier.

A typical profile of a cultivated Leon soil has a dark-gray, loose sand surface layer about 10 inches thick; a light-gray, loose sand subsurface layer about 5 inches thick; and a firm, dark-brown subsoil about 9 inches thick. Below the subsoil is gray or grayish-brown, loose coarse sand extending in most places to a depth of 60 inches.

In places there are gray or olive-gray clay or sandy clay layers between a depth of 30 and 60 inches. The dark subsoil ranges from 6 to 12 inches in thickness and averages about 8 inches. In most places it is firm, but in some it is friable and loose. Generally, the upper brown layer is between a depth of 16 and 24 inches, but other brown layers may be at any depth below this one. The content of gravel in these soils varies. Gravel is commonly in the substratum but is seldom abundant.

The Leon soils naturally are extremely acid. The water table is within a foot of the surface in winter, but it is at a depth between 1 and 2 feet in summer. These soils are moderately permeable. Their water table is kept high by deep clay layers.

The Leon soils occur mostly beside the St. Johns and the Lakehurst soils. They are grayer than the Lakehurst soils and do not have a thick, black surface layer like that in the St. Johns soils.

Because the Leon soils are infertile, they are not suitable for general crops, but blueberries and possibly strawberries can be grown profitably in most areas. These soils hold little water when drained, and the height of the water table must be controlled for crop production.

The Leon soils are less productive of blueberries than the St. Johns soils. They should be graded to improve drainage before blueberries are planted. If the need arises, these soils can be used to produce high-value vegetables by careful control of the water table. In most places the soils provide good sites for dugout ponds.

(Lo) **Leon sand.**—A profile of this soil is described as typical of the Leon series. Small areas of loamy sand and fine sand are included with this soil in mapping. Lenses of clay or sandy clay occur in some areas between a depth of 30 and 60 inches, but these areas were not extensive enough to be mapped separately. In places the light-gray subsurface layer is thicker than the darker surface layer. In these places the soil is less suitable for crops. In areas where a hardpan is continuous, the soil is less permeable.

This soil provides good sites for dugout ponds. In areas that have underlying clayey layers, however, the rate of recharge is slower than is normal for Leon soils. (Capability unit Vw–22; woodland suitability group 7; urban group 9)

(Ls) **Leon-St. Johns sands.**—This mapping unit contains areas of both Leon sand and St. Johns sand so intermingled that it is not practical to map them separately. A typical profile of St. Johns soil is described for the St. Johns series. Most areas of Leon-St. Johns sands occur adjacent to the main streams of the county and are flooded after exceptionally heavy rainfall. In places clay layers are between a depth of 30 and 60 inches. Also, in places, the surface layer is mucky.

Areas of the St. Johns sand are in lower positions. If used for blueberries, these areas are commonly graded before they are planted in order to reduce the drainage problem.

The soils of this unit provide good sites for dugout ponds. In areas underlain by clay layers, however, the rate of recharge is slower than is normal for these soils. (Capability unit Vw–22; woodland suitability group 7; urban group 9)

(Lv) Loamy Alluvial Land

This land type is composed mostly of fine sandy loam, sandy loam, or loam soil material deposited recently by floodwater. It is in nearly level areas beside meandering perennial streams. Generally, slopes range from ½ to 1 percent. Microrelief, or small knolls and depressions, however, occur within these nearly level areas. The knolls are generally sandy.

Generally, the texture of Loamy alluvial land is similar to that of the surrounding soils. A clayey subsoil has not had time to develop. In the greensand area, the soil material contains various amounts of glauconite. In places olive-colored, glauconitic layers underlie the sandy deposits. Deposits of gravel and coarse sand occur in places.

The natural vegetation consists mostly of pin oak, willow oak, white oak, northern red oak, elm, yellow-poplar, boxelder, ash, sweetgum, and river birch.

Natural drainage ranges from somewhat poor to poor. In winter the water table is between a depth of 0 and 2 feet and is only about 1 foot lower in summer.

This land is suited to forest, pasture, and wildlife. It can be developed for parks, and it provides a suitable site for dugout ponds. (Capability unit VIw–28; woodland suitability group 4; urban group 12)

(Ma) Made Land

This mapping unit consists of areas where the soil material has been so mixed by excavation, filling, or other disturbances that the original soil horizons have been destroyed. In sanitary landfills, for example, much foreign material was mixed with the soil before it was graded.

In most places in Camden County, the soil material near the surface of Made land is predominantly sand and gravel, but in a few places there is much fine material, especially in the Howell-Urban land soil association. In some places this land type is underlain by clayey layers. Along the Delaware River and other major streams, the material making up Made land came from pumping operations done to deepen stream channels. These areas contain boulders in addition to sand and gravel. Many recent residential and commercial building sites are in this mapping unit. Also, along the Cooper River this land has been developed as part of the Camden County system of parks. (Urban group 13)

Marlton Series

The Marlton series consists of nearly level to steep, moderately well drained to well drained sandy loams. These soils developed only in deposits that contain a large amount of glauconite. Both the subsoil and substratum contain more than 40 percent glauconite. The subsoil has distinctly finer texture than either the surface layer or the layers below.

The natural vegetation consists of red, black, and white oaks and beech. Yellow-poplar or Virginia pine naturally succeed these trees in the plant succession.

A typical profile of a Marlton soil has an olive-gray sandy loam plow layer about 8 inches thick; an olive, blocky, sandy clay subsoil 22 inches thick; and a stratified, friable, olive and gray sandy loam and sandy clay substratum. The subsoil is firm and plastic when moist and is very firm when dry.

The subsoil ranges from 18 to 36 inches in thickness and in some places has mottling in the lower part. In some places the color of the subsoil dominantly is olive brown, but in others small reddish blotches occur. Also, various amounts of rounded quartzose gravel occur throughout the profile in some areas.

Marlton soils naturally are extremely acid, but fields that have been heavily limed now are less acid. Because of the clayey subsoil, permeability is slow, runoff is very rapid, and erosion is severe. Some areas are ponded for short periods after heavy rains.

The Marlton soils occur beside the Kresson, Colemantown, Freehold, and Collington soils. They are less mottled and better drained than the Kresson and Colemantown soils. The Marlton soils contain more glauconite and clay and are more olive colored than the Freehold and Collington soils.

The Marlton soils do not warm early enough in spring for early crops. Because of their clayey subsoil, irrigation water must be applied slowly. Also, the clayey material is near the surface, and the soils are difficult to work. These soils are best suited to general crops. Apple orchards are suitable where air drainage is good and where the soils are well drained or have been artificially drained. Marlton soils are mostly well drained but are occasionally too wet for tillage on nearly level areas.

(MrA) **Marlton sandy loam, 0 to 2 percent slopes.**—This soil is on watershed divides where excess water runs off readily. It is also in nearly level areas at lower elevations where runoff is slow. In addition, the lower positions are likely to have a high water table, at least in winter.

Included with this soil in mapping are Kresson soils in small, circular depressions. Surface water stands in the depressions too long for some crops. Adequate drainage must be provided in these areas for crops that do not tolerate wet soil.

Because the sandy clay subsoil is close to the surface and is slowly permeable, this soil is generally suited to sweetpotatoes, asparagus, and peach orchards.

If this soil is used as a homesite, the slow permeability of the clayey underlying material may limit the use of the soil for a septic field. In low positions basement seepage may be a problem. (Capability unit IIe–2; woodland suitability group 2; urban group 8)

(MrB) **Marlton sandy loam, 2 to 5 percent slopes.**—On this gently sloping soil, runoff is rapid, and the soil is likely to erode if farmed. Plowing and cultivating are difficult in the eroded areas because the subsoil is sticky when wet and hard when dry. Also, the time between these unfavorable conditions is short. Contour farming and a rotation that includes a sod crop help to retard erosion. On long slopes diversion terraces also may be needed. This soil is suitable for general crops, summer vegetables, and apple orchards. (Capability unit IIe–2; woodland suitability group 2; urban group 8)

(McC3) **Marlton soils, 5 to 10 percent slopes, severely eroded.**—In fields, erosion has removed most of the sandy surface soil, and in places gullies several feet deep have formed. The gullies could easily be filled, but the soil material remaining after erosion is so difficult to manage that this soil is generally not suited to cultivated crops. It is best suited to hay, pasture, or wildlife food or cover. (Capability unit IVe-6; woodland suitability group 2; urban group 4)

(Mk) **Marlton and Kresson-Urban land complex.**—This mapping unit consists mostly of Marlton soils, but some areas of Kresson soils are included. Residential or commercial buildings are on most areas. The soil was not greatly disturbed where the older construction was done. Considerable cutting and filling, however, has been done during recent construction, and the original sequence of the soil horizons has been largely destroyed.

Slopes are mostly less than 3 percent, but in some areas they are as steep as 5 to 10 percent. These steeper areas are mainly Marlton soils. They have only a slight groundwater problem, but the erosion hazard is severe.

These soils have moderate limitations when used for sewage fields. Basement seepage is a moderate problem. The soils are moderately fertile, but large amounts of organic matter are needed to make them friable. (Urban group 8, Marlton part; urban group 7, Kresson part)

Matawan Series

The Matawan series consists of nearly level to gently sloping, well drained to moderately well drained soils that have a sandy surface layer over a yellowish-brown sandy clay subsoil. The native vegetation consists of a mixed forest of pine and oak.

A typical profile of Matawan soil has a dark grayish-brown sandy loam or loamy sand plow layer about 10 inches thick and a light yellowish-brown, blocky, sandy clay subsoil about 18 inches thick. Below the subsoil are alternating layers of clay, sandy clay, and sandy loam (fig. 7).

In places the lower part of the subsoil is mottled and may contain free water in winter. Except in extremely wet seasons, there is no significant problem of excess

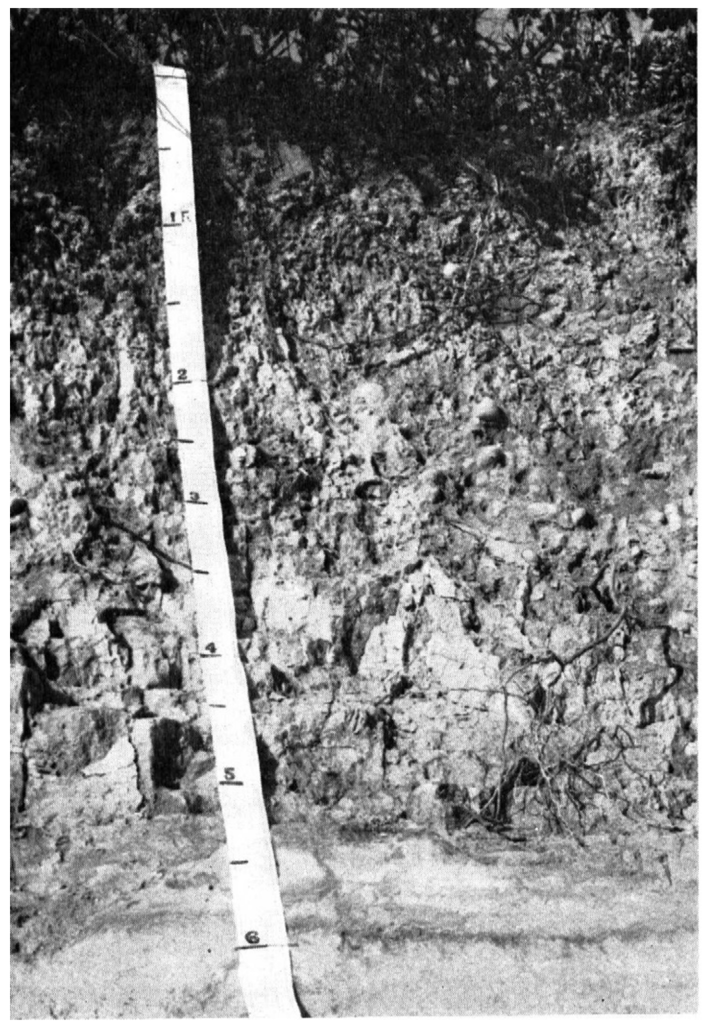

Figure 7.—A profile of Matawan sandy loam showing the blocky structure of the clayey subsoil and the structureless sand below a depth of 5 feet.

water during the growing season.

In Camden County, the Matawan soils occur beside the Downer and Woodstown soils. The Matawan soils naturally are extremely acid, but farmed fields have been heavily limed and are now less acid. Permeability of the Matawan soils ranges from slow to very slow, depending on the texture of the subsoil. If these soils are irrigated, the texture and depth of the subsoil are important in determining the amount of water to apply and the rate of application.

(MmB) **Matawan loamy sand, 0 to 5 percent slopes.**—A profile of this soil is described as typical of the Matawan series. The surface layer is somewhat thinner in the more sloping areas.

This soil occurs on gently sloping divides where excess water runs off rapidly and in depressions where runoff is slow. In places, ditches are needed in the depressions to speed up runoff.

The soil is easily worked, has a moderate water-holding capacity, and is subject to blowing if left bare. It warms early enough in spring for early vegetables. If this soil is irrigated, the texture and depth of the subsoil should be considered in determining the amount of water applied and the rate of application. (Capability unit IIs–6; woodland suitability group 1; urban group 8)

(MnA) **Matawan sandy loam, 0 to 2 percent slopes.**—This soil is mostly well drained, but nearly level areas that tend to be wet are included. It is moderately slowly permeable and has a moderate water-holding capacity. On most areas of this soil, runoff is the major problem. Ditches may be needed to speed runoff from the included nearly level areas.

This soil is suited to general crops, and the highest areas are generally suited to fruit and vegetables. The texture and depth of subsoil varies in this soil. This variation should be considered if the soil is irrigated. (Capability unit IIe–2; woodland suitability group 1; urban group 8)

(MnB) **Matawan sandy loam, 2 to 5 percent slopes.**—This soil is more sloping and is more likely to be eroded than Matawan sandy loam, 0 to 2 percent slopes. In some small areas in fields, the clayey subsoil has been mixed with the plow layer. These areas are more difficult to till than the uneroded areas, and crop yields are lower. On the longer slopes, diversion terraces can be used to control runoff. This soil is generally well suited to fruit and vegetables. (Capability unit IIe–2; woodland suitability group 1; urban group 8)

(Mo) Moderately Wet Land

Moderately wet land is made up of prominently mottled, moderately fine textured to fine textured material containing small to moderate amounts of glauconite. This land type is somewhat poorly drained and occurs in nearly level areas in low positions where runoff is slow or where water is ponded. Moderately wet land is west of the divide and slopes toward the Delaware River. In Camden County this land type is generally at elevations below 40 feet. In most places it contains ground water, and in some places the water is under pressure.

The natural vegetation consists of pin, willow, and white oaks, beech, sweetgum, and scattered red oak, yellow-poplar, and ash. Sweetgum grows well on this land type.

A typical profile of cultivated Moderately wet land has a dark-brown loam plow layer about 9 inches thick; a strong-brown, prominently mottled clay loam subsoil about 21 inches thick; and a substratum of stratified material ranging from fine sandy loam to loamy sand in texture and from olive to olive gray in color. In places the soil is underlain by dark-gray clay or sandy clay. In some areas the strong-brown subsoil is thinner than the 21 inches described as typical. Glauconite in this soil is commonly coated with iron and must be washed before it can be identified.

This land type is naturally extremely acid, but some fields have been heavily limed and are now less acid. Production of crops is controlled primarily by the amount of surface water on this land type and the amount of ground water under pressure. Because permeability is slow in most places, drainage by tile alone is usually not satisfactory. Shallow ditches, bedding, or land grading is needed to remove surface water. Ground water must be withdrawn through open ditches or tile lines. Otherwise, an excessive amount of water rises into these fine-textured soils through capillary action.

In this county, Moderately wet land occurs beside the Howell soils but in lower positions. It is wetter than the Howell soils and has mottles that are nearer the surface.

If adequately drained, this land type is best suited to general crops. If adequate drainage is not economical, Moderately wet land is restricted to hay or pasture made up of water-tolerant plants. Since this land type is in low areas, crops are subject to frost damage and the loamy surface soil is subject to frost heaving. (Capability unit IIIw–11; woodland suitability group 2; urban group 7)

(Mu) Muck

This mapping unit occurs adjacent to the sluggish, slow-moving streams that flow east into the Atlantic Ocean. The organic material in this soil ranges from 10 to 40 inches in thickness but averages about 24 inches. It is generally underlain by gray saturated sand and gravel, but in places it is underlain by clay.

The natural vegetation consists of extremely dense stands of Atlantic white-cedar. The white-cedar has been cut frequently and has been replaced by red maple in many places.

In winter the water table is at the surface, and generally it is not much lower in summer. Floods occur frequently. The soil is extremely acid.

In this county Muck occurs in narrow areas adjacent to major streams that have little fall. Because the organic matter in this soil is shallow, is extremely acid, and shrinks considerably upon drying, little of the acreage has been cleared for crop production. Most cleared areas were developed into cranberry bogs in the 1800's, but most of these have now reverted to forest. Some areas have recently been planted to blueberries. (Capability unit VIIw–30; woodland suitability group 5; urban group 12)

Nixonton Series

The Nixonton series consists of moderately well drained, gently sloping soils that have a high content of fine sand. These soils are dominantly yellowish brown and have mottling in the lower part of the subsoil. The mottling indicates that the soils are moderately well drained. The Nixonton soils are generally downslope from long slopes of Westphalia soils in the Westphalia-Nixonton-Barclay association.

The natural vegetation consists of hardwoods, mostly white oak, but in places white oak is mixed with red oak, yellow-poplar, beech, holly, and pine. The common shrubs are viburnum and spicebush.

A typical profile of a cultivated Nixonton soil has a dark grayish-brown loamy fine sand plow layer about 8 inches thick and a pale-brown or yellowish-brown, mottled very fine sandy loam subsoil extending to a depth of about 30 inches. Below a depth of 30 inches is stratified fine sandy loam and fine sand that ranges from pale brown to brownish yellow.

The mottles are generally in the lower part of the subsoil, but in places they extend into the upper part. Mottling ranges from faint to distinct. Rounded quartzose gravel occurs in places as remnants of old glacial outwash. Also, in places the substratum contains sand that is coarser than fine sand.

The Nixonton soils naturally are extremely acid, but some farmed fields have been heavily limed and are now less acid. These soils have a high water table late in winter and in spring. Where they are underlain by coarser material, the soils have a saturated substratum.

The Nixonton soils are generally beside the Westphalia and Barclay soils. They occupy positions downslope from the Westphalia and upslope from the Barclay soils. Mottling in the subsoil distinguishes the Nixonton soils from the Westphalia soils. The Nixonton soils are not so wet nor so gray as the Barclay soils.

If crops of high value are to be grown on the Nixonton soils, drainage is needed. For tile drains, special methods must be used to prevent the fine sand from entering and clogging the lines. When Nixonton soils are saturated, they have little cohesiveness and ditchbanks slough severely. If excavations are made in summer, the soils are less likely to slough. Permeability is slow in the upper 30 inches and is moderate below that depth. The capillary rise of moisture is moderate.

(NbA) **Nixonton and Barclay fine sandy loams, 0 to 3 percent slopes.**—This undifferentiated group consists of Nixonton and Barclay soils. The Nixonton soil is more extensive, and many areas consist mostly of this soil.

The average thickness of the surface layer is 14 inches, and the texture is fine sandy loam. Otherwise, the profiles of these soils are similar to those described as typical of the Nixonton and Barclay series.

In places where ponding occurs, surface drainage is needed in addition to underground drainage.

If they are adequately drained, the soils in this unit are suited to most crops except the earliest vegetables. If drainage is not economical, the soils can be used for corn, soybeans, or other late-planted general crops or for pasture. Some areas of Barclay soil are satisfactory for blueberries. (Capability unit IIw-14; woodland suitability group 1; urban group 7)

(NcA) **Nixonton and Barclay loamy fine sands, 0 to 5 percent slopes.**—In this undifferentiated group, the Nixonton soil is more extensive, and many areas consist mostly of this soil. Some areas, however, contain both Nixonton and Barclay soils. The Barclay soil is generally in lower positions than the Nixonton soil and is less sloping.

Drainage is needed if crops of high value are to be grown on these soils. Even though the surface layer of these soils is sandy and loose, the subsoil is slowly permeable. Special methods must be used to prevent fine sand from clogging tile drains laid in these soils. If trenches are dug when the soils are saturated, the sides cave in readily. (Capability unit IIw-15; woodland suitability group 1; urban group 7)

Pasquotank Series

The Pasquotank series consists of poorly drained, mottled, grayish soils that formed in deposits of uniformly fine sand. They are in low positions and have slopes of less than 1 percent. Runoff is slow, and some areas are ponded.

The natural vegetation consists of hardwoods, mostly pin, willow, and swamp white oaks, beech, yellow-poplar, holly, and sweetgum. Viburnum and spicebush are the natural shrubs. The thick stands of yellow-poplar and holly are outstanding features of these fine sandy loams. In fields that are left idle, sweetgum is first to form a pure stand.

A typical profile of Pasquotank soil has a dark-gray fine sandy loam plow layer about 10 inches thick, and a light brownish-gray fine sandy loam subsoil that contains a little more clay than the surface layer. The subsoil ranges from 10 to 20 inches in thickness and is distinctly mottled. The substratum ranges from grayish brown to yellowish brown in color and is stratified fine sand and fine sandy loam. In places the substratum contains coarse sand and rounded quartzose pebbles.

Pasquotank soils are naturally extremely acid, but some fields have been heavily limed and are now less acid. These soils commonly contain small amounts of mica.

The Pasquotank soils occur beside the Nixonton, Barclay, and Weeksville soils. They have a grayer subsoil than the Nixonton and Barclay soils, and their surface layer is not so dark nor so thick as that in the Weeksville soils.

These soils are wet most of the year. The water table in winter is within a foot of the surface, but it is below a depth of 5 feet in summer. If adequately drained, these soils are suited to general crops, pasture, and blueberries.

(Pa) **Pasquotank fine sandy loam.**—This poorly drained soil has moderately slow permeability. Tile drains generally need to be supplemented by bedding, shallow ditches, or land smoothing to provide adequate drainage. Ditchbanks slough severely when the soil is saturated. Special precautions must be taken to prevent the fine material from clogging tile lines.

Included in areas mapped as this soil are small areas of Barclay, Nixonton, and Weeksville soils.

This soil warms slowly in spring. It occurs in natural frost pockets. If the soil is adequately drained, it is suited to general crops, pasture, and blueberries. It is not well suited to fruit, alfalfa, or perennial crops. (Capability unit IIIw-21; woodland suitability group 4; urban group 9)

(Pc) **Pasquotank and Weeksville-Urban land complex.**—This mapping unit consists mostly of Pasquotank soils and some areas of Weeksville soils that are used for urban and suburban purposes. Construction has caused considerable mixing of the soil material. Areas in urban use have generally been drained, and some low areas have been filled with soil material. A special investigation of each site in this mapping unit is needed to determine its suitability for a specified use and to determine how much the soil at the site has been altered. (Urban group 9)

Pocomoke Series

The Pocomoke series consists of very dark gray, very poorly drained soils that have a sandy surface layer, a mottled gray, more clayey subsoil, and a loose sandy substratum. These soils have slopes of less than 1 percent and are in low positions in the southeastern part of the county. Runoff is slow, and some areas are ponded. Pocomoke soils occur at the border of swamps or in small, circular depressions. In Camden County these soils are not extensive.

The natural vegetation is hardwoods that consist of pin, willow, and swamp oaks, sweetgum, and red maple and a dense understory of highbush blueberry and sweet pepperbush.

A typical profile of a Pocomoke soil has a very dark gray sandy loam plow layer 10 inches thick and a dark-gray, mottled, sandy loam subsurface layer 4 inches thick. The subsoil is mottled, dark-gray, slightly more clayey sandy loam that extends to a depth of 24 inches. Below the subsoil is gray, loose loamy sand that extends to a depth of 60 inches. This layer is stratified and contains clayey layers in places.

In places the surface layer is black and contains a considerable amount of organic matter. Also, in some places the subsoil is sandy clay loam.

The Pocomoke soils naturally are extremely acid, but some fields have been heavily limed and are now less acid. The water table is at the surface in winter, but it is at a depth of 1 to 2 feet in summer. Permeability of Pocomoke soils is moderate in the upper 2 feet and is rapid below that depth.

The Pocomoke soils occur beside the Fallsington, Dragston, and Muck soils. They have a thicker and darker surface layer than the Fallsington soils. They have a grayer subsoil than the Dragston soils. The Pocomoke soils contain more mineral material and less fine organic material than Muck soils.

Drainage is needed if these soils are to be farmed. Tile drains normally work rapidly enough to drain these soils. If adequately drained, the soils are suited to general crops, late vegetables, and blueberries.

(Ps) **Pocomoke sandy loam.**—This soil has a dark surface layer that ranges from 6 to 14 inches in thickness. In places this layer is black. Included in areas mapped as this soil are small areas of Fallsington soils. Also included are small areas that have a subsoil texture as fine as sandy clay.

If adequately drained, this soil is suited to general crops, a few late-planted vegetables, and blueberries. It is not well suited to fruit, asparagus, or alfalfa. Because it has a high water table, this soil generally provides good sites for dugout ponds. (Capability unit IIIw-25; woodland suitability group 4; urban group 9)

St. Johns Series

The St. Johns series consists of soils that have successive layers of very poorly drained black, brown, and gray sand. In the black and gray layers, the sand is loose, but in most places the brown layer is firm enough to be a hardpan. These soils are in level areas that border swamps and in isolated, circular depressions in the eastern part of the county. Their very poor drainage is the result of a high water table.

The natural vegetation consists of pitch pine and scattered Atlantic white-cedar and a dense understory of highbush blueberry, sweet pepperbush, and other shrubs.

A typical profile of St. Johns soil has a black sand surface layer about 8 inches thick; a gray sand subsurface layer 3 inches thick; and a 4-inch layer of loamy sand stained very dark brown by organic matter. This layer ranges from friable to extremely firm in consistence, but in places it is discontinuous. Below this layer is a pale-brown or grayish-brown loose sand that contains many thin, dark-brown layers (fig. 8).

In Camden County, the St. Johns soils consist mostly of medium and coarse sand, but in some small areas they are dominantly fine sand. Also, in places a considerable amount of gravel is mixed with the sand.

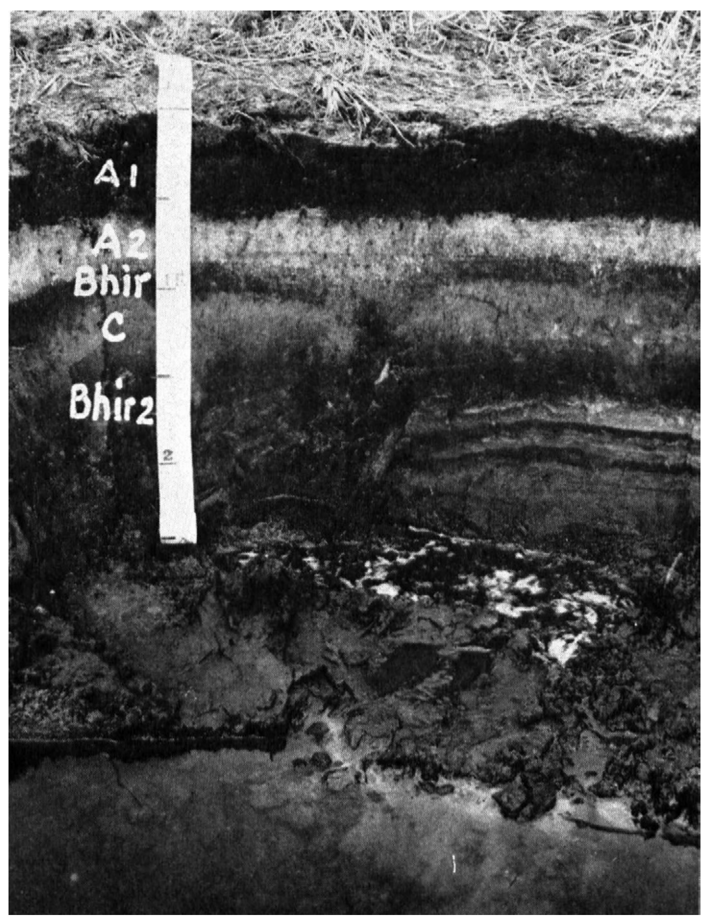

Figure 8.—**Profile of St. Johns soil showing successive layers of black, gray, and brown sand.**

The St. Johns soils are extremely acid. They are saturated to the surface throughout the year. Because they are extremely sandy and severely leached, they have low natural fertility. The soils are moderately permeable. The surface layer has a high content of organic matter, but when the soils are drained and cultivated, the organic matter is readily lost.

The St. Johns soils occur beside the Leon soils, Sandy alluvial land, and Muck. They have a darker surface layer than the Leon soils. They are not flooded so often as Sandy alluvial land, and their soil material is not so mixed. They contain less organic matter than Muck.

Although their fertility is too low for the production of most crops, these soils are suitable for blueberries, especially if management is used that controls the water level. The soils must be drained if they are to be farmed. After they are cleared, the soils should be graded to insure good surface drainage before planting blueberries. After the soils are drained, however, the organic pan layer becomes more firm.

(Sa) **St. Johns sand.**—A profile of this soil is described as typical of the St. Johns series. Areas that have a loamy sand surface layer and small areas that have a mucky surface layer are included in areas mapped as this soil. Also included are small areas that have clay lenses in the substratum. In many places this soil contains several dark-brown layers separated by loose gray layers. Most areas of this soil provide good sites for dugout ponds. (Capability unit Vw–26; woodland suitability group 7; urban group 9)

(Sc) **St. Johns sand, clayey substratum.**—The profile of this soil is similar to the one described as typical of the St. Johns series, except that it has clay or sandy clay layers between a depth of 30 and 60 inches. These clayey layers range from a few inches to several feet in thickness. They cause slow permeability in the lower part of the horizon and also increase the amount of ground water in summer by holding the water table high. The underlying clayey layers, however, reduce the recharge rate of dugout ponds. Areas where the clayey layers are within 30 inches of the surface are less desirable for blueberry production because of the difficulty in controlling the ground-water level.

Nearly all areas mapped as this soil include some areas of Leon soils, because the two soils occur together in most places. Also included are small areas of Fallsington and Pocomoke soils. (Capability unit Vw–26; woodland suitability group 7; urban group 9)

(Sg) Sand and Gravel Pits

This mapping unit consists of pits from which sand and gravel have been or are being excavated. It also includes borrow pits from which soil material has been taken and pits from which marl has been excavated. Also included in this mapping unit are spoil banks consisting of overburden that has been stripped and dumped near the pits. Deep excavations reach into the water table, which makes possible the use of a suction dredge. As a rule, the small sand, gravel, and borrow pits are shallow and dry.

Most of the gravel pits are in the Aura soils, and most of the sand pits are in the Lakewood and the Lakeland soils. Abandoned areas of Sand and gravel pits generally revert to pitch pine. Some small areas of abandoned pits have been leveled for farming. The abandoned marl pits generally revert to hardwoods.

(Sv) Sandy Alluvial Land

Sandy alluvial land consists mostly of coarse and medium sand. It occurs beside meandering perennial streams that rise in areas where the soils are mostly coarse textured. This land type is frequently flooded.

The natural vegetation consists of pitch pine, southern white-cedar, red maple, and bay magnolia trees and numerous shrubs. In a few places, yellow-poplar and sweetgum form a mixed stand with yellow birch.

The sand is normally dark at the surface and is gray or brown at lower depths. In places the soil material in the upper 6 inches, or more, contains enough organic matter to make it mucky. The water table is within a foot of the surface in winter and generally is not below a depth of 2 feet in summer.

This land type is low in natural fertility and normally is extremely acid. Because of flooding and low fertility, little of the acreage has been cleared for farming or for pasture. Sandy alluvial land is suited to woodland, wildlife, and parks. It provides suitable sites for dugout ponds. (Capability unit VIw–28; woodland suitability group 7; urban group 12)

Shrewsbury Series

The Shrewsbury series consists of nearly level, poorly drained soils that occur in low positions. Runoff is slow, and some areas are ponded. These soils have a dark-gray surface layer and a more clayey olive-gray subsoil. The substratum is generally stratified and consists mostly of loose loamy sand and sandy loam. These soils contain a low or moderate amount of glauconite. They occur in the greensand area of the county (Freehold-Holmdel-Collington association).

A typical profile of Shrewsbury soil has a dark-gray fine sandy loam plow layer 10 inches thick; an olive-gray fine sandy loam subsurface layer 6 inches thick; a prominently mottled, olive-gray, more clayey fine sandy loam subsoil 16 inches thick; and stratified olive-gray and olive fine sandy loam and loamy fine sand to a depth of 60 inches.

In Camden County the most common texture of the surface layer is fine sandy loam. The subsurface layer is absent in places. The color of the subsoil ranges widely; it is dominantly olive gray, but there are various amounts of yellowish brown. The substratum contains various amounts of rounded quartzose gravel and in places contains clayey layers with the stratified sand. Ironstone occurs in a few areas in layers as much as 1 foot thick or more. Generally, these areas are not extensive, but because the layers are within 30 inches of the surface in places, they interfere with farming and ditch digging. Iron accumulations have clogged tile drains in places.

The Shrewsbury soils naturally are extremely acid, but some farmed fields have been heavily limed and are now less acid. These soils are wet most of the year. The water table is near the surface in winter but is at a depth of about 2 feet in summer. Permeability of the subsoil ranges from moderate to slow. In most places, however, tile drains can be used to carry off excess ground water and surface water. The dark-colored surface layer indicates that the content of organic matter in these soils is moderate.

In Camden County, the Shrewsbury soils occur beside the Holmdel, Freehold, and Collington soils. A gray subsoil, however, distinguishes Shrewsbury soils from those soils.

All areas of these soils need to be drained if they are farmed. What they are best suited for depends on the degree of drainage.

(Sw) **Shrewsbury fine sandy loam.**—This soil occurs in the low positions and receives deposits of sand from the soils above. It is sandier and deeper than the soil described as typical of the Shresbury series and is not so dark. In places the substratum contains clayey layers that are highly glauconitic. In these places the substratum is slowly permeable.

Included in areas mapped as this soil are small areas of sandy loam and a few of loamy sand. Also included are small areas that have a black, very dark gray, or very dark brown surface layer.

Because this soil is in a low position, it is generally in a frost pocket. Also, it is subject to moderate frost heaving.

If it is adequately drained, this soil is suited to general crops, pasture, and blueberries. Sweetgum grows well on this soil. In most places this soil provides good sites for dugout ponds. (Capability unit IIIw–21; woodland suitability group 4; urban group 9)

(Sx) **Shrewsbury-Urban land complex.**—This mapping unit consists mostly of Shrewsbury soils that are used for urban or suburban purposes. There has been considerable mixing of the soil layers, especially around buildings. In places, soil material has been brought in to fill low areas. In most urban areas, drainage has been improved. Close examination of the soil at each site is needed to determine its suitability for a specified use. (Urban group 9)

(Tm) Tidal Marsh-Made Land Complex

This mapping unit occurs adjacent to the Delaware River and along its tributaries so far upstream that the tidal waters are fresh. Originally, this land was so low that it was covered by tidal waters daily. It consisted mostly of silt and organic matter and supported grasses and shrubs that could withstand daily flooding. Now most areas have been altered through diking, dredging, and filling.

Along the Cooper River, this unit has been dredged with pumps to make the channel deep enough for small boats. The soil material has been pumped behind dikes, where it is protected from tidal flooding. This area is part of the Camden County Park System, apparently an excellent use for this kind of land. Some areas have been similarly reclaimed and developed as shopping centers, but because they are in low positions, they are subject to flooding when tides are abnormally high. (Urban group 9)

(Um) Urban-Moderately Wet Land Complex

This mapping unit consists mainly of Moderately wet land that is being used for urban or suburban purposes, but there are small areas of idle land and narrow areas of woodland.

In areas where buildings have been constructed, the soils have been disturbed. As a result the original soil layers have been mixed, borrow material from other places has been added, and some material has been moved to other places. Therefore, special on-site investigations are needed to determine the suitability for any specified use. If this land is used for urban purposes, deep ditching is needed to lower the water table and to prevent flooding. (Urban group 7)

Weeksville Series

The Weeksville series consists of very poorly drained soils that have a very dark surface layer over a strongly gleyed gray subsoil. Both the surface layer and subsoil have a high content of fine sand. Also, in most places the substratum is composed mainly of fine sand. The soils are in low-lying positions in the west-central part of the county. Runoff is slow, and some areas are ponded. In many places the water is perched at the surface in winter, though the subsoil and substratum are only moist. In summer the water table is below a depth of 5 feet in most places.

The natural vegetation consists mostly of pin, willow, and swamp white oaks, holly, and scattered beech, ash, yellow-poplar, and sweetgum. In fields that are left idle, pure stands of sweetgum are first to occupy the site.

A typical profile of Weeksville soil has a black or very dark gray, fine sandy loam surface layer about 12 inches thick and a gray, very fine sandy loam subsoil about 20 inches thick. Below the subsoil is gray loamy fine sand interbedded in places with coarse sand or fine sandy loam.

The Weeksville soils naturally are extremely acid, but some farmed fields have been heavily limed and are now less acid.

The Weeksville soils occur mostly beside Barclay and Pasquotank soils. They have a darker surface layer than Barclay soils and a grayer subsoil than Pasquotank soils.

(Wd) **Weeksville fine sandy loam.**—The surface layer of this soil ranges from black to very dark gray or very dark brown in color. In places the texture of the subsoil is loam. Also, in places the subsoil is mottled. Colors in the substratum range from gray to yellowish brown. The texture is coarse sand with various amounts of rounded quartzose pebbles in places, mostly below a depth of 4 feet.

Included in areas mapped as this soil are small areas of Pasquotank and Barclay soils.

Permeability of this soil is slow. In places water ponds long enough to kill winter grain. Bedding or land leveling can be used to improve runoff. This soil occurs in natural frost pockets, and frost heaving is severe in places.

Drainage has been improved to some extent in all areas of this soil now farmed. If the soil is adequately drained, it is suited to general crops and blueberries. Because the soil contains much fine sand, capillary action is moderately high. If undrained, however, this soil is suited only to woodland or pasture. (Capability unit IIIw–25; woodland suitability group 4; urban group 9)

Westphalia Series

The Westphalia series consists of very dark grayish-brown, nearly level to very steep, well-drained sandy soils. The subsoil contains slightly more clay than the surface layer. These soils are in higher well-drained areas in the west-central part of the county.

The natural vegetation consists mainly of yellow-poplar and holly but there are some red, white, and scarlet oaks and beech.

A typical profile of a Westphalia soil has a very dark grayish-brown loamy fine sand plow layer 10 inches thick; a pale-brown loamy fine sand subsurface layer 8 inches thick; and a yellowish-brown very fine sandy loam subsoil 15 inches thick. The substratum is pale-brown, stratified loamy fine sand and fine sandy loam.

The surface layer ranges from fine sandy loam to loamy fine sand in texture. Rounded quartzose pebbles occur in places. Mica and glauconite are common in these soils, but the amount of each is small.

The Westphalia soils naturally are extremely acid, but some farmed fields have been heavily limed and are now less acid. Because the Westphalia soils are composed mostly of uniformly fine sand, they have a moderately high water-holding capacity and moderately slow to slow permeability. They are moderately fertile, and added fertilizer is not readily leached.

The Westphalia soils occur beside the Nixonton, Barclay, and Pasquotank soils.

(WaB) **Westphalia fine sandy loam, 0 to 5 percent slopes.**—In this soil the total thickness of surface and subsurface layers is about 14 inches. Included in areas mapped as this soil are some small areas of Nixonton soils. These small areas need to be drained.

Erosion is a problem in fields on the steeper slopes, especially if the soil is used continuously for vegetables. Contour planting and cover crops help to reduce erosion. Stripcropping can be used for general crops. Nursery crops also grow well on this soil. (Capability unit IIe–5; woodland suitability group 1; urban group 1)

(WfB) **Westphalia loamy fine sand, 0 to 5 percent slopes.**—The surface layer of this soil is loose when dry. Consequently, the soil blows readily and cuts tender, early season plants. It warms early enough in spring for early vegetables. The soil is moderately permeable but has a high water-holding capacity.

Contour planting is needed on the more sloping fields where water erosion is a problem. Cover crops and privet windbreaks are needed to prevent soil blowing. (Capability unit IIs–6; woodland suitability group 1; urban group 2)

(WfC) **Westphalia loamy fine sand, 5 to 10 percent slopes.**—This soil is like Westphalia loamy fine sand, 0 to 5 percent slopes, except that it is subject to water erosion if left without cover. Small gullies form easily in some fields and are hard to control. Contour planting, cover crops, and diversion terraces can be used to reduce erosion. (Capability unit IIIe–6; woodland suitability group 1; urban group 4)

(WhD) **Westphalia soils, 10 to 20 percent slopes.**—This mapping unit consists primarily of steeply sloping areas adjacent to streams. These soils range from fine sandy loam to loamy fine sand in texture. A permanent cover of trees, grass, or wildlife food plants is needed to prevent erosion.

Because of the steep slopes, locating houses and designing septic fields are problems. Also, the erosion hazard is severe. (Capability unit IVe–6; woodland suitability group 1; urban group 11)

(WhD3) **Westphalia soils, 10 to 20 percent slopes, severely eroded.**—These soils were cleared and farmed for a while. Erosion has removed most of the original surface soil and has cut deep gullies into the soils. Most fields have now been abandoned and are reverting to woodland. These soils are suitable for hay, pasture, woodland, or wildlife food and cover, but the gullies should be filled. Diversion terraces also may be needed to collect excess runoff and carry it to a safe place for disposal. (Capability unit VIe–5; woodland suitability group 1; urban group 11)

(Wr) **Westphalia and Nixonton-Urban land complex.**—Westphalia soils make up most of this mapping unit, but Nixonton soils are in lower positions. Slopes are generally less than 5 percent. The Nixonton soils have a high water table in winter.

Where urban development has been extensive, there has been much disturbance of the soil during construction. Leveling operations, deep cuts, and fills have changed the soil layers considerably. Where individual buildings have been built, there has been less disturbance.

Permeability of the subsoil is moderately slow, but in the substratum it is moderate or rapid. Because the soil material has uniform texture, it collapses easily if trenched when it is saturated. The soil at each site should be examined closely to determine its suitability for a specified use. (Urban group 1, Westphalia and Urban land parts; urban group 7, Nixonton part)

Woodstown Series

The Woodstown series consists of nearly level, moderately well drained soils that occur in intermediate positions. Their subsoil is slightly more clayey than the surface layer.

A typical profile of a Woodstown soil has a very dark grayish-brown sandy loam plow layer about 9 inches thick; a pale-brown sandy loam subsurface layer 5 inches thick; and a yellowish-brown or light olive-brown sandy loam subsoil about 18 inches thick that contains slightly more clay than the upper layers and is distinctly mottled in the lower half. Below the subsoil is yellowish-brown stratified sand and loamy sand containing some gravel.

The dominant color of the subsoil is yellowish brown. The mottles in the subsoil vary in size, number, and prominence. Generally, they are in the lower part. The substratum ranges from pale brown to yellowish brown in color. Quartzose pebbles are common on the surface.

The Woodstown soils naturally are extremely acid, but some farmed fields have been heavily limed and are now less acid. The water table is about 24 inches from the surface in winter, and in summer it is at a depth of 4 feet or more. Because the substratum is sandy, water cannot rise readily in these soils in summer when the water table is deep.

The Woodstown soils occur beside the Downer, Aura, and Matawan soils. The Woodstown soils are mottled, whereas the Downer soils are not. They are not red and firm like the Aura soils. The subsoil of Woodstown soils is not so clayey as that of Matawan soils.

The Woodstown soils need to be drained if alfalfa, fruit, or crops of high value are grown. Because the soils are generally permeable, tile drains remove excess water satisfactorily. The soils warm slowly in spring.

(WsA) **Woodstown and Dragston sandy loams, 0 to 3 percent slopes.**—This undifferentiated group contains both Woodstown and Dragston sandy loams. The Woodstown soil is more extensive, and some mapped areas are made up mainly of this soil. Some areas, however, contain both soils in an intricate pattern. The Dragston soils occur in lower positions and are less sloping than the Woodstown soils.

A high water table is a problem in these soils. It is higher and more serious in the Dragston soils than in the Woodstown. Both soils, however, need to be drained for optimum use.

In places clayey layers occur between a depth of 30 and 60 inches.

If they are adequately drained, the soils in this unit are suited to vegetables and general crops. Fruit is not well suited, but it can be grown if the soils are deeply drained. (Capability unit IIw–14; woodland suitability group 1; urban group 7)

(WtA) **Woodstown and Klej loamy sands, 0 to 3 percent slopes.**—This undifferentiated group consists of Woodstown and Klej soils. The Woodstown soil is extensive, and some mapped areas are made up mainly of this soil. The Klej soil predominates in areas of this group that are adjacent to extensive areas of the Lakeland soils.

The soils of this group have a water table that is high in winter, but normally it is below a depth of 5 feet in summer. The water table is high enough in spring to delay farming operations. Tile drains or open ditches can be used to lower the water table. Windbreaks, cover crops, and stripcropping can be used to reduce wind erosion and to maintain the organic-matter content. (Capability unit IIw–15, Woodstown part; capability unit IIIw–16, Klej part; woodland suitability group 1, Woodstown part; woodland suitability group 3, Klej part; urban group 7, both soils)

(WuA) **Woodstown and Klej loamy sands, clayey substrata, 0 to 3 percent slopes.**—This undifferentiated group consists of Woodstown and Klej loamy sands that have substrata containing layers of clay, sandy clay, or clay loam at a depth between 30 and 60 inches. These clayey layers generally range from 6 to 18 inches in thickness, but in occasional places they are several feet thick. The material between the clayey layers is a loose loamy sand containing variable amounts of quartzose gravel.

These clayey layers make the permeability of the substrata slow and tend to limit the absorption of effluent in septic-tank fields.

Agriculturally, this group is similar to Woodstown and Klej loamy sands, 0 to 3 percent slopes. The amount of water available for plants, however, is greater in this group because of the clayey substrata, and the average yields of unirrigated summer crops are slightly higher. (Capability unit IIw–15; woodland suitability group 1; urban group 7, both soils)

Use and Management of the Soils

This section is designed to help the landowner understand how soils behave and how they can be used. The first part is an explanation of the capability grouping system used by the Soil Conservation Service and a discussion of management by capability units. Next, estimated yields of principal crops under ordinary and improved management are given (table 2). Table 2 is followed by separate subsections on woodland, wildlife, engineering, and urban development.

Capability Groups of Soils

The capability classification is a grouping that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. Eight capability classes in the broadest grouping are designated by Roman numerals I through VIII; however, no soils in Camden County are in class VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be as many as four subclasses. The subclass is indicated 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* means that water in or on the soil will interfere 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 country, indicates 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 or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it are subject to little or no erosion but have other limitations that restrict their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils 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 identified by numbers assigned locally, for example, IIe–5 or IIIs–10. The numbers for capability units in this county are assigned according to a system used for the whole Coastal Plain geologic province and therefore the numbering of units is not consecutive in this county.

Soils are classified in capability classes, subclasses, and units according to the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, and the subclasses and units in this county, are described in the list that follows.

Class I. Soils that have few limitations that restrict their use.

(No subclasses)

Capability unit I–5.—Deep, nearly level, well-drained sandy loams and fine sandy loams.

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

Subclass IIe. Soils subject to moderate erosion if they are not protected.

Capability unit IIe–2.—Slowly permeable, well drained to moderately well drained, nearly level to gently sloping soils.

Capability unit IIe–5.—Deep, well-drained, gently sloping sandy loams.

Subclass IIs. Soils that have moderate limitations of moisture capacity or shallow rooting zone.

Capability unit IIs–6.—Nearly level to gently sloping, well-drained soils that have a very sandy, droughty surface soil.

Capability unit IIs–9.—Nearly level to gently sloping, well-drained soils that are shallow to a firm layer.

Subclass IIw. Soils that have moderate limitations because of excess water.

Capability unit IIw–14.—Deep, nearly level to gently sloping, moderately well drained and somewhat poorly drained soils that have a fine sandy loam or sandy loam surface layer.

Capability unit IIw–15.—Deep, nearly level to gently sloping, moderately well drained and somewhat poorly drained soils that have a loamy sand or loamy fine sand surface layer.

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

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.

Capability unit IIIe–6.—Deep, well-drained, moderately sloping soils mainly having a fine sandy loam or loamy fine sand surface layer.

Subclass IIIs. Soils that have severe limitations of moisture capacity or tilth.

Capability unit IIIs–7.—Nearly level to gently sloping sands over a more clayey substratum or over ground water.

Capability unit IIIs–10.—Nearly level to gently sloping, well-drained soils that have a loamy sand surface layer over a firm substratum.

Subclass IIIw. Soils that have severe limitations because of excess water.

Capability unit IIIw–11.—Nearly level, mainly somewhat poorly drained, slowly permeable soils.

Capability unit IIIw–16.—Nearly level, moderately well drained to somewhat poorly drained soils that have a loamy sand surface layer.

Capability unit IIIw–18.—Nearly level, poorly drained, slowly permeable soil.

Capability unit IIIw–21.—Nearly level, poorly drained, permeable or moderately to slowly permeable soils.

Capability unit IIIw–25.—Nearly level, very poorly drained, moderately permeable and slowly permeable soils.

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

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.

Capability unit IVe–6.—Deep, well-drained, moderately permeable or slowly permeable soils that are moderately steep, or are moderately sloping and severely eroded.

Subclass IVs. Soils that have very severe limitations because of low moisture capacity and low fertility.

Capability unit IVs–7.—Nearly level to gently sloping, very sandy, infertile soil.

Subclass IVw. Soils that have very severe limitations of low moisture capacity, and a high water table in winter.

Capability unit IVw–17.—Nearly level to gently sloping, very sandy, infertile soils that are moderately well drained to somewhat poorly drained.

Class V. Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that make regular cultivation impractical and that limit their use largely to woodland or wildlife food and cover.

Subclass Vw. Soils that are impractical to use for regular crops because of excess water and infertility.

Capability unit Vw–22.—Nearly level, poorly drained, infertile sands.

Capability unit Vw–26.—Nearly level, very poorly drained, infertile sands.

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

Subclass VIe. Soils severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Capability unit VIe–5.—Permeable soils that are steep or that are moderately steep and eroded.

Subclass VIw. Soils severely limited by excess water and generally unsuitable for cultivation.

Capability unit VIw–28.—Nearly level soils that are frequently flooded and have a high water table.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation, and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIs. Soils very severely limited by moisture capacity, stones, or other soil features.

Capability unit VIIs–8.—Deep, nearly level to steep, loose, sandy, infertile soils.

Subclass VIIw. Soils very severely limited by excess water.

Capability unit VIIw–30.—Highly organic soils that are frequently flooded and have a high water table.

Class VIII. Soils and landforms that have limitations that preclude their use, without major reclamation, for commercial production of plants; and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

No class VIII soils or landforms were mapped in Camden County.

Management by capability units

In this subsection the soils of the county are placed in capability units. Suggested for each unit are suitable uses and management practices. Clay pits, Made land, Sand and gravel pits, Tidal marsh-Made land complex, and mapping units containing an Urban land complex were not placed in capability units. Soils that are in the same capability unit have about the same limitations and similar risks of damage. In addition, they are suited to about the same crops and need about the same kind of management.

CAPABILITY UNIT I-5

Capability unit I-5 consists of deep, nearly level, well-drained sandy loams and fine sandy loams. These soils are easy to work. When managed well, they are permeable to water and to air. They are naturally acid and have a moderate to low supply of available nutrients. They are productive, however, when adequately limed and fertilized. The soils are—

Collington fine sandy loam, 0 to 2 percent slopes.
Downer sandy loam, 0 to 2 percent slopes.
Freehold fine sandy loam, 0 to 2 percent slopes.

The Collington and Freehold soils hold a large amount of water available to plants. Downer sandy loam has a low available moisture holding capacity. All the soils are well suited to fruits, vegetables, general crops, nursery plants, and pasture plants. In some places the soils in this unit are double cropped, and many crops of high value are irrigated (fig. 9).

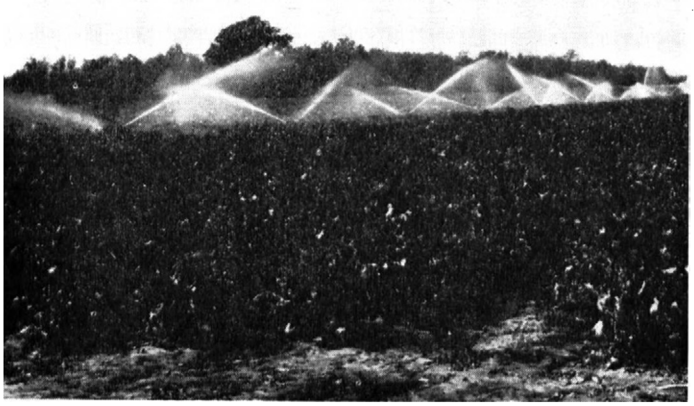

***Figure 9.*—Irrigating broccoli, a second crop of the season, on a soil of capability unit I-5.**

These soils can be tilled regularly without great risk of erosion. A fertilized cover crop grown after each row crop, or a sod crop grown every few years, helps to maintain the content of organic matter and good soil structure. Lime and fertilizer should be applied regularly in amounts determined by soil tests.

CAPABILITY UNIT IIe-2

Capability unit IIe-2 consists of nearly level to gently sloping, well drained to moderately well drained soils. These soils have a sandy surface soil and a clayey subsoil. Water moves through them slowly. The soils hold moisture fairly well, and they have moderate natural fertility. The soils are—

Marlton sandy loam, 0 to 2 percent slopes.
Marlton sandy loam, 2 to 5 percent slopes.
Matawan sandy loam, 0 to 2 percent slopes.
Matawan sandy loam, 2 to 5 percent slopes.

These soils are best suited to general crops that do not require frequent or intensive cultivation. They are also used to produce transplanted vegetables, such as tomatoes and peppers. Some areas of these soils are planted to fruit and others to vegetables, but these crops should be restricted to the areas adequately drained. Drainage may be needed in depressions.

In areas where the surface soil is thin, plowing and cultivation are difficult. On sloping areas runoff is rapid, and the erosion hazard is severe. Plow and plant on slight grades to provide surface drainage and to help control erosion. Plant general crops in strips with hay, and follow all row crops with a cover crop.

If these soils are irrigated, water must be applied slowly, especially where the surface soil is thin. Lime and fertilizer should be applied according to the results of soil tests. Most of the fertilizer can be plowed down with little risk of rapid leaching.

CAPABILITY UNIT IIe-5

Capability unit IIe-5 consists of deep, well-drained, gently sloping soils that have a fine sandy loam or sandy loam surface soil. If managed well, these soils are permeable to water and air. They are naturally acid and have moderate to low natural fertility. They are productive, however, when adequately limed and fertilized. The soils are—

Collington fine sandy loam, 2 to 5 percent slopes.
Downer sandy loam, 2 to 5 percent slopes.
Freehold fine sandy loam, 2 to 5 percent slopes.
Westphalia fine sandy loam, 0 to 5 percent slopes.

The water-holding capacity is high for the Collington, Freehold, and Westphalia soils, but is somewhat lower for the Downer soil. Irrigation water is needed in greater quantity and more frequently on the Downer soil.

The soils of this unit are well suited to vegetables, fruit, general crops, nursery plants, and pasture plants. On these gently sloping soils, however, there is an erosion hazard. Plow and plant on the contour where feasible. In addition, use diversion terraces on long slopes, and contour strips in fields of general crops. Apply lime and fertilizer regularly in amounts determined by soil tests.

CAPABILITY UNIT IIs-6

Capability unit IIs-6 consists of deep, nearly level to gently sloping, mostly well-drained soils that are somewhat droughty. In general, these soils have a thick, sandy surface and a slightly more clayey subsoil. They hold a moderate to small amount of water available to plants. The organic-matter content and natural fertility are low. If the soils are not protected, they are subject to wind erosion in winter.

Because of its small acreage, the moderately well drained Matawan loamy sand is included in this unit. The subsoil of Matawan loamy sand is more clayey and

Figure 10.—Young vineyard on Downer loamy sand. Soil is in capability unit IIs–6.

is more slowly permeable than that of other soils of this unit. In places the subsoil is so slowly permeable that water collects above it. These spots need drainage. The soils are—

Aura-Downer loamy sands, 0 to 5 percent slopes (Downer soil only).
Downer loamy sand, 0 to 5 percent slopes.
Downer loamy sand, clayey substratum, 0 to 5 percent slopes.
Freehold loamy fine sand, 0 to 5 percent slopes.
Matawan loamy sand, 0 to 5 percent slopes.
Westphalia loamy fine sand, 0 to 5 percent slopes.

These soils are best suited to asparagus, small fruit, peaches, apples, and other deep-rooted perennial crops (fig. 10). Sweetpotatoes also grow well. Irrigation is generally needed for crops of high value.

Use contour tillage in the more sloping areas. Follow all row crops by a cover crop sown as early as possible. If additional protection is needed from winter winds, plant a windbreak of privet (fig. 11). Apply fertilizer and lime in amounts determined by soil tests.

CAPABILITY UNIT IIs-9

Capability unit IIs–9 consists of nearly level to gently sloping, well-drained soils. In spring the soils work easily, but they become firm and hard in summer. They have low natural fertility and moderate to low available water capacity. The Aura soils are moderately deep over a hard sandy clay loam subsoil, which restricts root penetration. The soils are—

Aura sandy loam, 0 to 2 percent slopes.
Aura sandy loam, 2 to 5 percent slopes.
Aura-Downer sandy loams, 0 to 5 percent slopes.

The soils of this unit are best suited to general crops, fruits, and vegetables. Yields of hay and pasture are low, probably because of droughtiness.

Plow and plant on the contour to reduce runoff and to help control erosion. Follow all row crops with cover crops, or use a hay crop in the rotation to help maintain the organic-matter content and good soil structure. If land smoothing is done on the Aura soils, make the cuts shallow to prevent exposing the hard sandy clay loam subsoil. Apply irrigation water slowly and generally not below a depth of 2 feet. Apply lime and fertilizer in amounts indicated by soil tests.

CAPABILITY UNIT IIw-14

Capability unit IIw–14 consists of deep, moderately well drained and somewhat poorly drained soils that have a fine sandy loam or sandy loam surface layer. Permeability of these soils is generally moderate. Normally, the lower layers are saturated in winter. Where they are underlain by loose sand and gravel, these soils are easily drained through open ditches or by tile. The soils are—

Holmdel fine sandy loam, 0 to 3 percent slopes.
Nixonton and Barclay fine sandy loams, 0 to 3 percent slopes.
Woodstown and Dragston sandy loams, 0 to 3 percent slopes.

When adequately drained, these soils are suited to vegetables, general crops, and fruit. Surface drainage may be needed where the soils are dominantly fine sand.

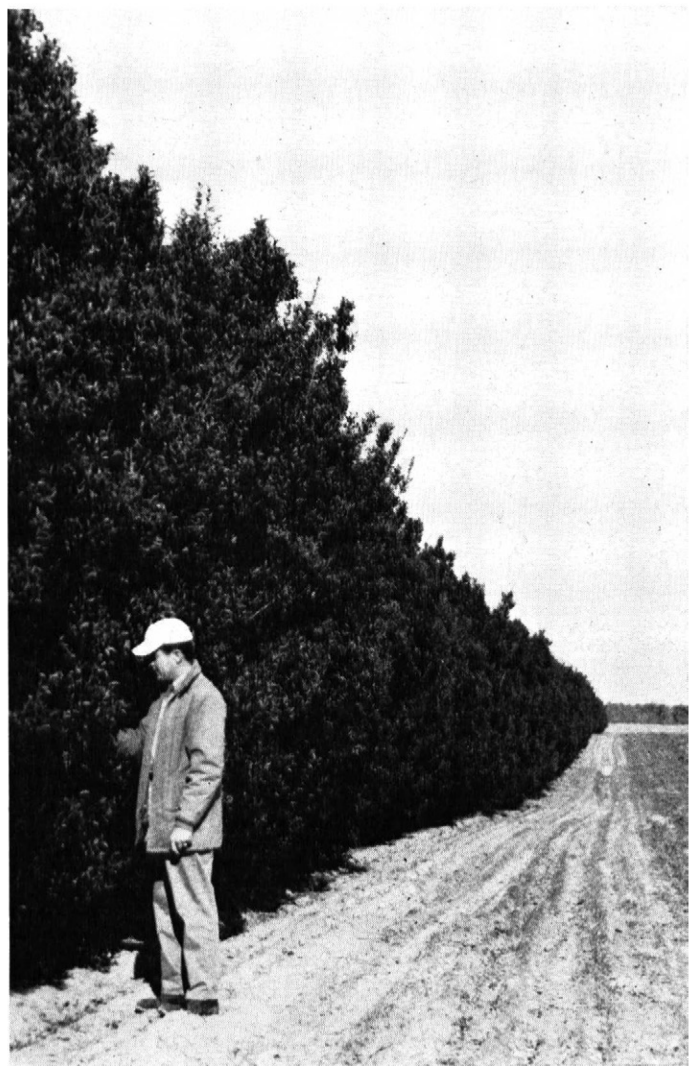

Figure 11.—A windbreak of privet helps to control wind erosion. The soil is in capability unit IIs–6.

Special precautions may be needed to prevent the fine sand from clogging the tile drains. The fine sandy loam soils are subject to flowing when saturated. Ditching during dry periods, however, minimizes this hazard.

CAPABILITY UNIT IIw-15

Capability unit IIw-15 consists of deep, moderately well drained and somewhat poorly drained soils that have a loamy sand or loamy fine sand surface layer. In extremely wet seasons, ground water rises to 24 inches below the surface of these soils.

Generally, these soils are permeable enough to be drained by underground tile lines. They are easily worked, and they warm early in spring. They are naturally acid and have low natural fertility. Because the surface layer is sandy, it is subject to blowing. The soils are—

- Holmdel loamy fine sand, 0 to 3 percent slopes.
- Nixonton and Barclay loamy fine sands, 0 to 5 percent slopes.
- Woodstown and Klej loamy sands, 0 to 3 percent slopes (Woodstown part).
- Woodstown and Klej loamy sands, clayey substrata, 0 to 3 percent slopes.

When adequately drained, the soils of this unit are suited to vegetables, general crops, and fruit. Those soils with much fine sand tend to clog tile lines and ditches. Maintain the content of organic matter by growing cover crops. If sweetpotatoes are grown regularly, use windbreaks of privet to help control blowing. Apply lime and fertilizer in amounts determined by soil tests. Apply fertilizer to vegetables as side dressing during the growing season to reduce losses through leaching.

CAPABILITY UNIT IIIe-6

Capability unit IIIe-6 consists of deep, well-drained, moderately sloping soils that have a fine sandy loam, sandy loam, loamy fine sand, and loamy sand surface layer. On these sloping soils, there is a distinct erosion hazard. The soils are permeable, and the water-holding capacity ranges from low to moderate. On slopes where runoff is rapid, it is difficult to hold rainfall long enough for the water to soak into the soils. Natural fertility is moderate to low. The soils are—

- Downer soils, 5 to 10 percent slopes.
- Downer-Aura complex, 5 to 10 percent slopes.
- Freehold fine sandy loam, 5 to 10 percent slopes.
- Freehold loamy fine sand, 5 to 10 percent slopes.
- Westphalia loamy fine sand, 5 to 10 percent slopes.

If runoff and erosion are controlled, the soils of this unit are suitable for vegetables, general crops, and fruit. Contour planting and sod can be used in orchards to help control erosion. Diversion terraces or crop rotations that include sod crops in strips can be used in fields of most vegetable and general crops. Row crops should be followed by a cover crop whenever possible. Lime and fertilizer should be applied regularly in amounts determined by soil tests.

CAPABILITY UNIT IIIs-7

Capability unit IIIs-7 includes deep sandy soils over a more clayey substratum or over a water table that is between a depth of 30 and 60 inches. The sand exceeds 30 inches in thickness, and the soils are therefore very droughty and are subject to blowing. Natural fertility is very low, and productivity is not easily improved. Permeability is rapid to a depth of at least 30 inches. The soils are—

- Freehold sand, thick surface variant, 0 to 5 percent slopes.
- Lakeland fine sand, firm substratum, 0 to 5 percent slopes.
- Lakeland sand, water table, 0 to 2 percent slopes.

Because these soils have a low moisture capacity in the upper 30 inches, they are not suitable for many crops. Peaches, sweetpotatoes, grapes, melons, and pumpkins grow best on these soils.

Seed cover crops early, and use privet windbreaks or wind stripcropping to prevent sandblasting of the crops. Irrigate if high-value crops are grown. Use lime and fertilizer according to the results of soil tests.

CAPABILITY UNIT IIIs-10

Capability unit IIIs-10 consists of soils that have a loamy sand surface layer and a low available moisture capacity. Most of the soils have a firm subsoil and shallow depth for roots. Slopes range from nearly level to gently sloping. Because the surface layer is sandy, it is subject to blowing. The natural fertility is low. The soils are—

- Aura loamy sand, 0 to 2 percent slopes.
- Aura loamy sand, 2 to 5 percent slopes.
- Aura-Downer loamy sands, 0 to 5 percent slopes (Aura part).

The soils are suited to fruit and early vegetables and to sweetpotatoes. Irrigation is generally needed for crops of high value. Use cover crops after all row crops where possible. If early crops or sweetpotatoes are grown regularly, use a privet windbreak to reduce blowing.

CAPABILITY UNIT IIIw-11

Capability unit IIIw-11 consists of nearly level, somewhat poorly drained soils that have a moderately fine to fine textured subsoil. In most places the subsoil is underlain by sandier material. The subsoil is slowly permeable to air and water, and early in spring excess water stands on the surface. The soils are moderately fertile and hold a large supply of water available to crops. Because they occur in depressions, these soils receive much runoff from adjacent higher soils. The soils are—

- Kresson sandy loam, 0 to 3 percent slopes.
- Moderately wet land.

If adequately drained, these soils are suited to tomatoes, pasture, and all general farm crops except alfalfa. Corn and soybeans are commonly grown. Stands of sweetgum grow moderately well. The soils are also suited to wildlife.

Either deep ditches or tile drains are needed to drain away ground water, but shallow ditches are generally most efficient in draining off surface water. Generally, the subsoil is so clayey that tile drains are not efficient in removing surface water from these soils. Graded row furrows can be used to drain away surface water on slopes. In some places it may not be economical to provide sufficient outlets for drainage because of the limited number of suitable crops that can be grown.

Pit, or dugout, ponds can be dug to impound ground water, but the rate of recharge ranges from poor to rapid, depending on the content of clay in the underlying layers.

776-501—66——3

CAPABILITY UNIT IIIw-16

Capability unit IIIw-16 consists of deep, nearly level, sandy soils that range from moderately well drained to somewhat poorly drained. Before drainage of these soils is improved, the water table is at a depth of about 2 feet in winter and about 5 feet in summer. The soils are easily worked, but because they are sandy, they are subject to blowing. They are naturally acid and have low natural fertility. Permeability is very rapid in woodland areas but is rapid in cultivated fields because of compaction of the surface layer. The soils are—

Klej loamy sand, 0 to 2 percent slopes.
Woodstown and Klej loamy sands, 0 to 3 percent slopes (Klej part).

The soils are suited to peaches, sweetpotatoes, and grapes. Lime and fertilizer should be applied in amounts determined by soil tests. The fertilizer should be applied as a side dressing to avoid excessive leaching. Cover crops should be sown as early as possible, or privet windbreaks should be grown to reduce blowing.

Because the water table normally is low in summer, irrigation is needed for most high-value crops. The soils hold little water and must be irrigated frequently, but the water can be applied rapidly.

Excess water can generally be removed by spot drainage or boundary ditches because of the low water table in summer. Dugout ponds in this soil must be deep to insure a constant water supply. The rate of recharge should be rapid unless the underlying clay is too near the surface.

CAPABILITY UNIT IIIw-18

The one soil in this capability unit, Colemantown loam, is nearly level, is poorly drained, and has a moderately fine textured subsoil. In most places the soil is underlain by alternating sandy and clayey material. The subsoil is slowly permeable to air and water, and consequently the soil is ponded or saturated with water early in spring. The soil is moderately fertile and can hold a large supply of water available to crops. Because it is in low areas, it receives much runoff from adjacent higher soils.

If adequately drained, this soil is suited to pasture and all general farm crops except alfalfa. Corn and soybeans are commonly grown. Small grain on this soil heaves severely.

Either deep ditches or tile drains are needed to remove water from the substratum. In addition, shallow ditches may be needed to remove surface water. In most places the subsoil is so clayey that tile drains do not remove surface water efficiently.

CAPABILITY UNIT IIIw-21

Capability unit IIIw-21 consists of nearly level, poorly drained soils that have a sandy loam or fine sandy loam surface layer. Drainage, however, has been improved in the farmed areas. The natural fertility of these soils is moderate and the organic-matter content is moderately high. Permeability of Fallsington sandy loam is moderate; that of the Shrewsbury and Pasquotank soils ranges from moderate to slow. The soils are—

Fallsington sandy loam.
Pasquotank fine sandy loam.
Shrewsbury fine sandy loam.

If adequately drained, these soils can be used for annual summer vegetables and for all general farm crops except alfalfa. Lime and fertilizer should be applied in amounts determined by soil tests. Undrained areas of soils in this unit are best suited to forest or to wildlife. The Pasquotank soil frequently supports stands of sweetgum and holly, which might be managed profitably. Most of the soils in this unit occur in frost pockets.

In unusually wet seasons, the upper soil layers become saturated, even where normal drainage improvements have been made. The water table needs to be lowered to provide enough air for roots. In general, tile drains are efficient in lowering the water table in these soils. The Pasquotank soil, however, requires special treatment because of the fine and uniform sand in it. In this soil the sand flows freely when saturated; therefore, excavations are easier to make late in summer when the soil is driest. Spacing between lines of tile should be relatively close, and the tile should be placed on boards and covered with material designed to keep out the fine sand. In addition, some surface drainage may be needed in ponded areas, especially if crops of high value are to be grown.

In most places these soils are suitable for dugout ponds. Unless a clayey layer is near the surface, the rate of recharge is rapid in the Fallsington and Shrewsbury soils. The recharge rate in the Pasquotank soil ranges from slow to rapid.

CAPABILITY UNIT IIIw-25

Capability unit IIIw-25 consists of nearly level, very poorly drained soils that have a sandy loam or fine sandy loam surface layer. Drainage, however, has been improved in the farmed areas. The natural fertility is moderate, and the organic-matter content is high. Permeability of the Pocomoke soil is moderate, and that of Weeksville soil is slow. The soils are—

Pocomoke sandy loam.
Weeksville fine sandy loam.

If adequately drained, these soils can be used for annual summer vegetables and all general farm crops except alfalfa. Lime and fertilizer should be applied in amounts determined by soil tests. Large or frequent applications of lime are needed because of the high content of organic matter in these soils. Undrained areas are best suited to forest or to wildlife. The Weeksville soil in many places supports stands of sweetgum and holly, which might be managed profitably. Most areas of these soils occur in frost pockets.

In unusually wet seasons, the upper soil layers become saturated, even where normal drainage improvements have been made. In general, tile drains are efficient in lowering the water table in these soils. The Weeksville soil, however, requires special treatment because of the fine and uniform sand in it. In this soil the sand flows freely when saturated; therefore, excavations are easier to make late in summer when the soil is driest. Spacing between lines of tile should be relatively close, and the tile should be placed on boards and covered with material designed to keep out the fine sand. In addition, some surface drainage may be needed in ponded areas, especially if high-value crops are to be grown.

In most places these soils are suitable for dugout ponds. Unless a clayey layer is near the surface, the rate of recharge is rapid in the Pocomoke soil. The rate of recharge in the Weeksville soil ranges from slow to rapid.

CAPABILITY UNIT IVe-6

Capability unit IVe–6 consists of deep, well-drained soils that are moderately steep or soils that are moderately sloping and severely eroded. The texture of the surface layer ranges from loamy fine sand to sandy clay but is most commonly fine sandy loam. Runoff is rapid, and erosion is a hazard in plowed areas. The soils are moderately or slowly permeable. Lime and fertilizer are easily washed away by runoff. The soils are—

Freehold and Collington soils, 10 to 15 percent slopes.
Marlton soils, 5 to 10 percent slopes, severely eroded.
Westphalia soils, 10 to 20 percent slopes.

The soils in this unit are best suited to hay, pasture, forest, and wildlife, or to crops that need only limited cultivation. Apple orchards can be planted if the soils are kept in sod. The soils are too steep for continuous row crops, but an occasional row crop can be planted after several years of small grain. If the soils are cultivated, use diversion terraces on the long slopes. Plow and plant on the contour. Use manure or other organic material on the severely eroded areas to improve the tilth. Where it is not necessary to use the soils intensively, plant pine for Christmas trees, holly for Christmas greens, black locusts for fenceposts, or shrubs for wildlife food and cover.

CAPABILITY UNIT IVs-7

The one soil in this capability unit, Lakeland sand, 0 to 5 percent slopes, is nearly level to gently sloping, deep, loose sand. The subsurface layer is not strongly bleached. This soil is low in natural fertility and is droughty. If it is left bare, it is subject to wind erosion. Tender plants on this soil are easily cut by the wind-driven sand. If fertilizer is added, it leaches out readily.

This soil is so droughty and leaches so readily that it is not suitable for hay, pasture, or many other crops. If the soil is irrigated, frequent applications are needed because the sandy soil holds so little water.

The crops best suited to the soil in this unit are sweetpotatoes, peaches, pumpkins, squash, and perennial small fruits.

CAPABILITY UNIT IVw-17

Capability unit IVw–17 consists of nearly level to gently sloping, strongly bleached, sandy soils that have a fluctuating water table. The bleached layer is 6 inches thick or more. The low natural fertility of these soils can be improved only temporarily because of the sand texture. Soluble materials leach readily. The water table is about 2 feet below the surface in winter, and about 5 feet below it in summer. It is generally too deep to benefit crops; therefore, the water that can be held available for plants by these soils is very low. The soils are—

Lakehurst sand, 0 to 3 percent slopes.
Lakehurst-Lakewood association, 0 to 5 percent slopes (Lakehurst sand part).

Because these soils have so many features that cause poor crop yield, they are not generally cultivated. Their best use is for woodland, wildlife, recreation, and water conservation. The primary management needed is fire prevention if the soils are used for woodland and wildlife.

CAPABILITY UNIT Vw-22

Capability unit Vw–22 consists of nearly level, poorly drained, sandy soils. In most places the soils have a dark organic layer in the subsoil. This layer ranges from slightly firm to very firm and varies considerably in thickness and in depth. In undrained areas, the water table is within a foot of the surface early in spring and is 2 feet or more lower in summer. The soils have low to very low natural fertility and are extremely acid. The soils are—

Leon sand.
Leon-St. Johns sands.

If drained, these soils are suited to blueberries (fig. 12). Areas planted in blueberries should be graded before planting. Drainage ditches should be so designed that structures can be installed to control the height of the water table in the field (fig. 13). Cover crops should be planted to maintain the content of organic matter, and fertilizer should be applied in amounts determined by soil tests.

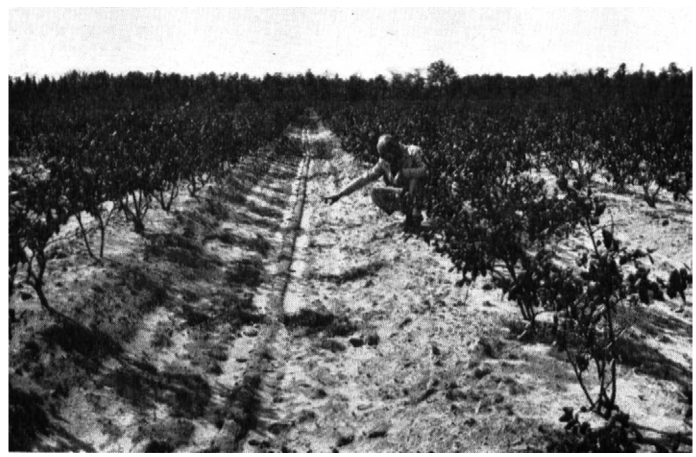

***Figure 12.*—Highbush blueberries on Leon sand.**

These soils are generally suitable sites for dugout ponds. The recharge rate is rapid unless a clayey layer is too near the surface.

CAPABILITY UNIT Vw-26

Capability unit Vw–26 consists of nearly level, very poorly drained, sandy soils. In most places the subsoil contains a dark organic layer. This layer is weakly cemented and ranges from slightly firm to firm. It varies in thickness and depth in places and is wavy. On undrained areas of these soils, the water table is within a foot of the surface early in spring and a foot or more lower in summer. The soils have low natural fertility and are extremely acid. The soils are—

St. Johns sand.
St. Johns sand, clayey substratum.

If drained, these soils are suited to cranberries and blueberries. Grade the area before planting. Design the drainage ditches so that structures can be installed to control the height of the water table in the field.

Dugout ponds are generally satisfactory on St. Johns sand. The recharge rate, however, may be slow for the St. Johns sand, clayey substratum.

CAPABILITY UNIT VIe-5

Capability unit VIe–5 consists of steep soils and moderately steep, eroded soils. The subsoil contains enough

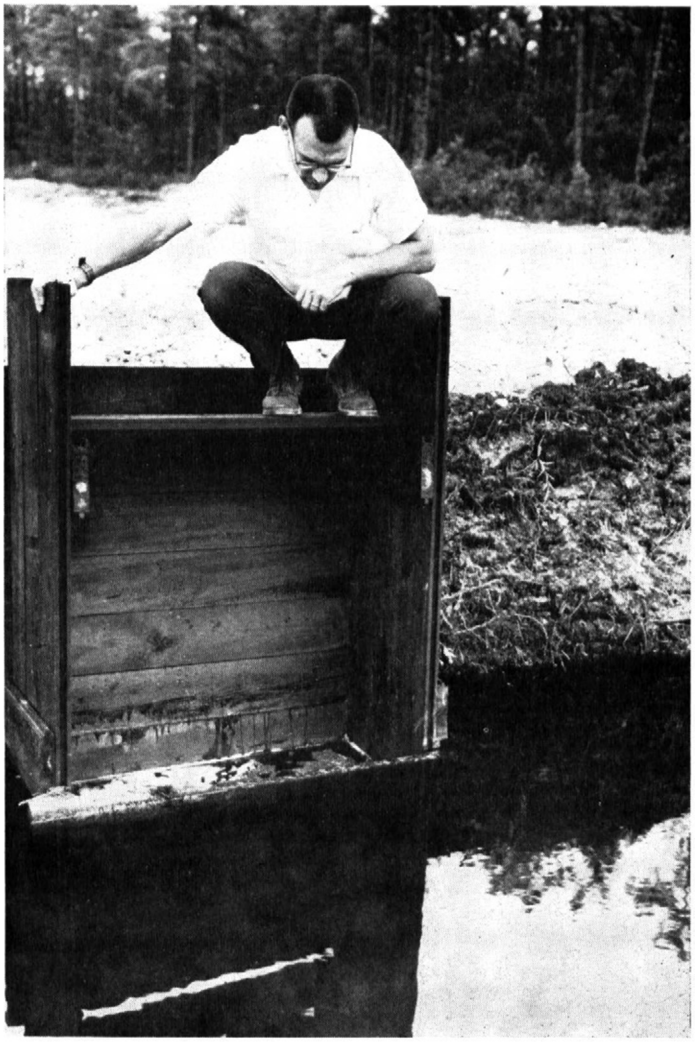

Figure 13.—**Structure used to control water level in a ditch in a blueberry field.**

clay to make these soils moderately to moderately slowly permeable. Also, there is enough clay to hold water available for plants. Runoff is rapid, and the erosion hazard is very high if these soils are cleared. These soils have low natural fertility and are extremely acid. They are—

Freehold soils, 15 to 30 percent slopes.
Westphalia soils, 10 to 20 percent slopes, severely eroded.

The soils in this group are best suited to hay, pasture, and forest or for recreation areas and wildlife habitats. If they are used for hay or pasture, lime and fertilizer should be applied according to the results of soil tests. Diversion ditches may be needed to reduce erosion in some fields. Pine, spruce, or fir can be planted for Christmas trees, holly for Christmas greens, and black locust for fenceposts.

CAPABILITY UNIT VIw-28

Capability unit VIw-28 consists of low-lying land types that are subject to flooding. Generally from one to four or more floods occur each year, though in some years there are none. The water table is near the surface throughout the year. In some places the hazard of flooding could be reduced considerably by building ditches, dikes, or other structures, but in most places these structures are not economically feasible. In some places drainage is needed in addition to the ditches and dikes. The soils are—

Loamy alluvial land.
Sandy alluvial land.

Because of flooding, these land types generally are not reclaimed for cultivation nor made suitable for residential sites. In places Loamy alluvial land is used for pasture. Some areas of Sandy alluvial land have been used for cranberries, but now nearly all have been abandoned.

These land types are most suitable as woodland, wildlife habitats, and recreation areas. Sweetgum grows best on areas of Loamy alluvial land that contains glauconite (*6*).[2] Most areas of these land types are good sites for dugout ponds.

CAPABILITY UNIT VIIs-8

Capability unit VIIs-8 consists of deep, loose, very sandy soils. No underlying clayey layers are within a depth of 60 inches, nor is the water table within that depth. Some of the soils have a bleached, almost white layer, 6 inches thick or more, just below the surface layer. The steeper soils contain ironstone fragments in places, especially at the highest elevations. The soils in this capability unit are rapidly permeable to a depth of 60 inches or more. The soils are—

Lakehurst-Lakewood association, 0 to 5 percent slopes (Lakewood part).
Lakewood fine sand, 0 to 5 percent slopes.
Lakewood fine sand, 5 to 10 percent slopes.
Lakewood fine sand, 10 to 25 percent slopes.
Lakewood sand, 0 to 5 percent slopes.
Lakewood sand, 5 to 10 percent slopes.
Lakewood and Lakeland sands, 10 to 30 percent slopes.

Because these soils have low natural fertility and are droughty, they are seldom cleared for farming. Nearly all areas formerly cleared have later been abandoned. The most common use is for pine pulpwood, but production is low on these sandy soils. It is a little higher on the fine sand types than on the sand types. Control of wildfire is the primary management problem on most of the soils. Other important uses for these soils are for wildlife habitats and recreation areas, and for urban development and water conservation. Because the soils are rapidly permeable, they are good sites for water disposal.

CAPABILITY UNIT VIIw-30

The one soil in this capability unit, Muck, consists of a highly organic soil primarily adjacent to the large streams that flow south or east toward the Atlantic Ocean. The organic material is decomposed. It ranges from 10 to 40 inches in thickness, but on the average it is about 24 inches thick. The water table is almost continuously at or near the surface. Flooding is common

Some areas of this soil have been cleared for cranbarries, but now nearly all have been abandoned. Clearing areas of Muck for vegetables has not been attempted, probably because the soil is extremely acid, shallow, and in small irregular areas. Furthermore, providing protection from floods would be expensive. Important uses

[2] Italic numbers in parentheses refer to Literature Cited, p. 93.

are for woodlands of southern white-cedar, for recreation, and for water conservation. These soils are also suitable for dugout ponds, and they can provide a large amount of water for use on adjacent farmlands.

Estimated Yields

The estimated index, or yield rating, for the principal crops grown on the soils of Camden County are given for two levels of management in table 2. The lowest rating is 1 and the highest 10. The index figures, or ratings, are converted to estimated yields in table 3.

Ratings in columns A are for yields expected under management used by most farmers in the county. Ratings in columns B are for yields to be expected if best current management is used for a specified soil. The ratings in columns B do not represent averages of the highest yields recorded under ideal conditions; instead, they represent averages of yields for a period of at least 5 years, after allowing for exceptional weather conditions, pest infestation, or disease. The differences between columns A and B may result from single factors or combinations of factors. In general all factors must be favorable to achieve yields in columns B.

TABLE 2.—*Yield ratings per acre for principal crops under two levels of management*

Ratings are from 1, the lowest, to 10, the highest. The ratings are converted to yields in table 3. Ratings in columns A are expected under management commonly used; those in columns B are expected under the best current management. Absence of data indicates crop is not generally grown on the soil]

Soil symbol	Soil	Asparagus (7-inch spear)		Tomatoes		Peppers		Sweetpotatoes		Corn		Alfalfa		Apples		Peaches	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
AmA	Aura loamy sand, 0 to 2 percent slopes	4	6	3	5	3	8	5	6	2	3	1	2	2	4	2	6
AmB	Aura loamy sand, 2 to 5 percent slopes	4	6	3	5	3	8	5	6	2	3	1	2	2	4	2	6
ArA	Aura sandy loam, 0 to 2 percent slopes	5	7	5	7	4	9	3	5	3	5	2	4	4	8	4	8
ArB	Aura sandy loam, 2 to 5 percent slopes	5	7	5	7	4	9	3	5	3	5	2	4	4	8	4	8
AtB	Aura-Downer loamy sands, 0 to 5 percent slopes:																
	Aura part	4	6	3	5	3	8	5	6	2	3	1	2	2	4	2	6
	Downer part	4	6	3	5	3	6	5	8	2	4	2	3	2	4	4	6
AvB	Aura-Downer sandy loams, 0 to 5 percent slopes:																
	Aura part	5	7	5	7	4	9	3	5	3	5	2	4	4	8	4	8
	Downer part	4	6	4	6	4	7	3	5	3	5	2	4	2	4	4	6
Cm	Colemantown loam	----	----	----	----	----	----	----	----	1	5	----	----	----	----	----	----
CoA	Collington fine sandy loam, 0 to 2 percent slopes	6	7	7	10	5	9	3	4	5	8	4	8	5	10	4	6
CoB	Collington fine sandy loam, 2 to 5 percent slopes	5	7	6	10	5	9	3	4	5	8	4	7	5	10	4	6
DoA	Downer loamy sand, 0 to 5 percent slopes	4	6	3	5	3	6	5	8	2	4	2	3	2	4	4	6
DrA	Downer loamy sand, clayey substratum, 0 to 5 percent slopes	4	6	4	6	3	6	5	8	2	4	2	4	2	4	4	6
DsA	Downer sandy loam, 0 to 2 percent slopes	4	6	4	6	4	7	3	5	3	5	2	4	2	4	4	6
DsB	Downer sandy loam, 2 to 5 percent slopes	3	6	3	6	4	7	3	5	3	5	2	4	2	4	4	6
DtC	Downer soils, 5 to 10 percent slopes	3	5	2	4	3	6	2	6	1	3	2	4	2	4	3	5
DxC	Downer-Aura complex, 5 to 10 percent slopes:																
	Downer part	3	5	2	4	3	6	2	6	1	3	2	4	2	4	3	5
	Aura part	3	5	2	4	3	6	2	6	1	3	2	3	2	4	3	6
Fd	Fallsington sandy loam	1	5	3	6	2	9	----	----	3	7	2	6	1	4	1	4
FfA	Freehold fine sandy loam, 0 to 2 percent slopes	7	10	6	9	4	9	3	4	5	8	4	7	6	10	6	10
FfB	Freehold fine sandy loam, 2 to 5 percent slopes	6	10	5	9	4	9	3	4	5	8	4	7	6	10	6	10
FfC	Freehold fine sandy loam, 5 to 10 percent slopes	5	9	4	8	3	8	2	3	4	7	3	6	4	8	5	9
FhB	Freehold loamy fine sand, 0 to 5 percent slopes	6	7	5	7	3	8	5	7	4	6	2	6	4	8	4	6
FhC	Freehold loamy fine sand, 5 to 10 percent	5	6	4	6	3	8	4	6	3	5	2	6	4	8	3	5
FnB	Freehold sand, thick surface variant, 0 to 5 percent slopes	1	2	----	----	----	----	2	3	----	----	1	2	----	----	1	2
FsE	Freehold soils, 15 to 30 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
FtD	Freehold and Collington soils, 10 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	1	4	2	6	----	----
HdA	Holmdel fine sandy loam, 0 to 3 percent slopes	6	8	4	7	3	9	2	4	4	8	8	10	8	10	1	4
HfA	Holmdel loamy fine sand, 0 to 3 percent slopes	5	7	3	6	3	9	5	7	3	6	6	8	6	8	2	6
KmA	Klej loamy sand, 0 to 2 percent slopes	4	6	3	4	3	7	5	7	2	3	1	2	2	4	2	4
KrA	Kresson sandy loam, 0 to 3 percent slopes	----	----	1	3	3	8	----	----	4	6	4	8	2	6	----	----
LaA	Lakehurst sand, 0 to 3 percent slopes	----	----	----	----	----	----	3	4	----	----	----	----	----	----	----	----

TABLE 2.—*Yield ratings per acre for principal crops under two levels of management*—Continued

[Ratings are from 1, the lowest, to 10, the highest. The ratings are converted to yields in table 3. Ratings in columns A are expected under management commonly used; those in columns B are expected under the best current management. Absence of data indicates crop is not generally grown on the soil]

Soil symbol	Soil	Asparagus (7-inch spear)		Tomatoes		Peppers		Sweetpotatoes		Corn		Alfalfa		Apples		Peaches	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
LbA	Lakehurst-Lakewood association, 0 to 5 percent slopes:																
	Lakehurst part	----	----	----	----	----	----	3	4	----	----	----	----	----	----	----	----
	Lakewood part	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
LcB	Lakeland fine sand, firm substratum, 0 to 5 percent slopes	1	2	2	3	2	3	5	7	----	----	1	2	1	2	1	2
LdA	Lakeland sand, 0 to 5 percent slopes	----	----	----	----	----	----	3	4	----	----	----	----	----	----	1	2
LeA	Lakeland sand, water table, 0 to 2 percent slopes	1	2	----	----	----	----	5	7	----	----	----	----	----	----	----	----
LfB	Lakewood fine sand, 0 to 5 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
LfC	Lakewood fine sand, 5 to 10 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
LfD	Lakewood fine sand, 10 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
LgB	Lakewood sand, 0 to 5 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
LgC	Lakewood sand, 5 to 10 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
LhE	Lakewood and Lakeland sands, 10 to 30 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Lo	Leon sand	----	----	----	----	----	----	----	----	1	2	----	----	----	----	----	----
Ls	Leon-St. Johns sands	----	----	----	----	----	----	----	----	1	2	----	----	----	----	----	----
Lv	Loamy alluvial land	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
McC3	Marlton soils, 5 to 10 percent slopes, severely eroded	3	5	2	4	2	3	----	----	2	4	4	6	2	6	1	4
MmB	Matawan loamy sand, 0 to 5 percent slopes	3	5	2	5	3	5	4	5	3	5	3	4	1	2	2	6
MnA	Matawan sandy loam, 0 to 2 percent slopes	4	6	3	6	3	7	3	4	4	6	4	5	2	4	2	6
MnB	Matawan sandy loam, 2 to 5 percent slopes	4	6	3	6	3	7	3	4	4	6	4	5	2	4	2	6
Mo	Moderately wet land	----	----	4	7	3	7	----	----	4	8	2	8	2	10	----	----
MrA	Marlton sandy loam, 0 to 2 percent slopes	5	7	4	6	3	7	----	----	4	7	6	9	4	8	2	6
MrB	Marlton sandy loam, 2 to 5 percent slopes	5	7	4	6	3	7	----	----	4	7	6	9	4	8	2	6
Mu	Muck	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
NbA	Nixonton and Barclay fine sandy loams, 0 to 3 percent slopes	6	8	4	7	4	9	2	4	4	8	4	9	6	10	2	6
NcA	Nixonton and Barclay loamy fine sands, 0 to 5 percent slopes	5	8	3	6	4	9	3	5	3	7	4	8	6	10	2	6
Pa	Pasquotank fine sandy loam	1	5	1	5	2	10	----	----	3	7	1	6	1	6	----	----
Ps	Pocomoke sandy loam	----	----	1	4	1	8	----	----	2	6	----	----	----	----	----	----
Sa	St. Johns sand	----	----	----	----	----	----	----	----	1	2	----	----	----	----	----	----
Sc	St. Johns sand, clayey substratum	----	----	----	----	----	----	----	----	1	2	----	----	----	----	----	----
Sv	Sandy alluvial land	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Sw	Shrewsbury fine sandy loam	2	6	2	5	2	9	----	----	4	8	1	8	1	6	1	4
Wd	Weeksville fine sandy loam	----	----	----	1	1	9	----	----	3	7	----	----	----	----	----	----
WaB	Westphalia fine sandy loam, 0 to 5 percent slopes	6	8	5	7	4	9	3	5	5	8	3	5	6	10	4	6
WfB	Westphalia loamy fine sand, 0 to 5 percent slopes	5	7	4	6	4	9	5	8	3	6	2	4	6	10	4	8
WfC	Westphalia loamy fine sand, 5 to 10 percent slopes	4	7	3	5	4	9	4	7	2	5	1	3	5	9	3	6
WhD	Westphalia soils, 10 to 20 percent slopes	----	----	----	----	----	----	----	----	----	----	1	2	----	----	----	----
WhD3	Westphalia soils, 10 to 20 percent slopes, severely eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
WsA	Woodstown and Dragston sandy loams, 0 to 3 percent slopes	5	8	3	5	3	7	3	5	3	6	8	10	6	8	1	3
WtA	Woodstown and Klej loamy sands, 0 to 3 percent slopes:																
	Woodstown part	5	6	2	4	3	7	4	6	2	4	2	4	4	6	2	6
	Klej part	4	6	3	4	3	7	5	7	2	3	1	2	2	4	2	4
WuA	Woodstown and Klej loamy sands, clayey substrata, 0 to 3 percent slopes	5	6	3	5	3	7	4	7	2	4	3	5	4	6	2	6

TABLE 3.—*Rating-yield per acre conversion table* [1]

Rating	Crop							
	Asparagus (7-inch spear)	Tomatoes	Peppers	Sweet-potatoes (U.S. No. 1)	Corn	Alfalfa	Apples	Peaches
	100 lb.	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Bu.*	*Bu.*
1	10	10	100	100	30	1.8	275	175
2	12	12	150	125	40	2.0	300	200
3	14	14	200	150	50	2.3	325	225
4	16	16	250	175	60	2.5	350	250
5	18	18	300	200	70	2.8	375	275
6	20	20	350	225	80	3.0	400	300
7	22	22	400	250	90	3.3	425	325
8	24	24	450	275	100	3.5	450	350
9	26	26	500	300	110	3.8	475	375
10	28	28	550	325	120	4.0	500	400

[1] Based on data gathered in 1957; estimates revised in 1963.

Specific criteria for best current management (columns B) change from year to year. Current detailed recommendations are published annually in various bulletins by the Agricultural Extension Service. In general, however, the following practices are always involved.

1. Use of plant varieties based on kind of soils, on climate, and on disease or pest resistance of the plants.
2. Seed treatment, such as inoculation and sterilization.
3. Use of appropriate seeding rates and maintenance of optimum plant population.
4. Fertilization, including formula, rates, timing, mode of application, adjusted to amount of available moisture and plant population.
5. Liming according to crop needs.
6. Control of pests and disease.
7. Control of weeds.
8. Use of optimum drainage and control of shallow water table.
9. Use of adequate irrigation.
10. Control of runoff and wind or water erosion.
11. Use of appropriate crop sequence, ground cover, and minimum tillage.
12. Maintenance of good tilth.

Estimated yield ratings are based on reports of growers from adjoining Gloucester County in 1957. Some yields have been adjusted upward to reflect recent increases in yields. For most crops this increase has been slight, but for tomatoes it is substantial. A yield breakthrough for certain crops occurs from time to time. Some apple yields of 1,000 bushels per acre have been reported, but these are generally restricted to specific varieties from orchards at prime age and in years of ideal weather. These yields are considerably above the average.

Estimated yields on soils for which no records were available were based on yields of similar soils. The county agricultural agent and other agricultural leaders helped to make the necessary adjustments.

Because they are not suited to crops or are not generally used for them, Clay pits, Made land, Sand and gravel pits, Tidal marsh-Made land complex, and mapping units containing an urban land complex were not listed in table 2.

Use of Soils for Woodland [3]

Originally all of Camden County, except the tidal marshes was in forest. In the northwestern one-third of the county, the more clayey and more fertile soils supported a forest of mixed hardwoods made up mostly of oak, yellow-poplar, chestnut, hickory, beech, ash, sweetgum, and redcedar, but there were a few scattered Virginia pines. Some mature trees were more than 120 feet high and 5 feet or more in diameter. At first the large trees were cut to supply local residents and cities with construction material, fuel, and lumber for export, and later all areas were repeatedly cut over to supply the local residents and nearby towns with fuel for their homes and for iron furnaces, glass factories, canning plants, and other industries. About 1904 the chestnut blight killed all the stems of chestnut trees in the area, though the roots still produce sprouts, some of which bear fruit before they die. By 1962 only small areas that are wet or steep were producing hardwoods.

In the southeastern two-thirds of the county, where the soils are considerably more sandy, drier, and less fertile, the forest was predominantly pitch pine mixed with oak, shortleaf pine, chestnut, and scattered hickory. In swamps the dominant trees were Atlantic white-cedar, red maple, blackgum, and sweetbay magnolia.

After the land was cleared and then abandoned, many areas reseeded to pines (fig. 14). On the sandier soils pines produce far more merchantable timber than oaks, which need better growing conditions to produce high-quality timber.

Because the native pitch pine, and, to a lesser extent, shortleaf pine are more fire resistant than other kinds of trees, these conifers dominate in areas where there have been repeated wildfires. Because they have been damaged, however, these pines often are of low quality and do not indicate the rate of growth possible in

[3] SILAS LITTLE, Northeastern Forest Experiment Station, U.S. Forest Service, assisted in preparing this section.

***Figure 14.*—The soils can support either oaks or pines. Pure stands of pine seeded in abandoned fields, but oaks eventually replace pines if left undisturbed.**

stands undamaged by wildfires. Adjacent to the large streams, where the water table is constantly high and where organic matter has accumulated, there were dense forests of Atlantic white-cedar. These trees have always been valuable because of their high volume per acre and the variety of their uses, some of which are for boat boards, poles, posts, shingles, boxes, crates, and rustic furniture.

By 1960 the area in woodland in the county was about 58,000 acres. Of this area about 14,000 acres, mostly pine-producing land, was State owned; about 12,000 acres in eastern Waterford Township was in the Wharton Tract; and 2,100 acres was in the Winslow Public Hunting Grounds. Some of this woodland undoubtedly will be used for recreation, mainly hunting, fishing, and camping. About 2,500 acres, mostly in hardwoods, are part of county, township, or municipal parks or part of farms. The acreage, however, is decreasing because of suburban expansion. Some woodland, though not much, is being cleared for crops, primarily blueberries, and some cleared farmland, particularly in holdings acquired by urban workers for rural residences, is reverting to woodland.

Woodland suitability grouping

Management of woodland can be planned more easily if soils are grouped according to those characteristics that affect growth of trees and management of stands. For this reason, the soils of Camden County have been placed in seven woodland suitability groups. They are grouped according to their potential productivity, or site index, and their management limitations or hazards. Although much more information is needed for an accurate and complete grouping, that which is available has been used to rate each soil; that is, a soil of a given series, of a specified surface texture, and of a specified slope. The soils are first rated separately, and those that have similar ratings are placed in the same suitability group. Minor differences are pointed out in the discussion of each woodland suitability group in the text. In these discussions, the soils are listed and briefly described and information about their use and management for woodland is given. The site index for various kinds of trees on each suitability group, the hazards and limitations that affect the management of each group, and the suitability of species for planting on each group are given in table 4. The terms used in this table and in the text are explained in the following paragraphs.

The potential productivity of a soil for trees is rated by means of the average *site index.* Site index for a given soil is expressed as the average height, in feet, that the dominant or codominant trees of a given species, growing

TABLE 4.—*Management data for woodland suitability groups*

Woodland suitability groups	Commercial trees	Site index	Limitation or hazard			Species suitable to—	
			Seedling mortality	Plant competition	Windthrow hazard	Favor in stand	Use for planting
Group 1: Nearly level to steep soils that have moderate to high available moisture, loamy subsoil, and moderate natural fertility— (CoA, CoB, DrA, FfA, FfB, FfC, FhB, FhC, FsE, FtD, HdA, HfA, MmB, MnA, MnB, NbA, NcA, WaB, WfB, WfC, WhD, WhD3, WsA, WtA[1], WuA).	Yellow-poplar Mixed oaks	80 to 108 75 to 90	Slight	Moderate to severe.	Slight to moderate.	Yellow-poplar or mixed oaks.	Yellow-poplar and white pine.
Group 2: Nearly level to strongly sloping soils that have moderate to high available moisture capacity, clayey subsoil, and low to moderate natural fertility— (KrA, McC3, MrA, MrB, Mo).	Yellow-poplar Mixed oaks	87 to 93 70 to 90	Slight	Slight to moderate.	Slight	Mixed oaks or yellow-poplar.	Yellow-poplar and white pine.
Group 3: Nearly level to strongly sloping, somewhat droughty soils that have low natural fertility— (AmA, AmB, ArA, ArB, AtB, AvB, DoA, DsA, DsB, DtC, DxC, FnB, KmA, WtA [2]).	Mixed oaks Pitch pine Shortleaf pine.	40 to 70 55 to 70 55 to 70	Slight	Slight to moderate.	Slight	Pine	Shortleaf, pitch, and white pines.
Group 4: Nearly level, very wet, loamy mineral soils and loamy alluvial soils— (Cm, Fd [3], Lv, Pa, Ps, Sw, Wd).	Sweetgum Mixed oaks	72 to 88 75 to 90	Slight	Severe	Moderate	Bottom land oaks and sweetgum.	([4]).
Group 5: Nearly level, very wet organic soils— (Mu).	Atlantic white-cedar.	35 to 55	Slight	Severe	Severe	Atlantic white-cedar.	([5]).
Group 6: Nearly level to steep sandy soils that are droughty and infertile— (LaA, LbA, LcB, LdA, LeA, LfB, LfC, LfD, LgB, LgC, LhE).	Mixed oaks Pitch pine Shortleaf pine.	35 to 50 45 to 65 45 to 65	Slight to severe.	Slight to moderate.	Slight	Shortleaf pine and pitch pine.	Shortleaf pine and pitch pine.
Group 7: Nearly level sandy soils that are very wet and are infertile— (Lo, Ls, Sa, Sc, Sv).	Pitch pine Shortleaf pine. Atlantic white-cedar.	55 to 70 55 to 70 ([6])	Slight	Severe	Moderate	Pitch pine	Pitch pine.

[1] Woodstown part.
[2] Klej part.
[3] Site index for this soil is lower than the range listed for the group.
[4] Planting generally not feasible.
[5] Not generally planted because of damage by browsing deer.
[6] Information not available.

on a given soil in an even-aged, well-stocked stand, will attain in 50 years.

The site index is obtained by measuring the height of trees, by determining their age by counting the rings, and by determining the kind of soil at the site. Then from height-age curves for each species, the height of a specified tree at 50 years of age can be determined. This height is determined for at least four trees at a site, and the average height of the trees is the site index.

Because the site index needs to reflect normal growth, sites should be selected that have not been damaged by fire, disease, insects, grazing, or other adverse factors. As a rule, there is a close relationship between the site index and the volume produced per acre, as expressed in board feet or cords. In New Jersey, the relationship between the soil and the site index for sweetgum and yellow-poplar has been partly studied. Estimates are based on these partial studies, on scattered observations in the State, and on information obtained elsewhere.

Seedling mortality refers to the expected loss of natural or planted seedlings as a result of unfavorable soil characteristics. In table 4 the rating *slight* means that

776-501—66——4

adequate natural regeneration ordinarily will take place if the seedbed and seed sources are adequate. On old field sites losses resulting from the effect of the soil are ordinarily less than 25 percent. Normally, satisfactory restocking by initial planting can be expected. The rating *moderate* means that there is a regeneration problem. On old field sites losses resulting from the effect of the soil are ordinarily between 25 and 50 percent. Normally, some replanting to fill openings will be necessary. Natural regeneration cannot be relied on for adequate and immediate restocking, even if seedbeds, seed sources, and weather are reasonably favorable. The rating *severe* means that losses resulting from the effect of the soil are ordinarily more than 50 percent. Natural regeneration can be relied on only if seedbeds, seed sources, and the weather are favorable.

Plant competition refers to the rate that undesirable plants invade the site when openings are made in the canopy. The rating *slight* means that there are no special problems of plant competition. The rating *moderate* means that plant competition develops but can be controlled by site preparation, weeding, or other simple management. The rating *severe* means that plant competition prevents adequate restocking of designated species, unless controlled burning, disking, use of chemical sprays, girdling, or other special management practices are used.

The ratings for windthrow hazard are based on soil characteristics or qualities that enable trees to resist the force of the wind. Windthrow damage is most severe on soils that remain wet for long periods, particularly the muck soils and soils in very low positions that receive much surface water. The ratings are *slight*, *moderate*, and *severe*, depending on the expected hazard of windthrow. Several woodland suitability groups have a range in ratings. This range is explained in the discussion of these groups.

The trees that are most suitable for favoring in the stand or for planting on each woodland suitability group are also given in table 4. These trees will provide the most valuable timber crop. In general, conifers are better suited to the sandy soils. Yellow-poplar, sweetgum, and oaks, however, are better suited to the finer textured, relatively moist soils. Only the species of pine that are available locally are listed in the table as suitable for planting. Other species of pine, spruce, fir, and other trees for special products are given in the text for each woodland suitability group. In some groups, however, no planting is suggested because of severe competition from other plants or because of successive failures caused by animals.

For specific information on what trees to plant or how to manage woodlands, landowners should consult their district forester of the New Jersey Department of Conservation and Economic Development. For general information concerning forestry, they should consult the extension forester of the Agricultural Extension Service.

Descriptions of woodland suitability groups

In this section the seven woodland suitability groups of Camden County are discussed, and the soils in each group are listed.

Because they are not suitable for, or generally are not used for woodland, the land types, Clay pits, Made land, Sand and gravel pits, and Tidal marsh-Made land complex, and soils in urban land complexes were not placed in woodland suitability groups.

WOODLAND SUITABILITY GROUP 1

This group consists of nearly level to steep soils that have moderate to high available moisture capacity, a loamy subsoil, and moderate natural fertility. The texture of the subsoil ranges from moderately coarse to moderately fine (sandy loam, loam, or sandy clay loam). The natural drainage of the soils in this group ranges from good to somewhat poor. The soils are—

CoA	Collington fine sandy loam, 0 to 2 percent slopes.
CoB	Collington fine sandy loam, 2 to 5 percent slopes.
DrA	Downer loamy sand, clayey substratum, 0 to 5 percent slopes.
FfA	Freehold fine sandy loam, 0 to 2 percent slopes.
FfB	Freehold fine sandy loam, 2 to 5 percent slopes.
FfC	Freehold fine sandy loam, 5 to 10 percent slopes.
FhB	Freehold loamy fine sand, 0 to 5 percent slopes.
FhC	Freehold loamy fine sand, 5 to 10 percent slopes.
FsE	Freehold soils, 15 to 30 percent slopes.
FtD	Freehold and Collington soils, 10 to 15 percent slopes.
HdA	Holmdel fine sandy loam, 0 to 3 percent slopes.
HfA	Holmdel loamy fine sand, 0 to 3 percent slopes.
MmB	Matawan loamy sand, 0 to 5 percent slopes.
MnA	Matawan sandy loam, 0 to 2 percent slopes.
MnB	Matawan sandy loam, 2 to 5 percent slopes.
NbA	Nixonton and Barclay fine sandy loams, 0 to 3 percent slopes.
NcA	Nixonton and Barclay loamy fine sands, 0 to 5 percent slopes.
WaB	Westphalia fine sandy loam, 0 to 5 percent slopes.
WfB	Westphalia loamy fine sand, 0 to 5 percent slopes.
WfC	Westphalia loamy fine sand, 5 to 10 percent slopes.
WhD	Westphalia soils, 10 to 20 percent slopes.
WhD3	Westphalia soils, 10 to 20 percent slopes, severely eroded.
WsA	Woodstown and Dragston sandy loams, 0 to 3 percent slopes.
WtA	Woodstown and Klej loamy sands, 0 to 3 percent slopes (Woodstown part).
WuA	Woodstown and Klej loamy sands, clayey substrata, 0 to 3 percent slopes.

The soils of this group are well suited to high-quality hardwoods, especially oaks and yellow-poplar. The site index for yellow-poplar is wide; it ranges from 80 to 108.

Plant competition is moderate to severe. It is moderate for most of the soils, but it is severe for the somewhat poorly drained areas occupied by Holmdel and Barclay soils. Plant competition is generally so severe that yellow-poplar seedlings will not grow unless special regeneration practices are used.

The windthrow hazard is slight to moderate. It is slight for most soils but is moderate for the somewhat poorly drained areas of Holmdel and Barclay soils.

In some old fields, plantings of white pine or yellow-poplar are successful. Plantings may also be made of trees for special purposes; for example, coniferous trees for Christmas trees, black locust for posts, and holly for Christmas greens. In places laurel is common and can be cut for Christmas decorations.

Because the slopes are steep and short and support a cover of shrubs, there is slight hazard of erosion. In extremely wet periods, there is a slight equipment limitation on the Holmdel and Barclay soils.

WOODLAND SUITABILITY GROUP 2

This group consists of nearly level to strongly sloping soils that have a moderate to high available moisture capacity and a clayey subsoil. Their natural fertility ranges from low to moderate. Drainage ranges from good to somewhat poor. The soils are—

KrA	Kresson sandy loam, 0 to 3 percent slopes.
McC3	Marlton soils, 5 to 10 percent slopes, severely eroded.
MrA	Marlton sandy loam, 0 to 2 percent slopes.
MrB	Marlton sandy loam, 2 to 5 percent slopes.
Mo	Moderately wet land.

This group is well suited to high-quality hardwoods, especially yellow-poplar and oaks. Sweetgum grows in places on Kresson sandy loam and Moderately wet land but rarely on the other soils.

Seedling mortality is moderate to severe on the severely eroded Marlton soils. Plant competition is moderate on Kresson sandy loam and Moderately wet land and is slight on the other soils in the group.

In old fields, plantings of white pine and yellow-poplar are successful. Special plantings for this group include Christmas trees, trees for fenceposts, holly, and laurel. Black locust should not be planted on the Kresson soil and on Moderately wet land.

WOODLAND SUITABILITY GROUP 3

This group consists of nearly level to strongly sloping soils that are somewhat droughty and are low in natural fertility. The texture of their subsoil ranges from coarse to fine. The natural drainage of the soils in this group ranges from good to somewhat poor. The soils are—

AmA	Aura loamy sand, 0 to 2 percent slopes.
AmB	Aura loamy sand, 2 to 5 percent slopes.
ArA	Aura sandy loam, 0 to 2 percent slopes.
ArB	Aura sandy loam, 2 to 5 percent slopes.
AtB	Aura-Downer loamy sands, 0 to 5 percent slopes.
AvB	Aura-Downer sandy loams, 0 to 5 percent slopes.
DoA	Downer loamy sand, 0 to 5 percent slopes.
DsA	Downer sandy loam, 0 to 2 percent slopes.
DsB	Downer sandy loam, 2 to 5 percent slopes.
DtC	Downer soils, 5 to 10 percent slopes.
DxC	Downer-Aura complex, 5 to 10 percent slopes.
FnB	Freehold sand, thick surface variant, 0 to 5 percent slopes.
KmA	Klej loamy sand, 0 to 2 percent slopes.
WtA	Woodstown and Klej loamy sands, 0 to 3 percent slopes (Klej part).

Because this group does not produce hardwoods of good quality, pines should be favored. Native pines include pitch, shortleaf, and Virginia. All three species are good for pulpwood, but shortleaf pine is best for sawtimber. Prescribed burning can be used to reduce the hazard of wildfire and to prepare a more favorable seedbed for pines. The site index varies widely. It is affected by rooting depth, by the moisture in the soil, and by soil texture.

Plant competition is slight to moderate for pines. The windthrow hazard is slight on these soils.

Christmas trees and black locust for posts can be planted on the soils of this group.

WOODLAND SUITABILITY GROUP 4

This group consists of nearly level, poorly drained and very poorly drained, loamy mineral soils and Loamy alluvial land. Their natural fertility ranges from low to moderate. The soils are—

Cm	Colemantown loam.
Fd	Fallsington sandy loam.
Lv	Loamy alluvial land.
Pa	Pasquotank fine sandy loam.
Ps	Pocomoke sandy loam.
Sw	Shrewsbury fine sandy loam.
Wd	Weeksville fine sandy loam.

These soils are well suited to hardwoods, especially oaks and sweetgum. The site index for sweetgum on the Fallsington and Pocomoke soils is considerably lower than average in areas where the sand is predominantly medium and coarse. Where Loamy alluvial land contains much glauconite, it has a high site index for sweetgum (*6*).

Holly could be planted or developed from natural stands on all soils of the group except Loamy alluvial land. On this land type the competition from other plants is too great, and flooding is a constant hazard. Excessive wetness on the soils of this group frequently limits the use of some equipment.

WOODLAND SUITABILITY GROUP 5

(Mu) Muck, the one soil in this group, is a nearly level, very wet organic soil. Atlantic white-cedar is the principal commercial species suited to this soil. Poorly shaped red maple and sweetbay magnolia occupy the area after Atlantic white-cedar has been cut. White-cedar, however, could be reestablished through the use of chemicals and direct seeding, but the success would depend on the amount of animal damage. On this soil excessive browsing by deer frequently prevents the survival and growth of enough white-cedar seedlings. In areas where the muck is shallow, pitch pine may be abundant enough to favor in the stand.

The use of equipment is severely limited by a high water table and by the unstable, saturated muck. Corduroy roads are generally necessary. The windthrow hazard is severe.

WOODLAND SUITABILITY GROUP 6

This group consists of nearly level to steep, droughty, infertile, sandy soils. The soils are—

LaA	Lakehurst sand, 0 to 3 percent slopes.
LbA	Lakehurst-Lakewood association, 0 to 5 percent slopes.
LcB	Lakeland fine sand, firm substratum, 0 to 5 percent slopes.
LdA	Lakeland sand, 0 to 5 percent slopes.
LeA	Lakeland sand, water table, 0 to 2 percent slopes.
LfB	Lakewood fine sand, 0 to 5 percent slopes.
LfC	Lakewood fine sand, 5 to 10 percent slopes.
LfD	Lakewood fine sand, 10 to 25 percent slopes.
LgB	Lakewood sand, 0 to 5 percent slopes.
LgC	Lakewood sand, 5 to 10 percent slopes.
LhE	Lakewood and Lakeland sands, 10 to 30 percent slopes.

This group consists of the common upland soils in an area called the New Jersey pine region. These soils are best suited to pitch and shortleaf pines.

Plant competition is from scrub oak and other oaks, especially in areas where wildfires have been numerous. Productivity on these soils has been limited mostly by wildfires.

WOODLAND SUITABILITY GROUP 7

This group consists of nearly level, very wet, infertile, sandy soils. The soils are—

Lo	Leon sand.
Ls	Leon-St. Johns sands.
Sa	St. Johns sand.
Sc	St. Johns sand, clayey substratum.
Sv	Sandy alluvial land.

This group consists of the poorly drained and very poorly drained soils of the area called the pine region. These soils are best suited to pitch pine. Atlantic white-cedar is the species to favor in the stand on some areas of St. Johns soils and on some of Sandy alluvial land. Windthrow hazard is moderate on all soils except Sandy alluvial land. It is severe on this land type.

In wet periods there are equipment limitations on the St. Johns soils and on Sandy alluvial land.

Use of Soils for Wildlife

In this section the suitability of the soils for specific wildlife habitats and for kinds of wildlife is discussed. Suitability ratings are given in table 5.

Suitability of soils for wildlife habitats

In this section the various wildlife habitats are discussed, and the soils of the county are rated according to their suitability for the establishment, improvement, or maintenance of each kind of habitat. The suitability ratings are given in table 5. These ratings are defined in the table.

Clay pits, Made land, Sand and gravel pits, Tidal marsh-Made land complex, and soils in mapping units that contain urban land complexes do not provide a suitable habitat for wildlife and therefore are not rated in table 5.

Soil ratings for the habitats listed in the table are explained as follows:

Grain and Seed Crop Habitat: The soils are rated according to their suitability for producing corn, sorghum, millet, soybeans, wheat, barley, oats, and other grain used as food by wildlife.

Grass and Legume Habitat: The soils are rated according to their suitability for producing introduced grasses, herbaceous legumes, and other forage crops commonly grown in the area. Cultivated grasses and legumes valuable for wildlife food and cover include alfalfa, clover, lespedeza, bluegrass, bromegrass, redtop, fescue, and orchardgrass.

TABLE 5.—*Suitability of the soils for wildlife habitats and kinds of wildlife*

[Soils rated 1 are well suited; 2, suited; 3, poorly suited; and 4, unsuited. Some soils that are not suitable for wildlife are not listed]

Soil series and map symbols	Kind of habitat										Kind of wildlife		
	Grain and seed crop	Grass and legume	Wild herbaceous upland plant	Hardwood woodland plant		Coniferous woodland plant		Wetland plant	Shallow water	Excavated pond	Openland wildlife	Woodland wildlife	Wetland wildlife
				Upland	Lowland	Upland	Lowland						
Aura:													
AmA, AmB	2	2	2	2	------	3	------	4	4	4	2	2	4
ArA, ArB, AtB, AvB	2	1	1	2	------	3	------	4	4	4	2	2	4
Colemantown:													
Cm	3	2	2	------	1	------	2	1	1	1	2	1	1
Collington:													
CoA	1	1	1	1	------	3	------	4	4	4	1	1	4
CoB	2	1	1	1	------	3	------	4	4	4	1	1	4
Downer:													
DoA, DrA	2	2	2	2	------	3	------	4	4	4	2	2	4
DsA, DsB, DtC, DxC	2	1	1	2	------	3	------	4	4	4	2	2	4
Fallsington:													
Fd	3	2	2	------	1	------	2	1	1	1	2	1	1
Freehold:													
FfA	1	1	1	1	------	3	------	4	4	4	1	1	4
FfB, FfC	2	1	1	1	------	3	------	4	4	4	1	1	4
FhB, FhC	2	2	2	2	------	3	------	4	4	4	2	2	4
FnB	3	3	3	3	------	1	------	4	4	4	3	3	4
FsE	4	3	1	1	------	3	------	4	4	4	3	1	4
FtD	3	2	1	1	------	3	------	4	4	4	2	1	4
Holmdel:													
HdA, HfA	2	1	1	1	1	3	3	[1] 2, 3	[1] 2, 3	[1] 2, 3	1	1	[1] 2, 3
Klej:													
KmA	3	2	2	3	------	1	------	3	3	3	2	3	3
Kresson:													
KrA	2	1	1	1	1	3	------	2	2	2	1	1	2

See footnotes at end of table.

TABLE 5.—*Suitability of the soils for wildlife habitats and kinds of wildlife*—Continued

[Soils rated 1 are well suited; 2, suited; 3, poorly suited; and 4, unsuited. Some soils that are not suitable for wildlife are not listed]

Soil series and map symbols	Kind of habitat										Kind of wildlife		
	Grain and seed crop	Grass and legume	Wild herbaceous upland plant	Hardwood woodland plant		Coniferous woodland plant		Wetland plant	Shallow water	Excavated pond	Openland wildlife	Woodland wildlife	Wetland wildlife
				Upland	Lowland	Upland	Lowland						
Lakehurst-Lakewood:													
LaA	4	4	4	4	------	1	------	3	3	3	4	4	3
LbA	4	4	4	4	------	1	------	4	[2] 3, 4	[2] 3, 4	4	4	4
Lakeland:													
LcB, LdA, LeA	3	3	3	3	------	1	------	4	4	4	3	3	4
Lakewood:													
LfB, LfC, LfD, LgB, LgC, LhE	4	4	4	3	------	1	------	4	4	4	3	3	4
Leon:													
Lo, Ls	4	3	3	3	------	1	------	3	1	1	4	3	2
Loamy alluvial land:													
Lv	4	2	2	------	1	2	------	1	2	1	3	1	1
Marlton:													
MrA	1	1	1	1	------	3	------	4	4	4	1	1	4
MrB	2	1	1	1	------	3	------	4	4	4	1	1	4
McC3	3	2	1	1	------	3	------	4	4	4	2	1	4
Matawan:													
MmB	2	2	2	2	------	3	------	4	3	3	2	3	4
MnA, MnB	2	1	1	1	------	3	------	4	3	3	1	1	4
Moderately wet land:													
Mo	3	2	2	1	1	2	2	1	1	1	2	1	1
Muck:													
Mu	4	3	4	4	------	------	2	2	1	1	4	4	1
Nixonton and Barclay:													
NbA, NcA	2	1	1	1	1	3	------	[3] 3, 2	[3] 3, 2	[3] 3, 2	1	1	[3] 2, 3
Pasquotank:													
Pa	3	2	2	------	1	------	2	1	1	1	2	1	1
Pocomoke:													
Ps	4	3	3	------	1	------	1	1	1	1	3	1	1
St. Johns:													
Sa, Sc	4	3	3	------	3	------	1	3	1	1	4	3	2
Sandy alluvial land:													
Sv	4	3	2	------	1	------	1	1	2	1	3	1	1
Shrewsbury:													
Sw	3	2	2	------	1	------	2	1	1	1	2	1	1
Weeksville:													
Wd	4	3	3	------	1	------	1	1	1	1	3	1	1
Westphalia:													
WaB	1	1	1	1	------	3	------	4	4	4	1	1	4
WfB, WfC	2	2	2	2	------	3	------	4	4	4	2	3	4
WhD, WhD3	4	3	1	1	------	3	------	4	4	4	3	1	4
Woodstown and Dragston:													
WsA	2	1	1	1	1	3	3	[4] 3, 2	[4] 3, 2	[4] 3, 2	1	1	[4] 2, 3
Woodstown and Klej:													
WuA, WtA (Woodstown part) (For Klej part, see Klej: KmA)	2	1	2	1	------	3	------	3	3	3	1	2	3

[1] Rating for HdA part, 2; rating for HfA part, 3.

[2] Rating for Lakehurst part, 3; rating for Lakewood part, 4.

[3] Rating for Nixonton part, 3; rating of Barclay part, 2.

[4] Rating for Woodstown part, 3; rating for Dragston part, 2.

Wild Herbaceous Upland Plant Habitat: The soils are rated according to their suitability for producing native or introduced perennial grasses and forbs (weeds) that provide food and cover principally for upland wildlife and that are established mainly through natural processes. Examples of these plants are lespedeza, beggarweed, wildbean, goldenrod, dandelion, bluestem, Indiangrass, wheatgrass, and wild rye.

Hardwood Woodland Plant Habitat: The soils are rated according to their suitability for producing hardwood trees and shrubs that make vigorous growth and produce fruit or seed. Most soils are rated for production of either upland or lowland plants, but several soils that are suited to both kinds of plants are rated for both. The most common seed-producing trees in the uplands are the upland oaks, beech, hickory, yellow-poplar, holly, dogwood, sassafras, and black birch. Among the shrubs and vines are lowbush blueberry, sumac, and grape. The most common trees in the lowlands are pin, willow, and swamp oaks, beech, yellow-poplar, maple, holly, gum, sassafras, and birch. Among the shrubs and vines are highbush blueberry, sweet pepperbush, viburnum, elderberry, bayberry, and greenbrier. The food produced consists of fruit, nuts, buds, catkins, twigs, or foliage.

Coniferous Woodland Plant Habitat: The soils are rated according to their suitability for producing coniferous trees. Most soils are rated for the production of either upland or lowland plants, but several soils are suited to both kinds and are rated for both. Examples of upland conifers are pitch pine, shortleaf pine, Virginia pine, and redcedar. Examples of lowland conifers are Atlantic white-cedar and pitch pine. A rating of 1 means that the plants are suited to the soil, but closure of the canopy is delayed. In areas where closure of the canopy is rapid, the soil is poorly suited and is rated 3.

Wetland Plant Habitat: The soils are rated according to their suitability for producing food and cover for waterfowl and furbearing animals. Annual and biennial plants are especially important in this habitat. Examples are smartweed, wildrice, wild millet, reed, burreed, three-square, bulrush, sedge, switchgrass, cordgrass, rice cutgrass, pondweed, duckweed, and cattail.

Shallow Water Habitat: The soils are rated according to their suitability for impoundments, excavations, or other structures for the control of water, generally to a depth not exceeding 5 feet. Examples are low dikes or levees, shallow dugout ponds, level ditches, and devices to control the water level of marshy streams or channels.

Excavated Pond Habitat: The soils are rated according to their suitability for dugout ponds or a combination of dugout ponds and low dikes that provide water of suitable quality, of suitable depth, and of ample quantity for the production of fish or wildlife. Depth should average 6 feet over at least one-fourth of the area. The soils should have a permanent high water table or provide some other dependable source of unpolluted water with a degree of acidity not less than pH 5.0.

Suitability of soils for different kinds of wildlife

The ratings showing suitability of the soils for different kinds of wildlife were made by evaluating their ratings for the different kinds of habitats. For example, the kinds of habitats that were considered most important for openland wildlife were grain and seed crops, grasses and legumes, wild herbaceous upland plants, and hardwood woodland plants. Therefore, weighted values based on the relative importance of each of these habitats were used in rating the soils for openland wildlife.

The kinds of wildlife, as listed in table 5, are defined as follows:

Openland wildlife: Birds and mammals that normally frequent croplands, pasture, meadows, lawns, and areas overgrown with grasses, herbs, and shrubby growth. Examples are quail, pheasants, meadow larks, field sparrows, redwinged blackbirds, cottontail rabbits, red foxes, and woodchucks.

Woodland wildlife: Birds and mammals that normally frequent areas wooded with hardwood trees and shrubs, coniferous trees and shrubs, or a mixture of such plants. Examples are ruffed grouse, thrushes, vireos, scarlet tanagers, towhees, gray and red squirrels, gray foxes, white-tailed deer, and raccoons.

Wetland wildlife: Birds and mammals that normally frequent wet areas, such as ponds, marshes, and swamps. Examples are black ducks, wood ducks, herons, shore birds, minks, muskrats, and beavers.

The ratings are useful to planners in selecting suitable wildlife habitats and in determining the intensity of management needed in a specified habitat. They are also useful for grouping the soils into good-sized areas suitable for wildlife management, for wildlife refuges, or for parks and other recreation. Farmers can use the ratings along with their soil map to locate places on their farms where habitats for desired wildlife can be established and to determine the best practices of management.

Engineering Applications [4]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. The properties most important to the engineer are permeability to water, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and pH. The depth to the water table and to bedrock, and the topography are also important.

This soil survey report contains information about the soils of Camden County that can be used by engineers to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural

[4] This section was written by KENNETH S. WERKMAN, conservation engineer, Soil Conservation Service.

drainage systems, farm ponds, irrigation systems, and diversion terraces.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway, airport, pipeline, and cable locations and in planning detailed investigations at the selected locations.
4. Locate probable sources of sand, gravel, or other construction materials.
5. Correlate performance of engineering structures with soil mapping units to develop information for planning that will be useful in designing and maintaining certain engineering practices and structures.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and reports and aerial photographs to make maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

The engineering interpretations reported here can be useful for many purposes. It should be emphasized that they may not eliminate the need for sampling and testing at the site of specific engineering works that involve heavy loads or where the excavations are deeper than the depth of the layers reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

To be able to make the best use of the soil maps and the soil survey report, the engineer should know the properties of the soil materials and the condition of the soil in place. Much of the information useful to engineers is given in tables 6, 7, and 8. These tables contain a summary of soil properties significant to engineering and some engineering interpretations. Preliminary evaluation of the engineering properties of the soils at any location in the county can be obtained from the detailed soil map at the back of this report and from the data in these tables.

Some of the terms used by soil scientists may be unfamiliar to the engineer, and some may have a special meaning in soil science. Those and other special terms that are used in this soil survey report are defined in the Glossary.

The engineering classification systems used to classify soil materials in tables 6 and 7 are discussed briefly in this section.

Additional information of special interest to engineers can be found in other parts of this report. Detailed profile descriptions of a typical soil of each series are given in the section "Descriptions of the Soil Series." Information on building foundations, septic effluent disposal, and other urban uses, are given in table 9 in the section "Soils in Urban Development."

Engineering classification systems

Most highway engineers classify soil materials according to the system approved by the American Association of State Highway Officials (AASHO) (*1*). In this system soil materials are classified in seven principal groups. The groups range from A–1, consisting of gravelly and coarse sandy soils of high bearing capacity, to A–7, consisting of clayey soils having low strength when wet. Within each group the relative engineering value of the soil material is indicated by a group index number. These numbers range from 0 for the best material to 20 for the poorest. The AASHO classification of soil types in Camden County is given in tables 6 and 7.

Some engineers prefer to use the Unified soil classification system (*12*). In this system the soils are identified according to their texture and plasticity and are grouped according to their performance as engineering construction material. Soil materials are classified as coarse grained (8 classes), fine grained (6 classes), or highly organic. The Unified classification of the soils in the county is given in tables 6 and 7.

Engineering test data

All engineering soil test data in this report are based on sampling and testing done by Rutgers University, College of Engineering (*5*, *7*).

In this study, soil samples from 48 locations in the county were tested in the laboratory. It was possible to identify the soil at only 26 of these locations in terms of mapping units that are shown on the detailed maps at the back of this report. The results of the test data for the 26 soils identified are given in table 6. Also in table 6, soil materials are classified according to the Unified and AASHO systems and the textural classification of the U.S. Department of Agriculture. In table 6 some of the soil names used in the original engineering study were changed to agree with current soil science classification.

Test data in table 6 have been interpreted and extended to cover all mapping units except Made land and Clay pits. This interpretation is shown in table 7, which gives estimated physical properties of the soils and a brief description of each soil type.

Soil properties significant to engineering

In table 7 the soils and map symbols are listed, and a brief description of each soil is given. Some of the properties significant to engineering are estimated. The information in this table is based on the test data in table 6 and other available data.

Permeability, as shown in table 7, was estimated for the soil as it occurs in place. The estimates were based on soil structure and porosity and were compared with the results of permeability tests on undisturbed cores of similar soil material.

The available water capacity is expressed in this table in inches per inch of soil depth. It is the approximate amount of capillary water in the soil when it is wet to field capacity. When the soil is air dry, this amount of water will wet the material described to a depth of 1 inch without deeper penetration.

The reaction, or pH, given in table 7 is that which would be expected for soil in its natural or untreated state. Heavy applications of lime, however, have raised the pH of most farmed fields.

TABLE 6.—*Engineering*

[Tests performed by the College of Engineering, Rutgers University, in accordance with

Soil type	Sampling site			Depth	Test results				
					Sieve analysis				
					Cumulative percentage passing—				
	Site number	Latitude	Longitude		¾ inch	No. 4 (4.7 mm.)	No. 10 (2 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
		Degrees, minutes, seconds	*Degrees, minutes, seconds*	*Inches*					
Aura loamy sand.	10	39°43′11″	74°59′08″	0 to 14	93	80	73	55	11
				14 to 30	99	94	92	79	40
				30 to 52	100	99	99	89	33
				52 to 72	100	100	99	79	30
Aura loamy sand.	21	39°46′58″	74°55′12″	0 to 3	------	------	------	------	------
				3 to 14	100	96	92	70	7
				14 to 18	------	------	------	------	------
				18 to 40	100	100	100	97	25
				40 to 60	100	100	98	95	11
				60 to 84	100	100	100	95	3
Aura sandy loam.	16	39°55′43″	75°01′10″	0 to 6	95	88	83	55	36
				6 to 20	90	73	70	38	22
				20 to 84	82	59	54	27	10
				84 to 108	100	100	99	69	16
Collington fine sandy.	40	39°51′58″	75°00′30″	0 to 10	100	100	100	92	49
				10 to 34	100	100	99	87	45
				34 to 60	100	100	99	89	48
				60 to 84	100	100	98	90	29
Downer sandy loam.	3	39°49′47″	74°55′30″	0 to 2	------	------	------	------	------
				2 to 20	98	89	86	65	20
				20 to 60	97	77	71	55	20
				60 to 90	100	100	99	84	6
Downer sandy loam.	4	39°45′40″	74°56′29″	0 to 20	86	68	63	48	22
				20 to 100	87	61	56	39	22
				100 to 220	100	99	92	48	7
				220 to 400	95	91	84	41	9
Downer sandy loam.	9	39°44′19″	75°00′19″	0 to 3	------	------	------	------	------
				3 to 16	100	100	98	81	34
				16 to 36	100	98	96	83	39
				36 to 54	94	65	56	40	12
				54 to 66	96	72	68	32	2
Downer loamy sand.	11	39°43′08″	74°50′17″	0 to 3	100	97	93	59	16
				3 to 16	100	95	94	58	23
				16 to 26	90	74	67	52	16
				26 to 36	------	------	------	------	------
				36 to 64	100	100	93	30	6
Freehold fine sandy loam.	14	39°52′06″	75°05′43″	0 to 6	100	100	99	83	35
				6 to 18	100	100	100	84	42
				18 to 42	100	100	100	89	28
				42 to 72	100	100	99	84	24
Freehold fine sandy loam.	18	39°54′15″	75°00′43″	0 to 8	100	100	100	92	37
				8 to 24	100	100	100	95	43
				24 to 40	100	100	100	92	27
				40 to 72	100	100	99	85	10
Freehold fine sandy loam.	19	39°54′45″	75°00′00″	0 to 8	100	100	98	93	27
				8 to 24	100	100	99	94	36
				24 to 48	100	100	98	93	27
				48 to 72	100	100	99	93	17

See footnotes at end of table.

test data

standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Test results—Continued						Classification		
Hydrometer analysis		Liquid limit [1]	Plasticity index [2]	Maximum density	Optimum moisture content	AASHO		Unified [3]
0.05–0.005 mm.	<0.005 mm.					Group	Group index	
Percent	*Percent*	*Percent*	*Percent*	*Lb. per cu. ft.*	*Percent*			
---	---	NL	NP	---	---	A-2-4	0	SP-SM.
17	21	23	7	---	---	A-4	1	SM-SC.
7	27	28	10	---	---	A-2-4	0	SC.
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	---	---	---	---	---	---	
---	---	NL	NP	---	---	A-3	0	SP-SM.
---	---	---	---	---	---	---	---	
1	24	27	9	---	---	A-2-4	0	SC.
---	---	NL	NP	---	---	A-2-4	0	SP-SM.
---	---	NL	NP	---	---	A-3	0	SP.
---	---	NL	NP	---	---	A-4	0	SM.
4	18	37	14	---	---	A-2-6	0	SC.
---	---	NL	NP	---	---	A-1-b	0	SP-SM.
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	NL	NP	---	---	A-4	3	SM.
16	27	31	13	115	15	A-6	3	SC.
24	20	27	9	117	13	A-4	3	SC.
7	19	31	14	---	---	A-2-6	1	SC.
---	---	---	---	---	---	---	---	
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	18	5	---	---	A-2-4	0	SM-SC.
---	---	NL	NP	---	---	A-3	0	SP-SM.
---	---	NL	NP	---	---	A-1-b	0	SM.
7	13	32	10	114	16	A-2-4	0	GC.
---	---	NL	NP	111	12	A-1-b	0	SP-SM.
---	---	NL	NP	---	---	A-1-b	0	SP-SM.
---	---	---	---	---	---	---	---	
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	NL	NP	---	---	A-4	1	SM.
---	---	NL	NP	---	---	A-1-b	0	SM.
---	---	NL	NP	---	---	A-1-b	0	SP.
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	---	---	---	---	---	---	
---	---	NL	NP	---	---	A-1-b	0	SP-SM.
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	21	6	---	---	A-4	1	SM-SC.
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	NL	NP	---	---	A-4	0	SM.
15	24	28	9	---	---	A-4	2	SC.
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	NL	NP	---	---	A-3	0	SP-SM.
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	NL	NP	---	---	A-4	0	SM.
---	---	NL	NP	---	---	A-2-4	0	SM.
---	---	NL	NP	---	---	A-2-4	0	SM.

TABLE 6.—*Engineering*

Soil type	Sampling site			Depth	Test results				
					Sieve analysis				
					Cumulative percentage passing—				
	Site number	Latitude	Longitude		¾ inch	No. 4 (4.7 mm.)	No. 10 (2 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
		Degrees, minutes, seconds	*Degrees, minutes, seconds*	*Inches*					
Freehold loamy fine sand.	28	39°51′27″	75°03′47″	0 to 20	100	100	100	83	4
				20 to 42	100	100	100	86	12
				42 to 44	----	----	----	----	----
				44 to 100	100	100	100	89	6
				100 to 130	100	100	100	96	17
				130 to 160	100	100	100	96	11
Freehold loamy fine sand.	29	39°51′55″	75°01′40″	0 to 6	100	100	99	68	4
				6 to 20	100	99	97	65	3
				20 to 42	99	99	98	76	22
				42 to 76	100	100	100	76	12
Freehold sand, thick surface variant.	32	39°53′17″	74°59′33″	0 to 24	100	100	100	98	5
				24 to 52	100	100	100	90	6
				52 to 72	100	100	100	92	15
				72 to 84	100	100	100	94	7
Freehold sand, thick surface variant.	33	39°54′02″	74°48′00″	0 to 10	100	100	100	95	14
				10 to 30	100	100	100	93	13
				30 to 44	100	100	99	95	29
				44 to 60	100	100	100	96	32
				60 to 84	100	100	98	93	10
Howell loam [4].	13	39°53′36″	75°05′18″	0 to 8	99	96	96	78	46
				8 to 26	99	98	98	87	58
				26 to 36	100	100	100	90	66
				36 to 70	100	99	98	72	25
				70 to 90	100	100	98	65	12
				90 to 100	100	100	99	89	66
Howell loam [4].	42	39°57′10″	75°02′11″	0 to 6	100	100	99	94	48
				6 to 24	100	100	100	97	65
				24 to 48	100	100	100	96	67
				48 to 64	100	98	97	83	28
Howell loam [4].	45	39°52′28″	75°06′20″	0 to 20	99	94	93	76	44
				20 to 36	100	100	100	93	84
				36 to 60	100	100	99	90	83
				60 to 96	100	100	100	93	78
Howell loam [4].	46	39°57′17″	75°01′36″	0 to 18	96	94	92	82	53
				18 to 48	99	97	96	91	68
				48 to 92	100	100	100	99	64
				92 to 120	100	100	96	94	36
Kresson sandy loam.	36	39°50′52″	75°00′59″	0 to 12	100	96	76	51	34
				12 to 30	100	100	100	97	75
				30 to 42	100	100	97	78	39
Kresson sandy loam.	38	39°52′27″	74°56′18″	0 to 12	100	100	100	94	74
				12 to 24	100	100	98	95	84
				24 to 60	100	100	100	81	45
Kresson sandy loam.	39	39°52′33″	74°58′05″	0 to 6	80	62	59	53	39
				6 to 24	100	100	99	98	95
				24 to 60	100	100	100	100	97
Lakewood fine sand.	23	39°46′18″	75°01′19″	0 to 6	100	100	95	75	9
				6 to 36	100	100	100	81	9
				36 to 48	100	100	99	80	5
				48 to 60	100	100	100	72	8
				60 to 84	98	88	78	59	6

See footnotes at end of table.

test data—Continued

Test results—Continued						Classification		
Hydrometer analysis		Liquid limit [1]	Plasticity index [2]	Maximum density	Optimum moisture content	AASHO		Unified [3]
0.05–0.005 mm.	<0.005 mm.					Group	Group index	
Percent	*Percent*	*Percent*	*Percent*	*Lb. per cu. ft.*	*Percent*			
		NL	NP			A-3	0	SP.
		NL	NP			A-2-4	0	SP-SM.
		NL	NP			A-3	0	SP-SM.
		NL	NP			A-2-4	0	SM.
		NL	NP			A-2-4	0	SP-SM.
		NL	NP			A-3	0	SP.
		NL	NP	104	14	A-3	0	SP.
		NL	NP			A-2-4	0	SM.
		NL	NP	115	13	A-2-4	0	SP-SM.
		NL	NP			A-3	0	SP-SM.
		NL	NP			A-3	0	SP-SM.
		NL	NP			A-2-4	0	SM.
		NL	NP			A-3	0	SP-SM.
		NL	NP			A-2-4	0	SM.
		NL	NP			A-2-4	0	SM.
		NL	NP			A-2-4	0	SM.
		NL	NP			A-2-4	0	SM.
		NL	NP			A-3	0	SP-SM.
		21	6			A-4	2	SM-SC.
		NL	NP	112	13	A-4	5	ML.
15	23	27	6			A-4	6	CL-ML.
		NL	NP	125	10	A-2-4	0	SM.
		NL	NP			A-2-4	0	SP-SM.
33	27	32	8			A-4	6	ML-CL.
		NL	NP			A-4	3	SM.
		22	4			A-4	6	CL-ML.
		23	6			A-4	6	CL-ML.
		NL	NP			A-2-4	0	SM.
		32	12			A-6	2	SC.
51	26	57	24	89	28	A-7-5	17	MH.
39	43	60	24	89	28	A-7-5	18	MH.
42	33	55	24			A-7-5	17	MH-CH.
		23	8			A-4	4	CL.
24	40	48	20	90	30	A-7-6	12	ML-CL.
25	37	49	17	90	30	A-7-5	10	ML.
		NL	NP			A-4	0	SM.
		45	13			A-2-7	1	SM.
		61	26	86	33	A-7-5	18	MH.
		49	17	95	29	A-7-5	3	SM.
		31	9			A-4	8	CL-ML.
47	34	34	11			A-6	8	CL.
		30	12			A-6	2	CL.
		37	12			A-6	2	GC.
		53	20	90	31	A-7-5	14	MH.
		45	12	95	27	A-7-5	10	ML.
		NL	NP			A-3	0	SP-SM.
		NL	NP	109	11	A-3	0	SP-SM.
		NL	NP			A-3	0	SP-SM.
		NL	NP			A-3	0	SP-SM.
		NL	NP	111	13	A-3	0	SP-SM.

TABLE 6.—*Engineering*

Soil type	Sampling site			Depth	Test results				
					Sieve analysis				
					Cumulative percentage passing—				
	Site number	Latitude	Longitude		¾ inch	No. 4 (4.7 mm.)	No. 10 (2 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
		Degrees, minutes, seconds	*Degrees, minutes, seconds*	*Inches*					
Lakewood sand.	26	39°40′21″	74°53′28″	0 to 4	100	100	98	62	8
				4 to 18	100	94	84	40	6
				18 to 72	100	98	90	51	9
Lakewood sand.	47	39°52′15″	74°57′10″	0 to 16	98	94	91	18	5
				16 to 70	100	98	95	21	3
				70 to 84	100	98	95	21	3
Shrewsbury fine sandy loam.	48	39°51′35″	75°04′30″	0 to 8	100	100	98	83	36
				8 to 68	100	100	100	95	48
				68 to 120	100	100	100	96	38

[1] NL used in this column means nonliquid.
[2] NP used in this column means nonplastic.

TABLE 7.—*Brief description of the soils and*

Map symbol	Soil name [1]	Depth to seasonally high water table	Description of soil	Depth from surface
				Inches
AmA AmB ArA ArB	Aura loamy sand, 0 to 2 percent slopes. Aura loamy sand, 2 to 5 percent slopes. Aura sandy loam, 0 to 2 percent slopes. Aura sandy loam, 2 to 5 percent slopes.	5 to 10 feet.	About 1 to 1½ feet of loamy sand or sandy loam over 1 to 2½ feet of firm sandy clay loam; underlain by stratified sandy loam; contains rounded quartzose gravel up to 2 inches in diameter and from 2 to 20 percent by volume; normally in high positions.	0–15 15–40 40–60
AtB	Aura-Downer loamy sands, 0 to 5 percent slopes.	------------	For data on the Aura soils, see Aura loamy sand and Aura sandy loam; for data on the Downer soils, see Downer loamy sand and Downer sandy loam.	
AvB	Aura-Downer sandy loams, 0 to 5 percent slopes.			
Ax	Aura-Urban land complex (Urban part).	5 to 10 feet.	Urban land consists of variable material that ranges from sandy loam to sandy clay loam; normally in high positions; slope generally ranges from 0 to 5 percent. For data on Aura part, see Aura sandy loam and Aura loamy sand.	0–60
Cm	Colemantown loam.	1 foot.	About 1 foot of highly organic loam over 2 feet of sandy clay; underlain by stratified sandy clay and sandy loam; in very low positions; slope ranges from 0 to 1 percent.	0–10 10–36 36–60
CoA CoB	Collington fine sandy loam, 0 to 2 percent slopes. Collington fine sandy loam, 2 to 5 percent slopes.	5 to 10 feet or more.	About 1 foot of fine sandy loam over 1½ feet of fine sandy clay loam; underlain by stratified loamy sand and sandy loam; in high positions.	0–13 13–32 32–60

See footnotes at end of table.

test data—Continued

Test results—Continued						Classification		
Hydrometer analysis		Liquid limit [1]	Plasticity index [2]	Maximum density	Optimum moisture content	AASHO		Unified [3]
0.05–0.005 mm.	<0.005 mm.					Group	Group index	
Percent	*Percent*	*Percent*	*Percent*	*Lb. per cu. ft.*	*Percent*			
----	----	NL	NP	----	----	A–3	0	SP–SM.
----	----	NL	NP	----	----	A–1–b	0	SP–SM.
----	----	NL	NP	----	----	A–3	0	SP–SM.
----	----	NL	NP	----	----	A–1–b	0	SP–SM.
----	----	NL	NP	108	17	A–1–b	0	SP.
----	----	NL	NP	107	17	A–1–b	0	SP.
----	----	NL	NP	----	----	A–4	0	SM.
----	----	NL	NP	----	----	A–4	3	SM.
----	----	NL	NP	----	----	A–4	1	SM.

[3] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points from the A-line are to be given a borderline classification. Examples on borderline classifications obtained by this use are SM–SC and CL–ML.

[4] Howell loam in this test represents the Howell part of the Howell-Urban land complex of soils.

their estimated physical and chemical properties

Classification			Mechanical analysis				Permeability	Available water capacity	Reaction [2]	Shrink-swell potential
USDA texture	Unified	AASHO	Percentage passing sieve—							
			No. 43	No. 10	No. 40	No. 200				
							Inches per hour	*Inches per inch of soil*	*pH*	
Loamy sand or sandy loam.	SP–SM or SM.	A–1, A–2, or A–3.	60–100	50–90	30–70	5–30	0. 2–2. 0	0. 08–0. 15	4. 0–4. 5	Low.
Sandy clay loam	SM or SC	A–2 or A–4	60–100	60–90	30–70	20–40	0. 2–0. 63	0. 12	4. 5–5. 0	Low to moderate.
Sandy loam	SM or SC	A–2 or A–3	50–90	50–90	30–70	10–30	0. 63–2. 0	0. 08	4. 5–5. 0	Low.
Sandy loam or sandy clay loam.	SM or SC	A–2	70–90	70–90	40–70	10–30	2. 0–6. 3	0. 12	4. 5–5. 0	Low.
Loam	ML or OL	A–4	95–100	95–100	80–90	50–60	0. 2–0. 63	[4] 0. 24	4. 0–4. 5	Low.
Sandy clay	CL or CH	A–7	95–100	95–100	80–90	60–80	0. 2–0. 63	[4] 0. 24	4. 5–5. 0	Moderate.
Sandy loam and sandy clay.	SM, SC, or ML	A–4	90–100	90–100	70–90	40–70	0. 63–2. 0	[4] 0. 20	4. 5–7. 0	Low to moderate.
Fine sandy loam.	SM	A–2 or A–4	95–100	95–100	85–95	30–50	0. 2–2. 0	0. 20	4. 0–4. 5	Low.
Fine sandy clay loam.	SM, SC, or ML.	A–6	95–100	95–100	85–95	35–55	0. 2–0. 63	0. 22	4. 5–5. 0	Moderate.
Loamy sand and sandy loam.	SP–SM	A–2 or A–4	95–100	95–100	80–90	20–40	0. 63–2. 0	0. 16	4. 5–5. 0	Low.

TABLE 7.—*Brief description of the soils and their*

Map symbol	Soil name [1]	Depth to seasonally high water table	Description of soil	Depth from surface
				Inches
DoA DsA DsB DtC DxC	Downer loamy sand, 0 to 5 percent slopes. Downer sandy loam, 0 to 2 percent slopes. Downer sandy loam, 2 to 5 percent slopes. Downer soils, 5 to 10 percent slopes. Downer-Aura complex, 5 to 10 percent slopes (Downer part).	5 to 10 feet.	About 1 to 1½ feet of loamy sand or sandy loam over 1 foot of sandy loam; underlain by stratified, loose loamy sand or sand; in places, contains rounded quartzose gravel up to 2 inches in diameter and 1 to 5 percent by volume; in intermediate positions. For data on the Aura part of Downer-Aura complex, see Aura loamy sand and Aura sandy loam.	0–18 18–30 30–60
DrA	Downer loamy sand, clayey substratum, 0 to 5 percent slopes.	5 to 10 feet.	About 1½ feet of loamy sand over 1 foot of sandy loam; underlain by stratified loamy sand and sandy loam that contain layers of sandy clay; in intermediate positions.	0–16 16–30 30–60
Fd	Fallsington sandy loam.	1 foot.	About 2 feet of sandy loam over stratified loamy sand and sandy loam; in places, contains small amount of rounded quartzose gravel up to 2 inches in diameter; soil is in low positions; slope ranges from 0 to 2 percent; soil originally ponded from late in fall until early in spring.	0–24 24–60
FfA FfB FfC FhB FhC FsE FtD	Freehold fine sandy loam, 0 to 2 percent slopes. Freehold fine sandy loam, 2 to 5 percent slopes. Freehold fine sandy loam, 5 to 10 percent slopes. Freehold loamy fine sand, 0 to 5 percent slopes. Freehold loamy fine sand, 5 to 10 percent slopes. Freehold soils, 15 to 30 percent slozes. Freehold and Collington soils, 10 to 15 percent slopes (Freehold part).	5 to 10 feet or more.	Freehold soils have about 1 or 1½ feet of fine sandy loam or loamy fine sand over loamy sand or sandy loam; underlain by stratified loamy fine sand and sandy loam, weakly cemented with iron in places; in high positions. For data on Collington soil in Freehold and Collington soils, see Collington fine sandy loam.	0–15 15–42 42–60
FnB	Freehold sand, thick surface variant, 0 to 5 percent slopes.	5 to 10 feet or more.	About 2½ feet of loose sand over 1 to 1½ feet of fine sandy loam; underlain by stratified loamy fine sand and fine sandy loam; in high positions.	0–30 30–40 40–60
FxB FxC	Freehold and Downer-Urban land complex, gently sloping (Urban land part). Freehold and Downer-Urban land complex, sloping (Urban land part).	5 feet or more.	About 5 feet of mixed loamy sand and sandy loam; in high positions; slope ranges from 0 to 5 percent. For data on Freehold part of this complex, see Freehold fine sandy loam and Freehold loamy fine sand. For data on Downer part, see Downer loamy sand and Downer sandy loam.	0–60
Fy	Freehold and Downer, clayey substrata, Urban land complex (Urban land part).	3 feet or more.	About 2 to 3 feet of mixed loamy sand or sandy loam underlain by layers of sandy clay; in high positions. For data on Freehold part of this complex, see Freehold fine sandy loam. For data on Downer part, see Downer loamy sand, clayey substratum.	0–30 30–60
HdA HfA	Holmdel fine sandy loam, 0 to 3 percent slopes. Holmdel loamy fine sand, 0 to 3 percent slopes.	2 to 3 feet.	About 10 inches to 1½ feet of fine sandy loam or loamy fine sand over 1½ to 2 feet of fine sandy loam or fine sandy clay loam; underlain by stratified fine sandy loam and loamy fine sand; in intermediate positions.	0–10 10–34 34–60

See footnotes at end of table.

estimated physical and chemical properties—Continued

Classification			Mechanical analysis				Permea-bility	Available water capacity	Reaction [2]	Shrink-swell potential
USDA texture	Unified	AASHO	Percentage passing sieve—							
			No. 4 [3]	No. 10	No. 40	No. 200				
							Inches per hour	*Inches per inch of soil*	*pH*	
Loamy sand or sandy loam.	SP-SM or SM.	A-2 or A-3	80-100	70-100	50-90	10-30	0. 63-2. 0	0. 10-0. 14	4. 0-4. 5	Low.
Sandy loam	SM	A-2	80-100	70-90	50-90	15-35	0. 63-2. 0	0. 12	4. 5-5. 0	Low.
Loamy sand or sand.	SP-SM	A-2 or A-3	70-100	60-100	40-70	10-20	2. 0-6. 3	0. 08	4. 5-5. 0	Low.
Loamy sand	SP-SM or SM.	A-2 or A-3	90-100	85-95	40-60	10-20	0. 63-2. 0	0. 10	4. 0-4. 5	Low.
Sandy loam	SM	A-2	90-100	85-95	40-60	15-25	0. 63-2. 0	0. 12	4. 5-5. 0	Low.
Loamy sand and sandy clay.	SP-SM or SM.	A-2 or A-4	70-90	60-80	40-60	10-50	0. 63-2. 0	0. 10	4. 5-5. 0	Low to moderate.
Sandy loam	SM	A-2 or A-4	95-100	95-100	60-80	30-40	0. 63-2. 0	[4] 0. 15	4. 0-4. 5	Low.
Loamy sand	SP-SM	A-2, A-3, or A-4.	95-100	90-100	50-80	10-40	2. 0-6. 3	[4] 0. 10	4. 5-5. 0	Low.
Loamy fine sand or fine sandy loam	SP-SM or SM.	A-2, A-3, or A-4.	100	95-100	75-95	5-40	0. 2-2. 0	0. 15-0. 20	4. 0-4. 5	Low.
Fine sandy clay loam.	SM-SC	A-2 or A-4	100	95-100	75-95	10-45	0. 63-2. 0	0. 18	4. 5-5. 0	Low to moderate.
Loamy sand and sandy loam.	SP-SM or SM.	A-2 or A-3	100	90-100	70-90	10-30	0. 63-6. 3	0. 15	4. 5-5. 0	Low.
Sand	SP or SP-SM.	A-2 or A-3	100	98-100	60-100	5-15	2. 0-6. 3	0. 10	4. 0-4. 5	Low.
Fine sandy loam.	SM	A-2	100	95-100	80-100	15-30	0. 63-2. 0	0. 15	4. 5-5. 0	Low.
Fine sand	SP-SM or SM.	A-2 or A-3	100	95-100	75-95	5-15	6. 3+	0. 12	4. 5-5. 0	Low.
Sandy loam or loamy sand.	SM or SP	A-2	90-100	85-100	60-90	10-30	0. 63-2. 0	0. 15	4. 5-5. 0	Low.
Sandy loam or loamy sand.	SM or SP-SM.	A-2	90-100	85-100	60-90	10-30	0. 63-2. 0	0. 15	4. 5-5. 0	Low.
Sandy clay	SC	A-2, A-4, or A-6.	95-100	85-100	60-90	20-50	0. 63-2. 0	0. 20	4. 5-5. 0	Low to moderate.
Fine sandy loam or loamy fine sand.	SM or SP-SM.	A-2, A-3, or A-4.	100	95-100	75-95	5-40	0. 63-2. 0	[4] 0. 15-0. 20	4. 0-4. 5	Low.
Fine sandy loam or fine sandy clay loam.	SM or SC	A-2 or A-4	100	95-100	75-95	15-50	0. 63-2. 0	[4] 0. 18	4. 5-5. 0	Low.
Loamy fine sand and fine sandy loam.	SM or SP-SM.	A-2 or A-3	100	90-100	70-95	5-25	0. 63-6. 3	[4] 0. 15	4. 5-5. 0	Low.

TABLE 7.—*Brief description of the soils and their*

Map symbol	Soil name [1]	Depth to seasonally high water table	Description of soil	Depth from surface
				Inches
Hm	Holmdel, clayey substratum, Urban land complex (Urban land part).	2 to 3 feet.	About 2½ feet of mixed fine sandy loam over stratified loamy fine sand and fine sandy loam; contains layers of sandy clay or silty clay; in intermediate positions; slope ranges from 0 to 2 percent. For data on Holmdel part of this complex (above 30 inches), see Holmdel fine sandy loam and Holmdel loamy fine sand.	0–30 30–60
Hn	Holmdel-Urban land complex (Urban land part).	2 to 3 feet.	5 feet of mixed sandy loam material; in intermediate positions; slope ranges from 0 to 2 percent.	0–60
HoB HoC	Howell-Urban land complex, gently sloping. Howell-Urban land complex, sloping.	4 feet or more.	5 feet of silty clay loam, generally mixed in upper 2 to 3 feet; well drained and moderately well drained; in high positions.	0–60
KmA	Klej loamy sand, 0 to 2 percent slopes.	2 to 3 feet.	5 feet of loamy sand; contains thin slightly clayey layers between a depth of 2½ and 5 feet in places; in intermediate positions.	0–60
KrA	Kresson sandy loam, 0 to 3 percent slopes.	2 to 3 feet.	About 1 foot of sandy loam or loam over 1½ feet of blocky sandy clay; underlain by stratified granular sandy loam and sandy clay loam; quartzose gravel rarely rounded, up to 20 percent of soil by volume and up to 2 inches in diameter; in intermediate positions; originally ponded.	0–10 10–32 32–60
LaA	Lakehurst sand, 0 to 3 percent slopes.	2 to 3 feet.	5 feet of loose sand; in places sand is mainly fine, and natural slopes are unstable; in intermediate positions.	0–60
LbA	Lakehurst-Lakewood association, 0 to 5 percent slopes.	------------	For data on Lakehurst part, see Lakehurst sand, 0 to 3 percent slopes. For data on Lakewood part, see Lakewood fine sand and Lakewood sand.	
LcB	Lakeland fine sand, firm substratum, 0 to 5 percent slopes.	10 feet or more.	About 3 feet of loose fine sand over 2 feet of weakly cemented sandy clay loam or gravelly sandy clay loam that becomes sandier with depth.	0–36 36–60
LdA	Lakeland sand, 0 to 5 percent slopes.	5 to 10 feet or more.	5 feet of loose sand, mainly medium and coarse, but fine in places.	0–60
LeA	Lakeland sand, water table, 0 to 2 percent slopes.	3 to 5 feet.	5 feet of loose sand, mainly medium and coarse, but fine in places.	0–60
LfB LfC LfD LgB LgC LhE	Lakewood fine sand, 0 to 5 percent slopes. Lakewood fine sand, 5 to 10 percent slopes. Lakewood fine sand, 10 to 25 percent slopes. Lakewood sand, 0 to 5 percent slopes. Lakewood sand, 5 to 10 percent slopes. Lakewood and Lakeland sands, 10 to 30 percent slopes (Lakewood part).	5 to 10 feet or more.	5 feet or more of loose, fine or medium, almost clean sand; on steeper slopes, ironstone fragments up to 1 or 2 feet thick in places; in high or intermediate positions. For data on Lakeland part of Lakewood and Lakeland sands, see Lakeland sand, 0 to 5 percent slopes.	0–60
Lo Ls	Leon sand. Leon-St. Johns sands (Leon part).	0 to 1 foot.	About 1 to 1½ feet of loose sand over 4 to 8 inches of weakly cemented sand; underlain by loose sand; small amount of rounded quartzose gravel up to 2 inches in diameter in places; in low positions; slopes range from 0 to 2 percent. For data on St. Johns part of this complex, see St. Johns sand.	0–15 15–19 19–60

See footnotes at end of table.

estimated physical and chemical properties—Continued

Classification			Mechanical analysis				Permea-bility	Available water capacity	Reaction [2]	Shrink-swell potential
			Percentage passing sieve—							
USDA texture	Unified	AASHO	No. 4 [3]	No. 10	No. 40	No. 200				
							Inches per hour	*Inches per inch of soil*	*pH*	
Fine sandy loam.	SM or SC	A–2 or A–4	100	95–100	80–95	25–40	0. 63–2. 0	[4] 0. 18	4. 0–5. 0	Low.
Loamy fine sand to sandy clay.	SM or SP–SM.	A–2	100	95–100	85–95	15–30	2. 0–6. 3	[4] 0. 15	4. 5–5. 0	Low.
Sandy loam	SM	A–2	100	95–100	80–95	20–35	0. 63–2. 0	[4] 0. 15	4. 0–5. 0	Low.
Silty clay loam	CL–ML, MH, or SM–SC.	A–6 or A–7	95–100	95–100	75–85	40–70	0. 2–0. 63	0. 24	4. 0–5. 0	Moderate.
Loamy sand	SP–SM or SM.	A–2 or A–3	90–100	90–100	50–70	10–20	2. 0–6. 3+	0. 10	4. 5–5. 0	Low.
Sandy loam or loam.	SM, SC, or CL–ML.	A–2, A–4, or A–6.	70–100	60–100	50–90	30–70	0. 2–0. 63	[4] 0. 22	4. 0–4. 5	Low to moderate.
Sandy clay	CL or MH	A–7	95–100	95–100	90–100	70–90	0. 2–0. 63	[4] 0. 24	4. 5–5. 0	Moderate.
Sandy loam or sandy clay loam.	SM–SC or ML.	A–4 or A–6	95–100	95–100	80–100	40–90	0. 2–0. 63	[4] 0. 18	4. 5–5. 0	Low to moderate.
Sand	SP or SP–SM.	A–3	95–100	90–100	50–90	2–12	6. 3+	0. 05	4. 5–5. 0	Low.
Fine sand	SP–SM or SM.	A–2 or A–3	95–100	95–100	80–100	5–15	2. 0– 6. 3	0. 10	4. 0–5. 0	Low.
Sandy clay loam or gravelly sandy clay loam.	SC	A–2 or A–3	70–90	60–90	40–60	20–40	0. 63– 2. 0	0. 10	4. 5–5. 0	Low to moderate.
Sand	SP or SP–SM.	A–2 or A–3	95–100	90–100	50–70	2–12	+6. 3	0. 05	4. 5–5. 0	Low.
Sand	SP or SP–SM.	A–2 or A–3	95–100	90–100	50–70	2–12	+6. 3	0. 05	4. 5–5. 0	Low.
Fine sand or sand.	SP or SP–SM.	A–2 or A–3	90–100	85–100	40–90	2–15	2. 0–6. 3	0. 05–0. 10	4. 0–5. 0	Low.
Sand	SP, SP–SM.	A–2 or A–3	90–100	90–100	50–70	2–12	2. 0–6. 3	0. 08	4. 0–5. 0	Low.
Loamy sand	SP–SM or SM.	A–2 or A–3	90–100	90–100	50–70	5–15	0. 63–2. 0	0. 08	4. 0–5. 0	Low.
Sand	SP or SP–SM.	A–3	90–100	90–100	50–70	0–10	+6. 3	0. 05	4. 5–5. 0	Low.

TABLE 7.—*Brief description of the soils and their*

Map symbol	Soil name [1]	Depth to seasonally high water table	Description of soil	Depth from surface
				Inches
Lv	Loamy alluvial land.	0 to 1 foot.	About 2 to 5 feet of recent stream alluvium over layers that range from sand and gravel to sandy clay; in very low positions; slope ranges from 0 to 2 percent; flooded annually.	0–24 24–60
Ma	Made land.	3 feet or more.	Mixed soil material; contains rubbish and fill.	0–60
MrA MrB McC3	Marlton sandy loam, 0 to 2 percent slopes. Marlton sandy loam, 2 to 5 percent slopes. Marlton soils, 5 to 10 percent slopes, severely eroded.	3 to 10 feet or more.	About 1 foot of sandy loam over 1½ feet of dense blocky sandy clay; underlain by stratified granular sandy loam or sandy clay loam; highly glauconitic; contains rounded quartzose gravel in places; in high positions; a few seeps.	0–8 8–30 30–60
Mk	Marlton and Kresson-Urban land complex (Urban land part).	2 to 4 feet or more.	About 2½ feet of mixed sandy clay underlain by stratified granular sandy loam and sandy clay; highly glauconitic; in high to intermediate positions; slope ranges from 0 to 5 percent. For data on Marlton part of this complex, see Marlton soils. For data on Kresson part, see Kresson sandy loam, 0 to 3 percent slopes.	0–30 30–60
MmB MnA MnB	Matawan loamy sand, 0 to 5 percent slopes. Matawan sandy loam, 0 to 2 percent slopes. Matawan sandy loam, 2 to 5 percent slopes.	2 to 4 feet or more.	1 to 1½ feet of loamy sand or sandy loam over 1 to 2 feet of blocky sandy clay; underlain by stratified sandy loam and sandy clay; in high to intermediate positions.	0–16 16–42 42–60
Mo	Moderately wet land.	2 to 3 feet.	About 1 foot of loam over 1½ feet of clay loam; underlain by layers of fine sandy loam and loam 1 to 3 feet thick; in turn, underlain by silty clay; in intermediate positions; originally ponded from fall to spring.	0–10 10–30 30–42 42–60
Mu	Muck.	0	About 2 feet of organic matter, generally underlain by loose sand and gravel but in places by clay; in very low positions; commonly flooded annually.	0–24 24–60
NbA NcA	Nixonton and Barclay fine sandy loams, 0 to 3 percent slopes. Nixonton and Barclay loamy fine sands, 0 to 5 percent slopes.	1 to 3 feet.	About 1½ feet of fine sandy loam or loamy fine sand over 1 or 1½ feet of very fine sandy loam; underlain by stratified fine sand and fine sandy loam; contains, rarely, small amounts of rounded quartzose gravel up to 2 inches in diameter.	0–18 18–34 34–60
Pa	Pasquotank fine sandy loam.	1 foot.	About 1 foot of fine sandy loam over 1 to 1½ feet of very fine sandy loam; underlain by fine sandy loam; in places, underlying layers contain coarse sand and gravel or clay; in low positions; slope ranges from 0 to 2 percent; originally ponded from late in fall to early in spring.	0–60
Pc	Pasquotank and Weeksville-Urban land complex (Urban land part).	0 to 1 foot.	About 5 feet of fine sandy loam, mixed in the upper 2 to 3 feet; in low or very low positions; slope ranges from 0 to 1 percent; originally ponded. For data on Pasquotank part of this complex, see Pasquotank fine sandy loam. For data on Weeksville part, see Weeksville fine sandy loam.	0–60

See footnotes at end of table.

estimated physical and chemical properties—Continued

Classification			Mechanical analysis				Permeability	Available water capacity	Reaction[2]	Shrink-swell potential
			Percentage passing sieve—							
USDA texture	Unified	AASHO	No. 4[3]	No. 10	No. 40	No. 200				
							Inches per hour	*Inches per inch of soil*	*pH*	
Sandy loam	SM	A–2	95–100	80–100	70–90	15–25	2.0–6.3	[4] 0.18	4.5–5.0	Low.
Sand to sandy clay.	SP–SM, SM, or SC.	A–3, A–4, or A–6.	90–100	80–100	60–90	10–50	0.63–6.3	[4] 0.15–0.20	4.5–5.0	Low to moderate.
----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	
Sandy loam	SM or ML	A–2 or A–4	70–100	60–100	40–90	30–80	0.2–0.63	0.22	4.0–4.5	Low.
Sandy clay	CL or MH or SC.	A–7	90–100	85–100	70–95	40–90	0.2–0.63	0.24	4.5–5.0	Moderate.
Sandy loam or sandy clay.	SM–SC, CL, or ML.	A–2 or A–7	95–100	85–100	70–90	20–60	0.63–2.0	0.18	4.5–5.0	Low to moderate.
Sandy clay	SM, ML, CL, or MH.	A–4 or A–6, A–7.	70–100	60–100	40–90	30–80	0.2–0.63	[4] 0.24	4.0–5.0	Moderate.
Sandy loam or sandy clay.	SM–SC, CL, or ML.	A–2 or A–7	95–100	85–100	70–90	20–60	0.63–2.0	[4] 0.18	4.5–5.0	Moderate.
Loamy sand or sandy loam.	SP–SM or SM.	A–2 or A–4	80–100	70–100	40–90	10–40	0.63–2.0	0.12–0.15	4.0–5.0	Low.
Sandy clay	SC	A–2 or A–7	90–100	70–100	60–90	30–50	<0.2–0.63	[4] 0.18	4.5–5.0	Moderate.
Sandy loam and sandy clay.	SM–SC	A–2, A–4 or A–6.	90–100	80–100	80–90	20–40	0.63–2.0	[4] 0.15	4.5–5.0	Low.
Loam	SM–SC or ML–CL.	A–4 or A–6	98–100	95–100	80–95	40–65	0.2–0.63	[4] 0.24	4.0–4.5	Low to moderate.
Clay loam	CL–ML or MH.	A–6 or A–7	98–100	95–100	90–100	55–85	0.2–0.63	[4] 0.22	4.5–5.0	Moderate.
Loam	SM or ML	A–4 or A–6	95–100	95–100	80–100	40–70	0.2–0.63	[4] 0.20	4.5–5.0	Moderate.
Silty clay	ML or MH	A–7	98–100	95–100	90–100	60–80	0.2–0.63	0.22	4.5–5.0	Moderate.
Unclassified	Pt	----------	----------	----------	----------	----------	0.2–0.63	0.24	4.0–4.5	Low.
Sand	SP–SM or SM.	A–2 or A–3	90–100	80–100	50–80	10–20	2.0–6.3	0.10	4.5–5.0	Low.
Fine sandy loam or loamy fine sand.	SP–SM or SM.	A–2 or A–4	95–100	95–100	70–95	10–40	0.2–0.63	[4] 0.18–0.20	4.0–4.5	Low.
Very fine sandy loam.	SM	A–2 or A–4	90–100	85–95	70–90	15–45	0.2–0.63	[4] 0.18	4.5–5.0	Low.
Loamy fine sand and fine sandy loam.	SM or SP–SM.	A–2	85–100	80–95	70–90	10–25	0.63–2.0	[4] 0.15	4.5–5.0	Low.
Fine sandy loam.	SM	A–2	95–100	95–100	70–90	15–35	0.2–0.63	[4] 0.18	4.0–5.0	Low.
Fine sandy loam.	SM	A–2	95–100	95–100	70–90	15–35	0.2–0.63	[4] 0.18	4.0–5.0	Low.

TABLE 7.—*Brief description of the soils and their*

Map symbol	Soil name [1]	Depth to seasonally high water table	Description of soil	Depth from surface
				Inches
Ps	Pocomoke sandy loam.	0	About 3 feet of sandy loam; underlain by stratified loamy sand and sandy loam; small amount of rounded quartzose gravel in lower part in places; in very low positions; slope ranges from 0 to 1 percent; originally ponded.	0–24 24–60
Sa	St. Johns sand.	0	About 1 foot of loose sand high in organic-matter content over 4 to 8 inches of weakly cemented sand; underlain by loose sand; in places underlying layer contains rounded quartzose gravel or lenses of clay; in very low positions; slope ranges from 0 to 1 percent; high water table.	0–11 11–15 15–60
Sc	St. Johns sand, clayey substratum.	0	About 1 foot of loose sand containing a large amount of organic matter; overlies 4 to 8 inches of weakly cemented sand; then loose sand that contains layers of sandy clay; in very low positions; slope ranges from 0 to 1 percent; high water table.	0–11 11–15 15–30 30–60
Sv	Sandy alluvial land.	0	5 feet of recent stream alluvium, mostly loose, medium, and coarse sand; some rounded quartzose gravel of fine and medium size in thin beds; in very low positions; slope ranges from 0 to 1 percent.	0–60
Sw	Shrewsbury fine sandy loam.	1 foot.	About 2½ feet of fine sandy loam underlain by loamy sand; in low positions; slope ranges from 0 to 2 percent; high water table.	0–32 32–60
Sx	Shrewsbury-Urban land complex (Urban land part).	1 foot.	About 2½ feet of mixed sandy loam underlain by stratified sandy loam and loamy sand; in low positions; slope ranges from 0 to 2 percent. For data on Shrewsbury part of this complex, see Shrewsbury fine sandy loam.	0–30 30–60
Tm	Tidal marsh-Made land complex.	0	Variable depth of mixed silt and organic matter; originally flooded daily by tides, now has been dredged, raised, or placed behind dikes, mixed, and leveled; in very low positions; slope ranges from 0 to 5 percent.	0–60
Um	Urban-Moderately wet land (Urban part).	2 to 3 feet.	3 to 5 feet of mixed clay loam or silty clay loam; in intermediate positions; originally ponded from fall to spring. For data on Moderately wet land part, see Moderately wet land.	0–60
Wd	Weeksville fine sandy loam.	0	5 feet of sandy loam or very fine sandy loam; in places underlying layers contain coarse sand; in very low positions; slope ranges from 0 to 1 percent; natural slopes unstable; originally ponded from fall to spring.	0–60
WaB WfB WfC WhD WhD3	Westphalia fine sandy loam, 0 to 5 percent slopes. Westphalia loamy fine sand, 0 to 5 percent slopes. Westphalia loamy fine sand, 5 to 10 percent slopes. Westphalia soils, 10 to 20 percent slopes. Westphalia soils, 10 to 20 percent slopes, severely eroded.	5 to 10 feet or more.	About 1 to 1½ feet of fine sandy loam or loamy fine sand over 1 to 1½ feet of very fine sandy loam; underlain by stratified fine sand and fine sandy loam.	0–18 18–33 33–60

See footnotes at end of table.

estimated physical and chemical properties—Continued

Classification			Mechanical analysis				Permeability	Available water capacity	Reaction [2]	Shrink-swell potential
			Percentage passing sieve—							
USDA texture	Unified	AASHO	No. 4 [3]	No. 10	No. 40	No. 200				
							Inches per hour	*Inches per inch of soil*	*pH*	
Sandy loam	SM–SC	A–2 or A–4	95–100	90–100	60–80	30–40	0. 63–2. 0	[4] 0. 15	4. 0–5. 0	Low.
Loamy sand	SM	A–2, A–1, or A–4.	90–100	90–100	50–80	15–40	2. 0–6. 3	0. 10	4. 5–5. 0	Low.
Sand	SP–SM or SM.	A–2 or A–3	95–100	90–100	50–70	5–15	2. 0–6. 3	0. 05	4. 0–4. 5	Low.
Loamy sand	SP–SM or SM.	A–2 or A–3	95–100	90–100	60–75	5–15	0. 63–2. 0	0. 08	4. 5–5. 0	Low.
Sand	SP or SP–SM.	A–2 or A–3	90–100	90–100	55–75	5–15	6. 3+	0. 05	4. 5–5. 0	Low.
Sand	SP–SM or SM.	A–2 or A–3	95–100	90–100	50–70	5–15	2. 0–6. 3	0. 05	4. 0–4. 5	Low.
Loamy sand	SP–SM or SM.	A–2 or A–3	95–100	90–100	60–75	5–15	2. 0–6. 3	0. 08	4. 5–5. 0	Low.
Sand	SP or SP–SM.	A–2 or A–3	90–100	90–100	50–75	5–15	6. 3+	0. 05	4. 5–5. 0	Low.
Sand with sandy clay layers.	SM	A–2 or A–4	90–100	90–100	60–90	10–50	0. 63–6. 3	0. 15	4. 5–5. 0	Low.
Loamy sand	SP–SM or SM.	A–3	90–100	70–90	30–50	5–15	6. 3+	[4] 0. 08	4. 5–5. 0	Low.
Sandy loam	SM	A–2 or A–4	100	95–100	85–95	30–50	0. 63–2. 0	[4] 0. 20	4. 0–5. 0	Low.
Loamy sand	SM	A–2 or A–4	100	100	85–95	30–50	2. 0–6. 3	[4] 0. 15	4. 5–5. 0	Low.
Sandy loam	SM	A–2 or A–4	100	90–100	85–95	30–50	0. 63–2. 0	[4] 0. 20	4. 0–5. 0	Low.
Loamy sand	SM	A–2 or A–4	100	100	85–95	30–50	2. 0–6. 3	[4] 0. 15	4. 5–5. 0	Low.
Unclassified	OL	----------	--------	--------	--------	--------	----------	----------	----------	
Loam to clay loam.	CL	A–4 or A–6	95–100	95–100	90–100	50–70	0. 2–0. 63	[4] 0. 22	4. 5–5. 0	Low to moderate.
Fine sandy loam.	SM	A–2 or A–4	95–100	90–100	70–90	20–40	0. 2–0. 63	[4] 0. 18	4. 0–5. 0	Low.
Fine sandy loam or loamy fine sand.	SM	A–2	95–100	90–100	80–100	10–35	0. 2–2. 0	0. 20	4. 0–4. 5	Low.
Very fine sandy loam.	SM	A–2 or A–4	95–100	90–100	80–100	15–40	0. 2–0. 63	0. 15	4. 5–5. 0	Low.
Loamy fine sand and fine sandy loam.	SP–SM or SM.	A–2 or A–3	90–100	80–100	70–95	10–25	0. 63–2. 0	0. 12	4. 5–5. 0	Low.

See footnotes at end of table.

TABLE 7.—*Brief description of the soils and their*

Map symbol	Soil name [1]	Depth to seasonally high water table	Description of soil	Depth from surface
				Inches
Wr	Westphalia and Nixonton-Urban land complex (Urban land part).	2 to 5 feet or more.	2½ feet of mixed fine sandy loam and loamy fine sand over loamy fine sand; in high to intermediate positions; slope ranges from 0 to 5 percent; natural slopes unstable. For data on Westphalia part of this complex, see Westphalia soils. For data on Nixonton part, see Nixonton and Barclay soils.	0–30 .. 30–60
WsA	Woodstown and Dragston sandy loams, 0 to 3 percent slopes.	1 to 3 feet.	2 to 2½ feet of sandy loam over stratified loamy sand and sandy loam; in places contains variable amount of quartzose gravel up to 2 inches in diameter; in intermediate positions.	0–32 32–60
WtA	Woodstown and Klej loamy sands, 0 to 3 percent slopes (Woodstown part).	3 feet.	About 1½ feet of loamy sand over 1 foot of sandy loam; underlain by loose, stratified loamy sand and sandy loam; in places contains gravel; in intermediate positions. For Klej part of this undifferentiated unit, see Klej loamy sand.	0–16 16–28 28–60
WuA	Woodstown and Klej loamy sands, clayey substrata, 0 to 3 percent slopes.	3 feet.	For data on the Woodstown part of this undifferentiated unit, see Woodstown and Klej loamy sands (Woodstown part). For data on the Klej part, see Klej loamy sand, 0 to 2 percent slopes. The data shown here is representative of the clayey substrata in both the Woodstown and Klej loamy sands.	28–60 .

[1] The physical and chemical properties for Clay pits and Sand and gravel pits were not estimated.

[2] Reaction rating is for an unlimed soil. Areas heavily limed are not so acid.

The shrink-swell potential indicates the volume change to be expected in the soil material with changes in moisture content. In this table it is rated as low, moderate, or high. This potential is based on the results of volume-change tests or on other physical properties or characteristics of the soil. For example, the soil material from the B horizon of Marlton sandy loam (containing montmorillonite clay) is very sticky when wet and develops extensive shrinkage cracks when the material becomes dry. Therefore, it has a moderate shrink-swell potential. In contrast, the material from the B horizon of the Lakewood sand (containing little clay) is structureless and nonplastic. Consequently, it has a low shrink-swell potential.

Engineering interpretations of soils

In table 8 are given suitability ratings for the soils in Camden County as a source of gravel, road subgrade, and road fill, and features of the soils that affect stated engineering practices. These interpretations are based on the test data shown in table 6, the estimated soil properties shown in table 7, and experience in using the soils in Camden County and other parts of the State.

As a rule, interpretations in table 8 are made by soil series unless there are members of the series that have different properties of engineering significance. For example, an interpretation is made for the Freehold series, including most of the mapping units of that series. This is followed by an interpretation for Freehold sand, thick surface variant, which is sufficiently different from the other Freehold mapping units to require a separate interpretation.

In table 8 susceptibility to frost action is rated low, moderate, or high. The ratings are based primarily on the content of silt and the probability of a high content of moisture.

The suitability of the soils as a source of gravel, road subgrade, and road fill is rated unsuitable, poor, fair, or good. These ratings are based only on the soil material. For gravel, the ratings are only for amounts large enough for commercial use. In places a high water table or other soil characteristics make excavation of the material impossible.

In table 8 the soil features listed that affect engineering practices are mainly those that limit use. Favorable features, however, are noted in some places.

Soils in Urban Development

This section was prepared mainly for planners, developers, zoning officials, and landowners and prospective landowners. It indicates the relative suitability of each soil in the county for urban and recreational uses. Planners and zoning officials who are interested in comparing the urban suitability of the soils with their agricultural capability will be interested in the section "Capability

estimated physical and chemical properties—Continued

Classification			Mechanical analysis				Permea-bility	Available water capacity	Reaction [2]	Shrink-swell potential
			Percentage passing sieve—							
USDA texture	Unified	AASHO	No. 4 [3]	No. 10	No. 40	No. 200				
							Inches per hour	*Inches per inch of soil*	*pH*	
Fine sandy loam or loamy fine sand.	SM, SP-SM.	A-2	90-100	80-100	70-90	10-35	0. 63-2. 0	0. 18	4. 0-5. 0	Low.
Loamy fine sand.	SM	A-2 or A-4.	95-100	75-95	60-100	15-40	0. 63-2. 0	[4] 0. 12	4. 5-5. 0	Low.
Sandy loam	SM	A-2 or A-4.	95-100	90-100	60-80	20-40	0. 63-2. 0	0. 14	4. 0-4. 5	Low.
Loamy sand	SM	A-2	60-100	50-100	40-60	15-25	2. 0-6. 3	[4] 0. 10	4. 5-5. 0	Low.
Loamy sand	SP-SM, SM.	A-2	90-100	90-100	70-90	10-20	2. 0-6. 3	[4] 0. 12	4. 0-4. 5	Low.
Sandy loam	SM, SP-SM.	A-2	85-100	80-100	65-85	10-25	2. 0-6. 3	[4] 0. 12	4. 5-5. 0	Low.
Loamy sand	SP-SM or SM.	A-2 or A-3.	80-100	75-95	55-80	10-20	6. 3+	0. 10	4. 5-5. 0	Low.
Loamy sand and sandy clay.	SM or SP-SM.	A-2 or A-4.	90-100	80-100	80-100	10-40	0. 2-2. 0	0. 15	4. 5-5. 0	Low.

[3] Portions of soils not passing 4 sieve are larger than 0.185 inches. Where coarser than 0.75 inches, gravel is mentioned in description of soil.

[4] The supply of available water may be supplemented by the water table.

Groups of Soils." Readers needing more information about mapping units, however, should refer to the section "Descriptions of the Soils."

The soils of the county were grouped according to their suitability for specific urban uses. Each group consists of soils that have about the same suitability for building sites, landscaping, athletic fields, and similar uses. In table 9 the 13 urban soil groups are listed and are rated according to the degree of limitation for the various uses. For the moderate and severe ratings in the table, the main cause of the limitation is listed.

The limitations of soils for urban and recreational uses were rated for light industrial building sites, low residential building sites, septic effluent disposal, sanitary land fill, landscaping (lawns and ornamental plants), athletic fields, parks and playgrounds, and campsites. In the following paragraphs, the major factors used in rating the limitations of the soils are listed for each use, and the limitation ratings are discussed.

Light industrial building sites.—The primary factors in rating the limitations of the soils for light industrial building sites are slope, natural soil drainage, presumptive bearing values, and the hazard of flooding.

A limitation rating of *slight* means that there are few or no problems. The slopes are gentle (0 to 5 percent) and excavations can be made relatively easily and generally without serious water problems. In places, however, underlying clayey layers cause local water problems in the construction of foundations, but these normally can be overcome by slight alterations in construction, and limitations, therefore, are rated as slight.

A rating of *moderate* is assigned to moderately sloping soils (5 to 10 percent slopes) because of the increased cost of excavation. A moderate rating is also listed for soils that annually have a moderately high water table. For these soils, deep drainage is needed to lower the water table, and should be done before the construction is started. Also, soils that have low presumptive bearing values are rated moderate because special foundations and footings may be required.

A rating of *severe* is listed for soils that have a high water table annually, have strong to steep slopes (more than 10 percent), or are subject to flooding by streams. In some places sufficient drainage can be installed to keep the water table low, but in many places drainage outlets cannot be attained. The cost of excavation and of septic field installation is higher on the steeper slopes.

Low residential building sites.—The primary factors in rating the limitations of soils for low residential building sites are slope, natural soil drainage, and the hazard of flooding.

A limitation rating of *slight* means that there are few or no problems. Slopes are gentle or moderate (0 to 10 percent). In places, underlying clayey layers may cause water problems in the construction of foundations, but slight alterations in the design and construction normally overcome these problems.

TABLE 8.—*Engineering*

Soil and map symbol[1]	Susceptibility to frost action	Suitability for— Gravel	Suitability for— Road subgrade	Suitability for— Road fill	Features affecting engineering practices — Impoundments — Reservoir area	Features affecting engineering practices — Impoundments — Dikes or embankments
Aura, (AmA, AmB, ArA, ArB).	Low to moderate.	Good for road gravel.	Good	Good	Permeable substratum.	Stable; good for core, fair for shell.
Aura-Downer (AtB, AvB).	Low	Fair for road gravel.	Fair	Good	Not suitable; permeable substratum.	Stable; good for core, fair for shell.
Colemantown (Cm)	High	Not suitable	Poor	Fair	Slowly permeable substratum; high water table.	Stable to fairly stable; impervious for core and shell; substratum sandy.
Collington (CoA, CoB).	Low to moderate.	Not suitable	Fair	Good	Permeable substratum.	Fairly stable; good for core, fair for shell; sandy substratum.
Downer (DoA, DrA, DsA, DsB, DtC, DxC).	Low	Not suitable	Good	Good	Rapidly permeable substratum.	Stable; good for core; sandy substratum.
Fallsington (Fd)	Low to moderate.	Not suitable	Fair	Good	Permeable substratum; high water table.	Fairly stable; good for core, fair for shell; sandy substratum.
Freehold (FfA, FfB, FfC, FhB, FhC, FsE, FtD).	Low	Not suitable	Fair	Good	Permeable substratum.	Fairly stable; impervious when compacted; sandy substratum.
Freehold sand, thick surface variant (FnB).	Low	Not suitable	Fair	Good	Permeable substratum.	Suitable in homogenous mixture.
Holmdel (HdA, HfA)	Low	Not suitable	Fair	Good	Permeable substratum.	Fairly stable; impervious when compacted; rapidly permeable substratum.
Klej (KmA)	Low	Not suitable	Fair	Good	Rapidly permeable.	Rapid permeability; low cohesion; fairly stable in flat areas.
Kresson (KrA)	Moderate	Not suitable	Fair to poor	Good	Seepage unlikely; slowly permeable substratum.	Stable; impervious; sandy substratum.
Lakehurst (LaA, LbA).	Low	Not suitable	Fair to good	Good	Rapid permeability.	Fairly stable; rapid permeability; low cohesion.
Lakeland fine sand, firm substratum (LcB).	Low	Fair for road gravel.	Fair to good	Good	Rapid permeability.	Fairly stable; rapid permeability; low cohesion.
Lakeland (LdA, LeA).	Low	Not suitable	Fair	Good	Rapid permeability.	Fairly stable; rapid permeability; low cohesion.
Lakewood (LfB, LfC, LfD, LgB, LgC, LhE).	Low	Not suitable	Fair	Good	Rapid permeability.	Fairly stable; rapid permeability; low cohesion.
Leon (Lo, Ls)	Low to moderate.	Not suitable	Fair	Good	Permeable substratum.	Fairly stable; rapid permeability; low cohesion.

See footnote at end of table.

interpretations of the soils

Features affecting engineering practices—Continued			
Dugout ponds	Land smoothing	Agricultural drainage	Irrigation
Low water table; reservoir must be sealed.	Shallow surface soil and restricted root zone limit grading to shallow cuts.	Not needed	Low water-holding capacity; slow to moderate permeability.
Low water table; reservoir must be sealed.	Shallow surface soil and abrupt texture change limit grading to shallow cuts.	Not needed	Low water-holding capacity; slow to rapid permeability.
High water table; slow recharge.	Plastic nature of subsoil limits grading to shallow cuts.	Excess surface water and possibly ground water; slow permeability.	High water-holding capacity; slow permeability.
Low water table; reservoir must be sealed.	Suitable for deep cuts	Not needed	High water-holding capacity; moderate permeability.
Not suitable; rapidly permeable substratum.	Shallow surface soil and abrupt texture change limit grading to medium depth.	Not needed	Low water-holding capacity; moderate permeability.
Rapid recharge; high water table.	Shallow surface soil and abrupt texture change limit grading to shallow cuts.	Moderate permeability; seasonally high water table; subsurface drainage needed.	Moderate water-holding capacity; moderate permeability.
Low water table	Suitable for deep cuts	Not needed	Moderate water-holding capacity; moderate to slow permeability.
Low water table	Suitable for deep cuts	Not needed	Low water-holding capacity; rapid permeability to a depth of 30 inches.
Low water table in summer; rapidly permeable substratum.	Suitable for deep cuts	Moderate to moderately slow permeability; seasonally high water table; subsurface drainage satisfactory.	Moderate water-holding capacity; moderate to moderately slow permeability.
Low water table in summer; rapidly permeable substratum.	Suitable for deep cuts	Rapid permeability; seasonally high water table; subsurface drainage satisfactory.	Low water-holding capacity; rapid permeability.
Slow recharge; moderately high water table.	Sandy clay subsoil limits grading to shallow cuts.	Because of slow permeability, soil requires surface drainage and possibly subsurface drainage.	High water-holding capacity; slow permeability.
Low water table in summer; rapidly permeable substratum.	Soil too infertile to justify smoothing.	Soil too infertile to justify drainage.	Soil too infertile to justify irrigation.
Rapid permeability; low water table.	Suitable for deep cuts	Not needed	Very low water-holding capacity; rapid permeability to a depth of 30 inches.
Low water table	Suitable for deep cuts	Not needed	Very low water-holding capacity; rapid permeability.
Low water table; rapid permeability.	Soil too infertile for leveling	Not needed	Soil too infertile to justify irrigation.
Rapid recharge; high water table.	Suitable for moderate cuts; stockpiling and spreading surface soil may be needed.	Moderate permeability; suitable for controlled water table.	Not needed; permanently high water table.

776-501—66——5

TABLE 8.—*Engineering*

Soil and map symbol [1]	Susceptibility to frost action	Suitability for—			Features affecting engineering practices	
					Impoundments	
		Gravel	Road subgrade	Road fill	Reservoir area	Dikes or embankments
Loamy alluvial land (Lv).	Moderate	Not suitable	Poor; high water table.	Fair; high water table.	Variable; high water table.	Fairly stable; toe drains probably needed.
Marlton (McC3, MrA, MrB).	Low to moderate.	Not suitable	Fair	Good	Slowly permeable substratum.	Stable; impervious substratum; sandy.
Matawan (MmB, MnA, MnB).	Low to moderate.	Not suitable	Fair	Good	Slow permeability.	Stable; impervious.
Moderately wet land (Mo).	Moderate to high.	Not suitable	Poor	Fair	Permeable substratum; moderately high water table.	Poor to fair stability; good for core; substratum sandy.
Muck (Mu)	High	Not suitable	Not suitable	Not suitable	Moderate permeability; high water table.	Not suitable
Nixonton and Barclay (NbA, NcA).	Low to moderate.	Not suitable	Poor	Good	Permeable substratum.	Subject to piping
Pasquotank (Pa)	Moderate	Not suitable	Poor	Good	Permeable substratum; high water table.	Subject to piping
Pocomoke (Ps)	Moderate to high.	Not suitable	Good	Good	Permeable substratum; high water table.	Fairly stable; impervious when compacted; substratum sandy.
St. Johns (Sa, Sc)	Low to moderate.	Not suitable	Fair	Good	Substratum rapidly to slowly permeable.	Fairly stable; rapid permeability; low cohesion.
Sandy alluvial land (Sv).	Low to moderate.	Not suitable	Fair; high water table.	Fair; high water table.	Rapid permeability; high water table.	Fairly stable to stable; toe drains probably needed.
Shrewsbury (Sw)	Low to moderate.	Not suitable	Fair	Good	Moderate to moderately slow permeability.	Impervious when compacted; fairly stable.
Weeksville (Wd)	Moderate to high.	Not suitable	Poor	Good	Permeable substratum; high water table.	Subject to piping; fairly stable.
Westphalia (WaB, WfB, WfC, WhD, WhD3).	Low to moderate.	Not suitable	Poor	Good	Permeable substratum.	Subject to piping; fairly stable.
Woodstown and Dragston (WsA).	Low to moderate.	Not suitable	Good	Good	Rapidly permeable substratum.	Fairly stable; impervious when compacted.
Woodstown and Klej (WtA, WuA)	Low to moderate.	Not suitable	Good	Good	Seepage likely; rapidly permeable substratum.	Fairly stable; permeable

[1] The map symbols in parentheses stand for the soils that are included in the interpretations. The mapping units that contain urban land complexes are not listed because the urban part is now in residential or light industrial use. Clay pits, Made land, Sand and gravel pits, and Tidal marsh-Made land complex are not listed because their characteristics are variable.

interpretations of the soils—Continued

Features affecting engineering practices—Continued			
Dugout ponds	Land smoothing	Agricultural drainage	Irrigation
High water table	Impractical because of flooding	Impractical for cropland; surface drainage for pasture may be feasible.	High water table.
Low water table	Unfavorable texture of surface soil for cultivation makes smoothing impractical.	Surface ponded in places; slow permeability; shallow surface soil.	Slow permeability; high water-holding capacity.
Low water table	Texture of lower subsoil unfavorable for cultivation and limits cuts to medium or shallow depth.	Surface ponded in places; slow permeability; shallow surface soil.	Slow permeability; moderate water-holding capacity.
Slow recharge; moderately high water table.	Texture of lower subsoil unfavorable for cultivation and limits cuts to shallow or medium depth.	Excess surface water and possibly ground water; slow permeability.	High water-holding capacity; slow permeability.
Rapid recharge; high water table.	Too shallow for smoothing	Too shallow; areas are too small; soil too acid.	High water table.
Low water table in summer	Suitable for deep cuts	Slow permeability; requires surface and subsurface drainage.	Slow permeability; moderate water-holding capacity.
High water table; in places; water table low in summer; moderate recharge.	Suitable for deep cuts	Slow permeability; requires surface and subsurface drainage.	Slow permeability; moderate water-holding capacity.
Rapid recharge unless clay layers are too near surface; high water table.	Suitable for deep cuts	Moderate permeability; subsurface drainage satisfactory.	High water table; moderate water-holding capacity.
High water table; rapid recharge except where underlain by clay.	Suitable for shallow cuts; stock piling and spreading surface soil may be needed.	Moderate permeability; suitable for controlled water table.	Moderate permeability.
Rapid permeability; high water table.	Impractical because of flooding	Impractical for general crops; diking and ditching needed for special crops.	Water table control needed for special crops.
Moderately high water table	Suitable for deep cuts	Moderate to moderately slow permeability; seasonally high water table; rapidly permeable substratum.	Moderate water-holding capacity; moderately high water table.
In places, water table low in summer; recharge moderate.	Suitable for deep cuts	Slow permeability; requires surface and subsurface drainage.	Slow permeability; moderately high water-holding capacity; surface ponded in winter.
Low water table	Suitable for deep cuts	Not needed	Slow permeability; moderately high water-holding capacity.
Low water table in summer	Shallowness of surface soil to an abrupt textural change to coarse material limits cuts to shallow depth.	Moderate permeability; subsurface drainage satisfactory.	Moderate water-holding capacity; moderate permeability.
Low water table in summer	Suitable for medium cuts	Moderate permeability; subsurface drainage satisfactory.	Moderate to low water-holding capacity; moderate to rapid permeability.

TABLE 9.—*Limitations of soils for*

Urban group number and description	Map symbol and soil	Urban use: Building sites [1]: Light industrial	Urban use: Building sites [1]: Low residential	Urban use: Septic effluent disposal
Group 1: Nearly level to gently sloping, well-drained soils that have a moderate water-holding capacity.	CoA Collington fine sandy loam, 0 to 2 percent slopes. CoB Collington fine sandy loam, 2 to 5 percent slopes. FfA Freehold fine sandy loam, 0 to 2 percent slopes. FfB Freehold fine sandy loam, 2 to 5 percent slopes. FxB Freehold and Downer-Urban land complex, gently sloping (Freehold and Urban land parts). Fy Freehold and Downer, clayey substrata, -Urban land complex (Freehold and Urban land parts). WaB Westphalia fine sandy loam, 0 to 5 percent slopes. Wr Westphalia and Nixonton-Urban land complex (Westphalia and Urban land parts).	Slight	Slight	Slight
Group 2: Nearly level to gently sloping, well-drained soils that have a moderate to low water-holding capacity.	AtB Aurora-Downer loamy sands, 0 to 5 percent slopes (Downer part). AvB Aura-Downer sandy loams, 0 to 5 percent slopes (Downer part). DoA Downer loamy sand, 0 to 5 percent slopes. DrA Downer loamy sand, clayey substratum, 0 to 5 percent slopes. DsA Downer sandy loam, 0 to 2 percent slopes. DsB Downer sandy loam, 2 to 5 percent slopes. FhB Freehold loamy fine sand, 0 to 5 percent slopes. FnB Freehold sand, thick surface variant, 0 to 5 percent slopes. FxB Freehold and Downer-Urban land complex, gently sloping (Downer part). Fy Freehold and Downer, clayey substrata, -Urban land complex (Downer part). WfB Westphalia loamy fine sand, 0 to 5 percent slopes.	Slight	Slight	Slight; rapid permeability of substratum in Downer soils may permit pollution of ground water.
Group 3: Nearly level to gently sloping, well-drained soils that have a firm substratum.	AmA Aura loamy sand, 0 to 2 percent slopes. AmB Aura loamy sand, 2 to 5 percent slopes. ArA Aura sandy loam, 0 to 2 percent slopes. ArB Aura sandy loam, 2 to 5 percent slopes. AtB Aura-Downer loamy sands, 0 to 5 percent slopes. (Aura part). AvB Aura-Downer sandy loams, 0 to 5 percent slopes. (Aura part). Ax Aura-Urban land complex. LcB Lakeland fine sand, firm substratum, 0 to 5 percent slopes.	Slight	Slight	Moderate; slow permeability of substratum.

See footnotes at end of table.

urban and recreational uses

Urban use—Continued			Recreation use		
Sanitary land fill	Landscaping		Athletic fields	Parks and playgrounds	Campsites [2]
	Lawns	Ornamental plants			
Slight	Slight	Slight	Slight for soils that have 0 to 2 percent slopes. Moderate for soils that have 2 to 5 percent slopes.	Slight	Slight.
Slight	Moderate; low available water capacity. Severe limitation for Freehold sand, thick surface variant, since it has very low available water capacity.	Moderate; low available water capacity.	Slight for sandy loams and soils that have 0 to 2 percent slopes. Moderate for loamy sands and soils that have 2 to 5 percent slopes. Severe for Freehold loamy sand because it is droughty and infertile.	Slight	Slight.
Moderate; firm substratum difficult to move.	Moderate; low available water capacity. Severe for Lakeland sand, firm substratum, because of very low available water capacity.	Slight	Slight for sandy loams and soils that have 0 to 2 percent slopes. Moderate for loamy sands and soils that have 2 to 5 percent slopes. Severe for Lakeland sand, firm substratum, which has very low available water capacity.	Slight for most soils. Severe for playgrounds on Lakeland sand, firm substratum, which is droughty and infertile.	Slight.

TABLE 9.—*Limitations of soils for urban*

Urban group number and description	Map symbol and soil	Urban use: Building sites [1]: Light industrial	Urban use: Building sites [1]: Low residential	Urban use: Septic effluent disposal
Group 4: Moderately sloping, well drained and modately well drained soils.	DtC Downer soils, 5 to 10 percent slopes. DxC Downer-Aura complex, 5 to 10 slopes. FfC Freehold fine sandy loam, 5 to 10 percent slopes. FhC Freehold loamy fine sand, 5 to 10 percent slopes. FxC Freehold and Downer-Urban land complex, sloping. HoC Howell-Urban land complex, sloping. McC3 Marlton soils, 5 to 10 percent slopes, severely eroded. WfC Westphalia loamy fine sand, 5 to 10 percent slopes.	Moderate; moderate slopes; presumptive bearing value low and foundation problems for Howell soils.	Slight; foundation water problems for Howell, Marlton, and other soils underlain by clay.	Slight; slopes increase cost of filter fields. Moderate for Marlton soils, which have underlying clayey layers in places. Severe for Howell soils, which have underlying clayey layers.
Group 5: Nearly level to gently sloping, droughty, infertile sands.	LbA Lakehurst-Lakewood association, 0 to 5 percent slopes (Lakewood part). LdA Lakeland sand, 0 to 5 percent slopes. LfB Lakewood fine sand, 0 to 5 percent slopes. LgB Lakewood sand, 0 to 5 percent slopes.	Slight	Slight	Slight; coarse texture may permit pollution of ground water.
Group 6: Moderately sloping, droughty, infertile sands.	LfC Lakewood fine sand, 5 to 10 percent slopes. LgC Lakewood sand, 5 to 10 percent slopes.	Moderate; moderate slopes.	Slight	Slight; coarse texture may permit pollution of ground water.
Group 7: Nearly level to gently sloping soils with a moderately high water table.	HdA Holmdel fine sandy loam, 0 to 3 percent slopes. HfA Holmdel loamy fine sand, 0 to 3 percent slopes. Hm Holmdel, clayey substratum-Urban land complex. Hn Holmdel-Urban land complex. KrA Kresson sandy loam, 0 to 3 percent slopes. Mk Marlton and Kresson-Urban land complex (Kresson part). Mo Moderately wet land. NbA Nixonton and Barclay fine sandy loams, 0 to 3 percent slopes. NcA Nixonton and Barclay loamy fine sands, 0 to 5 percent slopes. Um Urban-Moderately wet land complex. Wr Westphalia and Nixonton-Urban land complex (Nixonton part). WsA Woodstown and Dragston sandy loams, 0 to 3 percent slopes. WtA Woodstown and Klej loamy sands, 0 to 3 percent slopes. WuA Woodstown and Klej loamy sands, clayey substratam, 0 to 3 percent slopes.	Moderate; seasonally high water table, generally possible to lower; low presumptive bearing value.	Moderate; seasonally high water table, generally possible to lower.	Moderate; seasonally high water table. Severe for Holmdel clayey substratum, Kresson sandy loam, Moderately wet land, and Woodstown and Klej loamy sands, clayey substratum, because of high water table and underlying clayey layers.

See footnotes at end of table.

and recreational uses—Continued

Urban use—Continued			Recreation use		
Sanitary land fill	Landscaping		Athletic fields	Parks and playgrounds	Campsites [2]
	Lawns	Ornamental plants			
Moderate; moderate slope. Severe for Howell soils because of clayey substratum.	Slight erosion hazard; moderate for Marlton soils because of clayey texture.	Slight; moderate for Marlton soils because of clayey texture.	Moderate; moderate slopes.	Slight for parks. Moderate for playgrounds because of moderate slopes.	Slight.
Slight	Severe; very low fertility; very low water-holding capacity.	Severe; very low fertility; very low water-holding capacity.	Severe; very low fertility; very low water-holding capacity.	Slight for parks. Moderate for playgrounds; low fertility.	Slight.
Moderate; moderate slopes.	Severe; low fertility; low water-holding capacity; erosion hazard.	Severe; low fertility; low water-holding capacity.	Severe; moderate slopes; low fertility; low water-holding capacity.	Slight for parks. Severe for playgrounds; low fertility; moderate slopes.	Slight.
Severe; seasonally high water table.	Slight; grading and drainage may be needed.	Slight; grading and drainage may be needed.	Moderate; seasonally high water table; drainage needed.	Slight; playground use may be curtailed during wet periods.	Moderate; high water table may restrict use in extremely wet periods.

TABLE 9.—*Limitations of soils for urban*

Urban group number and description	Map symbol and soil		Urban use: Building sites [1] — Light industrial	Urban use: Building sites [1] — Low residential	Urban use: Septic effluent disposal
Group 8: Nearly level to gently sloping soils with a fine-textured subsoil; well drained to somewhat poorly drained.	HoB MrA MrB Mk MmB MnA MnB	Howell-Urban land complex, gently sloping. Marlton sandy loam, 0 to 2 percent slopes. Marlton sandy loam, 2 to 5 percent slopes. Marlton and Kresson-Urban land complex (Marlton part). Matawan loamy sand, 0 to 5 percent slopes. Matawan sandy loam, 0 to 2 percent slopes. Matawan sandy loam, 2 to 5 percent slopes.	Moderate; seasonally high water table; low presumptive bearing value.	Slight; seasonally high water table.	Severe; slow permeability.
Group 9: Nearly level soils with a high water table.	Cm Fd Lo Ls Pa Pc Ps Sa Sc Sw Sx Tm Wd	Colemantown loam. Fallsington sandy loam. Leon sand. Leon-St. Johns sands. Pasquotank fine sandy loam. Pasquotank and Weeksville-Urban land complex. Pocomoke sandy loam. St. Johns sand. St. Johns sand, clayey substratum. Shrewsbury fine sandy loam. Shrewsbury-Urban land complex. Tidal marsh-Made land complex. Weeksville fine sandy loam.	Severe; high water table, not easily lowered; local flooding hazard; low presumptive bearing value.	Severe; high water table is not easily lowered.	Severe; high water table.
Group 10: Nearly level to gently sloping sands with a moderately high water table.	KmA LaA LbA LeA	Klej loamy sand, 0 to 2 percent slopes. Lakehurst sand, 0 to 3 percent slopes. Lakehurst-Lakewood association, 0 to 5 percent slopes (Lakehurst part). Lakeland sand, water table, 0 to 2 percent slopes.	Moderate; seasonally high water table, generally easy to lower.	Moderate; seasonally high water table, generally easy to lower.	Moderate; seasonally high water table.
Group 11: Strongly sloping to steep soils.	FsE FtD LfD LhE WhD WhD3	Freehold soils, 15 to 30 percent slopes. Freehold and Collington soils, 10 to 15 percent slopes. Lakewood fine sand, 10 to 25 percent slopes. Lakewood and Lakeland sands, 10 to 30 percent slopes. Westphalia soils, 10 to 20 percent slopes. Westphalia soils, 10 to 20 percent slopes, severely eroded.	Severe; strong slopes.	Severe; steep slopes; seeps likely.	Severe; steep slopes make filter fields difficult and expensive to install.
Group 12: Soils subject to stream flooding.	Lv Mu Sv	Loamy alluvial land. Muck. Sandy alluvial land.	Severe; stream flooding is a hazard.	Severe; stream flooding is a hazard.	Severe; stream flooding is a hazard; high water table.
Group 13: Areas of fill and disturbed soil; variable.	Ma	Made land.	Variable	Variable	Variable

[1] Not more than 3 stories.

and recreational uses—Continued

Urban use—Continued			Recreation use		
Sanitary land fill	Landscaping		Athletic fields	Parks and playgrounds	Campsites [2]
	Lawns	Ornamental plants			
Moderate; clayey textured subsoil difficult to move.	Slight for most soils. Moderate for Matawan loamy sand, which has low water-holding capacity.	Slight	Slight for soils that have 0 to 2 percent slopes; moderate for soils with steeper slopes and for Matawan loamy sand.	Slight	Slight for well-drained soils; moderate for somewhat poorly drained soils.
Severe; high water table.	Moderate; drainage may be needed.	Severe; restricted to water-tolerant species.	Severe; high water table is not easily lowered.	Moderate for parks; use will be curtailed during wet periods. Severe for playgrounds because of high water table.	Severe; high water table restricts use.
Moderate; seasonally high water table.	Severe; low fertility; low water-holding capacity.	Severe; low fertility; low water-holding capacity.	Moderate; low fertility; low water-holding capacity.	Slight for parks. Moderate for playgrounds because of low fertility and low water-holding capacity.	Slight.
Severe; steep slopes	Moderate; severe erosion hazard; sodding may be needed.	Moderate; severe erosion hazard.	Severe; steep slopes	Slight for parks. Severe for playgrounds because slopes are steep.	Severe; steep slopes.
Severe; stream flooding is a hazard; high water table.	Moderate; high water table; may need some drainage.	Moderate; restricted to water-tolerant plants.	Severe; stream flooding is a hazard; high water table.	Moderate; stream flooding is a hazard; use may be restricted in wet seasons.	Severe; stream flooding is a hazard.
Variable	Variable	Variable	Variable	Slight	Slight.

[2] Intensive use for tents.

776-501—66——6

A rating of *moderate* is listed for soils that have strong slopes (10 to 15 percent) and for soils that annually have a moderately high water table. If a public sewer system is available, the rating for these soils is moderate; but if a private septic system must be used, the rating is severe for those soils that have water table problems. Normally, drainage properly designed and installed during construction reduces ground-water problems.

A rating of *severe* is listed for soils that have a high water table annually and for land that is subject to flooding from streams. In these areas, septic fields cannot function properly throughout the year, and adequate drainage for construction is difficult. In many places sufficient depth for a drainage outlet cannot be reached, or the outlet is a great distance from the site. Drainage in these places may be possible but costly.

Septic effluent disposal.—The primary factors in rating the limitation of soils for septic effluent disposal are the permeability of the soil below a depth of 30 inches, depth to the water table, slope, and the hazard of stream flooding. The United States Public Health Service lists two conditions for the suitability of soils for septic effluent disposal. They are (1) permeability in excess of 1 inch per hour, and (2) a maximum height of ground water at least 4 feet below the surface (*10*). Any impervious strata should be at least 4 feet below the bottom of the trench.

The interpretations reported here will not eliminate the need for percolation tests, but the tests can be used mainly in the more questionable areas or to designate the exact location of septic fields. Percolation tests, however, have some limitations. For example, if they are made in summer, they give no indication of water table problems. Also, the percolation rate may be more rapid in summer than in other seasons.

A limitation of *slight* means that permeability is rapid and that there is no problem of an annual water table within 4 feet of the surface. This rating indicates the coarse-textured soils that might permit the pollution of drinking water in wells and springs because of rapid permeability.

A rating of *moderate* is listed for soils having a moderately high water table, slopes exceeding 10 percent, and slow or variable permeability. In some places drainage can be used to keep the water table low. Percolation tests can be used to indicate the location of better filter fields on the slowly permeable and variable soils.

A rating of *severe* is listed for soils having a high water table not easily lowered, underlying clayey layers, slow permeability, a high hazard of stream flooding, or steep slopes. Installation costs are greater on the steeper slopes.

In places where two ratings are listed, the first rating fits most soils. The soils affected and their special limitations are listed under the second rating.

Sanitary land fill.—The primary factors in rating limitations of soils for sanitary land fill are slope, height of the water table, hazard of flooding, and texture and firmness of the soil, which affects the ease of movement.

A limitation rating of *slight* means that there are few or no problems caused by a high water table or soil movement.

A rating of *moderate* is listed for soils that have a fine-textured (clayey) subsoil or a firm subsoil, and for sands that have a moderately high water table. Some soils that have a firm substratum are quite variable, and their limitation may not be moderate in all places.

A rating of *severe* is listed for soils subject to flooding and for soils that have a moderately high or high water table, strong to steep slopes, and fine texture. Fine-textured soils are difficult to move when wet.

Lawns.—The primary factors in rating the limitations of soils for lawns are natural fertility, water-holding capacity, slope, and natural drainage. It is assumed that the normal amount of grading, liming, and fertilizing is needed on all sites.

A rating of *slight* means that there are few or no problems. Erosion control and possibly sodding of moderate slopes may be necessary. Drainage may be needed for some soils.

A rating of *moderate* is listed for soils that are somewhat droughty, have less than normal natural fertility, need drainage, or have steep slopes. The steep slopes may have to be sodded.

A rating of *severe* is listed for soils of sandy texture that are extremely infertile and have a low moisture-holding capacity. The sands that have a moderately high water table are also rated severe because the water table is lowest in summer when the moisture is needed most.

Ornamental plants.—The primary factors in rating the limitations of soils for ornamental plants are natural fertility, available moisture capacity, natural drainage, and slope.

A limitation rating of *slight* means that there are few or no problems. Soils with loamy sand texture need watering more frequently than soils with other textures.

A rating of *moderate* is listed for the soils that have a moderate to low water-holding capacity, are steep, or are subject to flooding.

A rating of *severe* is listed for very infertile sands and soils that have a high water table. Sandy soils that have a moderately high water table are also rated *severe* because the water table is lowest in summer when the moisture is most needed.

Athletic fields.—The primary factors for rating the limitations of soils for athletic fields are slope, natural drainage, available moisture capacity, and natural fertility.

A rating of *slight* means that there are few or no problems. Slopes are nearly level or gently sloping, (0 to 2 percent). The soils are well drained, have moderate to high available moisture capacity, and are moderately fertile.

A rating of *moderate* is listed for gently sloping soils that have slopes of 2 to 5 percent and for moderately sloping soils (5 to 10 percent slopes). The loamy sands also have a rating of *moderate;* they are less desirable for athletic fields than the sandy loams because of lower fertility, lower available moisture capacity, and poorer trafficability (footing). Drainage is needed for soils that have a moderately high water table.

A rating of *severe* is listed for soils having strong to steep slopes (more than 10 percent), a high water table, very low fertility, and a low moisture-holding capacity.

Parks and playgrounds.—Because they have similar soil requirements, parks and playgrounds are listed together. Playgrounds are restricted to lower slopes than parks, but in most other respects the suitabilities are quite similar.

The primary factors in rating the limitations of soils for parks and playgrounds are the height of the water table, slope, natural fertility, and the water-holding capacity. For several urban groups, two ratings are used. One rating is for parks and one is for playgrounds. Steep slopes or poor natural fertility are the two factors that cause this dual rating.

A limitation rating of *slight* means that there are few or no problems. Use of the areas may be curtailed somewhat on soils with a moderately high water table.

A rating of *moderate* is listed for soils subject to flooding and for those that are moderately sloping (5 to 10 percent slopes). Also, the droughty and infertile sands are rated *moderate* for playgrounds. Use of the playgrounds may be curtailed at times by flooding, and equipment, buildings, and contents may be damaged.

A rating of *severe* is listed for the moderately sloping, droughty, and infertile sands used for playgrounds and for soils on strong to steep slopes. No severe limitations are listed for soils used for parks.

Campsites.—The primary factors in rating the limitations of soils for campsites are height of the water table, flooding, and slopes. Intensive use of the campsites for tents is assumed.

A limitation rating of *slight* means that there are few or no problems.

A rating of *moderate* is listed for soils that have strong to steep slopes (more than 10 percent). During periods of excessive rainfall, use may be curtailed on the soils that have a fluctuating water table. These soils are also rated moderate.

A rating of *severe* is listed for strongly sloping to steep soils and for soils subject to flooding or that have a high or moderately high water table. Access may be limited, equipment may be damaged, and pollution and health problems may occur on such soils. Strong or steep slopes limit access and free movement of campers.

Formation and Classification of Soils

In this section, the formation of the soils is discussed and the soil series are classified by great soil groups. Detailed descriptions of the soil series are also given.

Formation of the Soils

The important factors that have influenced the development of the soils and their characteristics in Camden County are (1) parent material, (2) climate, (3) relief, (4) biological activity, and (5) time. A discussion of these factors follows.

Parent material

All the soils of Camden County have formed from unconsolidated geologic strata, some of which are mainly sand and some mainly clay. The sand strata contain some clay and silt. The clay strata contain some silt and sand. Gravel occurs in some layers of both beds. These beds were laid down in a succession of ocean deposits and then were tilted to the southeast. The elevation of the land rises in a southeasterly direction from the Delaware River (fig. 15) as far as the drainage divide near the center of the county. From there the elevation gradually declines toward the Atlantic Ocean.

Although glaciers did not reach as far south as this county, it is believed that water from the melting glaciers covered most of the county. Certainly the climate of the area was affected by the great ice sheets that came within 60 miles of the northern boundary of the county. The glacial waters brought more deposits containing much rounded quartzose gravel; the last deposit along the Delaware River was probably mostly a river deposit. During this period the water levels changed from time to time. When the water level was low, much wind and water erosion reworked the original deposits.

The main geologic formations and the soil series developed from them are listed in table 10. This table gives characteristics of the formations and shows the different degrees of drainage under which the soils have developed. Blank spaces in table 10 indicate that a soil of the given drainage class on the formation named is not present to any significant extent in the county. As shown in the table, there is a close relationship between the geologic formation and the soils developed on them. Some soils, however, have formed from mixed parent materials because the older geologic strata were eroded, intermingled, and redeposited. Some soils, the Freehold for example, have developed on several geo-

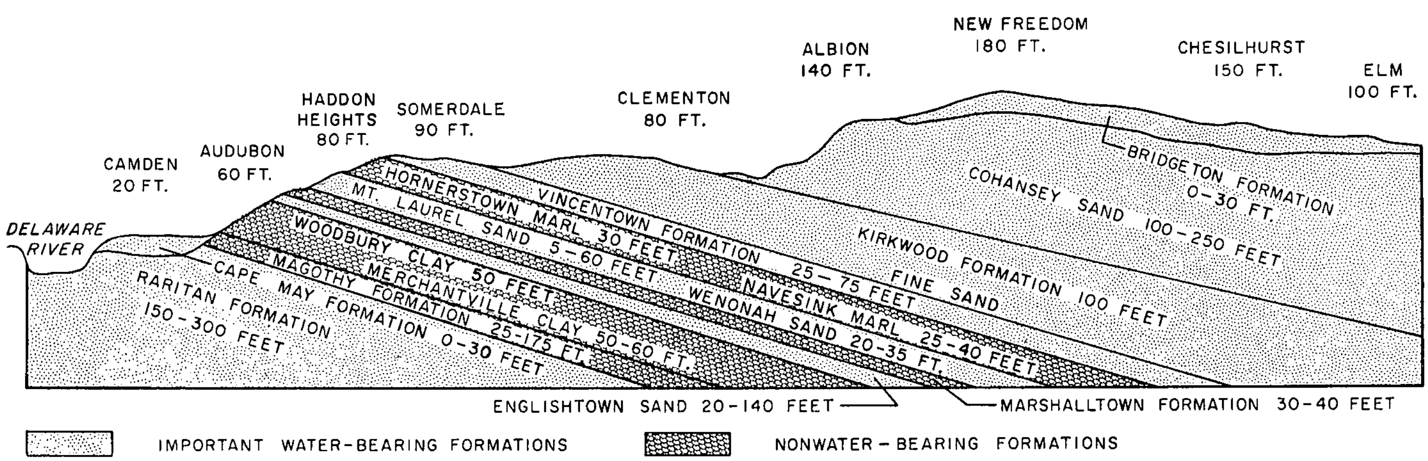

***Figure 15.*—Section from the Delaware River to Elm showing the main geologic formations and their thickness. Vertical scale exaggerated. Sketch is based on "Geologic Map of New Jersey" (*4*) and Bulletin 50, "The Geology of New Jersey" (*3*).**

logic formations. And some formations, the Bridgeton for example, give rise to several series, as the Aura and Downer, under the same degree of drainage. Also shown in table 10 are the kinds of clay that are in the various geologic formations (*2*). From this table, one can postulate the kind of clay that can be expected in the soils of a given series.

Although time of deposition or kinds of fossils found are criteria for separating some geologic formations, they are not criteria for separating soils. One important basis for separating soils into series is the texture of the subsoil. Although the texture of the subsoil must cover a range to avoid the separation of innumerable units that could not be shown accurately on a map, the soils with sand, sandy clay loam, or clay subsoil are generally classified as separate soil series. It is quite natural that Lakewood and Lakeland soils, which have very sandy subsoils, have developed on the Cohansey sands. Similarly the Marlton soils, which have a sandy clay subsoil, have developed on the clayey Hornerstown and Navesink marls. The Freehold and Downer soils, which have a sandy subsoil, have developed from mixed sandy geologic deposits.

In this county the glauconite content is important in the classification of the Freehold, Collington, and Marlton soils. Of the three, Freehold soils have the lowest glauconite content. They also have the lowest exchange capacity. The Collington soils are intermediate in glauconite content; whereas, the Marlton soils are highly glauconitic and have high exchange capacities. The Freehold soils have developed on the sandy, low-glauconite geologic formations such as the Englishtown and Mt. Laurel-Wenonah sands. The Collington soils have developed on the Marshalltown and Navesink formations.

The soil series of Camden County are arranged according to texture of the subsoil and natural drainage classes in table 11.

TABLE 10.—*Geologic formations, some of their characteristics, and soils developed from them*

Geologic formations	Thickness	Type of clay	Drainage class and soil developed					
			Excessively drained	Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
	Feet							
Cape May formation.	0–30	----	----	Downer	Woodstown	Dragston	Fallsington	Pocomoke.
Pennsauken formation.	0–60	----	----	Downer	Woodstown	Dragston	Fallsington	Pocomoke.
Bridgeton formation.	0–30	----	----	Downer	Woodstown	Dragston	Fallsington	Pocomoke.
			----	Aura	----	----	----	
Cohansey sand	100–250	Kaolinite dominant; some chlorite and mica; montmorillonite in places.	----	Downer	Woodstown	Dragston	Fallsington	Pocomoke.
			----	Matawan	Matawan	----	----	
			Lakewood	----	Lakehurst	Lakehurst	Leon	St. Johns.
			Lakeland	----	Klej	Klej	----	
Kirkwood formation.	100	Some kaolinite, chlorite, montmorillonite, and mica.	Lakewood	----	Lakehurst	Lakehurst	Leon	St. Johns.
			----	Westphalia.	Nixonton	Barclay	Pasquotank	Weeksville.
Vincentown sand	25–100	Montmorillonite dominant; mica in places.	----	Freehold	Holmdel	Holmdel	Shrewsbury	----
Hornerstown marl.[1]	30	Some montmorillonite; mica in places.	----	Marlton	Marlton	Kresson	Colemantown.	----
Navesink marl[1]	25–40	Some chlorite, montmorillonite, and mica.	----	Marlton	Marlton	Kresson	Colemantown.	----
			----	----	Holmdel	Holmdel	Shrewsbury	----
			----	Collington	----	----	Shrewsbury	----
Mt. Laurel sand Wenonah sand	5–60 35–20	Some chlorite, montmorillonite, and mica; kaolinite in places.	----	Freehold	Holmdel	Holmdel	Shrewsbury	----
Marshalltown formation.	30–40	Some chlorite, montmorillonite, and mica.	----	----	Holmdel	Holmdel	Shrewsbury	----
				Collington	----	----	Shrewsbury	----
Englishtown sand	20–40	Some kaolinite, chlorite, and mica; montmorillonite in places.	----	Freehold	Holmdel	Holmdel	Shrewsbury	----
Woodbury clay	50	Some kaolinite, chlorite, montmorillonite, and mica.	----	Howell	Howell		----	----
Merchantville clay.	50–60	Some kaolinite, chlorite, montmorillonite, and mica.	----	Howell	Howell	----	----	----
Magothy formation.	25–175	Some kaolinite, chlorite, and mica.	----	----	----	----	----	----
Raritan formation	150–300	----	----	----	----	----	----	----

[1] This material, called marl, is highly glauconitic.

TABLE 11.—*Soil series arranged according to subsoil texture and natural drainage classes*

Subsoil texture [1]	Natural drainage classes					
	Excessively drained	Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
	Uniform colors to a depth of 30 inches	Uniform colors to a depth of 30 inches; sandy loam or more clayey B horizon	Uniform colors to a depth of 20 inches; mottled colors or distinctly paler colors between depths of 20 and 30 inches	Dark grayish-brown surface layer; mottled colors of distinctly paler color between depths of 10 and 20 inches	Dark-gray surface layer; light-gray or olive subsoil, with or without mottling	Nearly black surface layer; light-gray or olive subsoil, with or without mottling
Sand or loamy sand (nonglauconitic).	Lakwood Lakeland		Lakehurst Klej	Lakehurst Klej	Leon	St. Johns.
Sandy loam to sandy clay loam:						
Nonglauconitic material—						
Sand, medium to coarse, with gravel—firm.		Aura				
Sand, medium to coarse, generally without gravel—loose.		Downer	Woodstown	Dragston	Fallsington	Pocomoke.
Sand, uniformly fine to very fine.		Westphalia	Nixonton	Barclay	Pasquotank	Weeksville.
Glauconitic material—						
Medium content—sand, fine to medium.		Collington			Shrewsbury	
Low content—sand, fine to medium.		Freehold	Holmdel	Holmdel	Shrewsbury	
Sandy clay to clay:						
Nonglauconitic material.		Matawan	Matawan			
Glauconitic material		Marlton	Marlton	Kresson	Colemantown	
Silty clay loam to clay		Howell	Howell			

[1] Subsoil texture listed in order of increasing clay content.

Climate and relief

The effects of climate and relief on the formation of soils are interrelated and will be discussed together.

According to geologists (*3*), climate in the area has changed several times since the oldest geologic materials were deposited. Recently, however, all the soils have been subject to a temperate climate with an average annual rainfall of about 44 inches. The nearly level, high-lying sandy soils absorb most of this rainfall. The soils on sloping lands lose some rainfall through runoff, which enters the streams or collects in low areas. These low areas may receive 80 or more inches of water a year. In addition to surface water, some low areas receive underground lateral flow of water from the adjacent slopes. Excess ground water has been important in the development of the soils in the county.

Six natural drainage classes are used locally in classifying the soils in this county. How these drainage classes are related to the soils is shown in tables 10 and 11.

The drainage classes are determined by soil color variations, which are the result of long periods of wetness. The time a soil remains wet after saturation varies; some soils are wet for a few minutes or hours, whereas others are wet for 10 months or more. These classes are not determined by texture or the permeability of the soil of a given texture. Most degrees of drainage or wetness are common to all textures. There are very poorly drained sands, just as there are very poorly drained clays. Excessive drainage, however, is confined to the soils of coarse textures.

Biological activity

In Camden County the effect of animals and vegetation on soil formation is not so apparent as that of the factors previously described.

Bleaching of the surface layer of Podzol soils is a process related to soil texture, vegetation, and time. In this county bleaching is deepest in coarse-textured soils under pine, but it occurs also in fine sands. Only sands of considerable age are bleached; those deposited most recently in the Cape May formation are not bleached.

If not destroyed by fire, organic matter from decaying vegetation accumulates on and in the surface soil to a depth of several inches. In the undisturbed areas of woodland in the sandy upland, the organic matter is not consumed by the few earthworms, and it accumulates faster than it is consumed by termites and other insects. In low-lying wet areas, it accumulates fast enough to make the surface soils black to a depth of 6 or more inches in places. In Muck areas, the surface soil exceeds 12 inches in thickness.

Time

For most of the soils of the county, including those developed in young material (an estimated 15,000 years old) along the Delaware River, there has been sufficient time and rainfall to leach out most of the readily soluble bases and thus leave the soil strongly acid in reaction. The extent to which clay has moved from the surface soil and has accumulated in the subsoil is an indication of the time that a soil has been exposed to soil-forming factors. Most soils in Camden County are old enough to show some increase in clay in the subsoil. This increase, however, is hardly apparent in the sands or alluvial soils, which are constantly being reworked by wind or water, or by both.

The estimated age of the oldest geologic beds of the county is about 150 million years. The rounded quartz gravel in these beds, however, indicates that material has been mixed in them in recent times, probably by water from melting ice sheets to the north of the county. In areas where the soil material is unmixed, the soil-forming processes have apparently been operating much longer without interruption.

Genesis and Classification [5]

In the first part of this section, some soil-forming processes are explained more specifically for soils mapped in Camden County. In the second part the soils are classified in higher categories.

Soil genesis

The multiple parent materials of the soils have been altered by weathering processes, including oxidation, reduction of oxides, and bleaching of particles. There have been additions of organic matter, movement of material from surface soils to subsoil (illuvation), aggregation, segregation of iron, and change of consistence, including, in some cases, cementation.

Soils that developed in parent material mainly of one kind but that differ in color and in some other ways are placed in a group called a catena. The discussions in this section are based largely on these groups.

The Lakeland, Lakewood, Lakehurst, Klej, Leon, and St. Johns soils have formed in materials that contained 90 percent or more of sand, mostly medium to coarse. About 90 percent or more of the sand was quartz.

The Westphalia, Nixonton, Barclay, Pasquotank, and Weeksville soils have formed in somewhat sandy materials, but the sand grains in these soils are predominantly fine and very fine.

[5] Prepared by GRANVILLE A. QUAKENBUSH, soil correlator for New Jersey.

The Collington, Freehold, Holmdel, and Shrewsbury soils have also formed in less sandy materials, but the sand is mainly fine and medium and contains small to moderate amounts of glauconite.

The Marlton, Kresson, and Colemantown soils have formed in materials somewhat more clayey and generally much higher in glauconite.

The surface layers of many soils in the county have developed from sandy sediments that differ from the parent material of the subsoil. The Matawan soils are distinct in this respect; in these soils sand overlies the very clayey strata that constitute the subsoil.

Muck, by contrast, consists of incompletely decomposed plant remains that accumulated to a depth of 1 to several feet in shallow water.

The Lakewood, Lakehurst, Leon, and St. Johns soils have developed in very sandy material by the removal of all original coloring from the upper part of the soil and by the accumulation of humus. The water table affected these processes in the Lakehurst, Leon, and St. Johns soils, and the bleaching and leaching probably were increased by fluids from the humus. The droughty Lakewood soils have a pale gray smudge of organic residue 1 to 4 inches thick at the surface, or, in places, none at all. To a depth of 6 to 15 inches or more, the sand grains are almost colorless. Below this zone there is a discontinuous, slight accumulation of illuviated humus 1 to 2 inches thick. In contrast, the generally wet Leon soils are dark or very dark gray from the surface to a depth of 4 or 5 inches. The bleached horizon in these soils may continue to depths of 10 to 24 inches. The underlying brownish horizon may be 8 inches to more than 10 inches thick. The St. Johns soils, which are swampy, have a nearly black and thicker surface layer, and the brownish B horizon is as strongly developed as in Leon soils, or more strongly developed. The stage of development of the Lakehurst soils is intermediate between that of the Lakewood soils and the Leon soils.

In such soils as Collington, Freehold, and Howell, the processes of bleaching and illuviation of humus have not progressed so far as in the St. Johns. The illuviation of clay and the aggregation of the subsoil into structural units are the evident processes in these soils.

The Collington and Freehold soils are basically brown throughout their depths. This coloring is produced by oxidation of iron. In the Holmdel soils, there is uneven oxidation because of seasonal saturation with water and, consequently, a partial exclusion of air from the soil. The Shrewsbury soils have been wet so much, because of a high water table, that the surface soil is gray or nearly gray, and there is prominent segregation of iron oxides in brightly toned brown mottles.

The Dragston soils are prominently mottled gray and brown in the subsoil because of the reduction of oxides under limited aeration that was caused by a high water table. In these soils, as in the Shrewsbury, the brown color is believed to come from segregated iron oxides. The Fallsington soils developed in similar materials, but the water table was higher over a longer period. As a result of the prolonged wetting, they have more of the grayer colors with low chromas. The color of the surface soil tends strongly toward gray. The Pocomoke soils, also developed in somewhat similar materials, have a thick, very dark surface horizon and a still grayer subsoil resulting from still more complete and extended wetting. The Pasquotank and Weeksville soils, in finer sandy material, have colors comparable to those of the Fallsington and Pocomoke, respectively, for like reasons.

Of the soils mapped in Camden County, the Lakeland soils show the least change from the deposited sediments. The Lakewood and Downer soils probably come next in degree of change, although they differ in kinds of development. The eluviation of organic matter has occurred in the Lakewood soils, whereas, the eluviation primarily of mineral matter has occurred in the Downer soils. The Collington and Freehold soils illustrate intermediate stages of development in weathering, translocation of very fine matter, formation of structure, and other soil-forming processes.

The Marlton are representative of highly developed soils. The subsoil of these soils is more clayey than the surface soil and substratum and may contain 40 percent or more of clay and be strongly aggregated into cubical blocks. The faces of these blocks are more or less smooth and waxy looking.

Of all the soils in Camden County, the Aura soils show the strongest and some of the deepest weathering. In the deeper parts of this soil, minerals as resistant as chert are so decayed that they can be cut with a knife or broken with the fingers. This weathering extends to depths that are as much as 15 feet, and is therefore below what is regularly considered genetic soil. The main section of the subsoil, to a depth of 5 to 8 feet, consists of bedded sand and gravel coated with clay. About one-half to three-fourths of each space between the particles of sand and gravel is occupied by clay and very little silt. The clay is predominantly reddish. This intensive weathering and the coating and bonding with colored clay suggest that the development of the Aura soils was earlier or for a longer time than that of the more loamy, more friable, less horizonated soils in less weathered materials. The Nixonton, Downer, and even Freehold and Westphalia are examples of the latter soils.

Classification

In this section the soil series of the county have been placed in great soil groups. A great soil group is a broad group of soils, all of which have the same chemical and physical properties and sequences of horizons.

The soil series of Camden County are classified by great soil groups in the following list:

Great soil group:	*Series*
Regosols	Lakeland, Klej.
Podzols	Lakehurst, Lakewood.
Ground-Water Podzols	Leon, St. Johns.
Red-Yellow Podzolic	Aura.
Humic Gley	Pocomoke, Weeksville.
Low-Humic Gley	Barclay, Colemantown, Dragston, Fallsington, Pasquotank, Shrewsbury.
Bog soils	Muck.
Gray-Brown Podzolic intergrading to Red-Yellow Podzolic.	Collington, Freehold, Holmdel, Howell, Marlton, Matawan, Westphalia, Woodstown.
Gray-Brown Podzolic intergrading to Regosols.	Downer, Nixonton.
Gray-Brown Podzolic intergrading to Low-Humic Gley.	Kresson.

As seen in the preceding list, most of the soil series have characteristics that are representative of a great soil group and are classified accordingly. Some soil series, however, have some characteristics of two great soil groups. Such soil series are grouped with the great soil group they resemble most closely, but they are classified as intergrading to the other great soil group.

The Lakeland and Klej are very sandy soils with little alteration except for the slight darkening of the surface. They are classed as Regosols.

The Lakewood and Lakehurst soils have unusually thick, bleached, ashy-looking surface layers and unusually thin, dark B horizons containing organic matter with very little iron. Because of these features, these soils have been classed with the Podzol group, even though they have only very thin layers of decayed organic matter on the surface and beneath the bleached layer. According to some soil scientists, these soils should be intergraded to Regosols because of the thinness of these organic-rich layers.

The Leon and St. Johns soils, on the other hand, are classed as Ground-Water Podzols. They are classified in this group because of the thick organic surfaces, the bleached A2 horizons, and the illuviated organic layers in the subsoil. Also there is evidence of a year-round high water table.

The Aura soils are the reddest in Camden County. Strong weathering and clay enrichment of the B horizon are characteristic of these soils. For these reasons the Aura soils are the soils in the county that most nearly meet the criteria for the Red-Yellow Podzolic group.

The Pocomoke and Weeksville soils belong to the Humic Gley group. They have a black or nearly black surface soil, 8 or 10 inches thick, composed of organic residue mixed with mineral grains. These soils have been saturated with water in the presence of organic matter for long periods, and intensive reduction of oxides has taken place. The gleying is indicated in the subsoil by pale-gray colors of very low chroma.

The Barclay, Colemantown, Dragston, Fallsington, Pasquotank, and Shrewsbury soils are classed with the Low-Humic Gley group. They differ from the Humic Gley soils, such as Pocomoke and Weeksville, in having a mottled brown and gray subsoil. The Colemantown soils are classed with the Low-Humic Gley group because of their low topographic position, low relief, and slow permeability. These conditions are normally favorable to the formation of Low-Humic Gley soils in Camden County. However, where this soil is composed mainly of dark-green glauconite grains, as it commonly is, organic staining is difficult to appraise and the gleying of the subsoil may be scant or not apparent.

Muck contains a large amount of organic matter and is classified as a Bog soil. The rest of the soils of Camden County are not clearly representative of a specific great soil group. This fact may result from the geographic and climatic position of New Jersey, which straddles the zones in which the Gray-Brown and the Red-Yellow Podzolic groups of soils are typically developed.

Until the early 1950's, all unmottled and lightly mottled soils with a distinct increase in clay in the B horizons in Camden County were classified as Gray-Brown Podzolic (*9*). Since that time more attention has been given to criteria characteristic of Red-Yellow Podzolic soils.

Some soils of the county have some features characteristic of both the Gray-Brown and Red-Yellow Podzolic groups. These soils are classified as Gray-Brown Podzolic soils intergrading to Red-Yellow Podzolic in the preceding list and are discussed in the following paragraphs.

The Collington and Freehold soils are such intergrades. Where never disturbed by cultivation, the A1, or dark surface layer, of the soils of these two series is 2 to 4 inches thick; the A2, though slightly paler than the A1 or the B, is brown rather than grayish brown or a paler color. The color contrast between the A2 and B horizons is too weak for typical Red-Yellow Podzolic soils but too strong for typical Gray-Brown Podzolic soils. The same is true of the texture contrast between the two horizons. There is distinctly more clay in the B than in the A horizons, but the increase is not prominent. The base saturation tends to be low, though it does increase with depth. The subsoil color of the Collington soils is olive brown rather than reddish. The clay coatings on ped faces are distinct though thin, rather than thick and prominent. There is no evidence of red streaking nor reticulation in the lower subsoil, though the ped coatings are redder than the matrices.

The Howell, Holmdel, and Woodstown are examples of soils that have high chromas in only slightly paled and mottled subsoils. These are also classified as Gray-Brown Podzolic soils intergrading to the Red-Yellow Podzolic. Some soils of the Holmdel series have stronger mottling than normal and light olive-brown colors, especially in the lower B horizon, and therefore approach the Low-Humic Gley soils in characteristics.

The color contrast and horizon contrast in Westphalia soils in Camden County are similar to those for the Gray-Brown Podzolic group. The yellowish colors in the subsoil, however, are suggestive of the Red-Yellow Podzolic group.

The horizon contrast in the Matawan soils is marked by the clay layers underlying the sandier surface soil. From the A2 to the upper sandy clay loam B horizon, the transition is not abrupt. The transition is abrupt, however, from the upper to the lower B horizons. Nevertheless, only thin yellowish-brown clay films are noted in the B horizon. Base saturation is low throughout the soil. For these reasons the Matawan soils are classified as Gray-Brown Podzolic soils intergrading to Red-Yellow Podzolic.

The Marlton soils are dominated by the olive color and high clay content of the parent material. Low chromas are characteristic. These soils are classed with the Gray-Brown Podzolic soils intergrading to the Red-Yellow Podzolic.

The color and horizonation of the Downer and Nixonton soils suggest the Gray-Brown Podzolic group. These soils, however, have so little clay in the B horizon that they have been classed as Gray-Brown Podzolic soils intergrading to Regosols. Because of some redness and high chromas in the subsoil, along with strong acidity throughout, the Downer soils also tend toward the Red-Yellow Podzolic group.

The Kresson soils are similar to the Marlton soils except for the mottling and accumulation of organic matter at the surface. The Kresson soils are wet as much of the time as some Low-Humic Gley soils, but except for unconforming surface layers, there is little or no detectable gleying. Therefore, the Kresson soils are considered to be Gray-Brown Podzolic intergrading to Low-Humic Gley.

Descriptions of the Soil Series

This section includes a detailed soil description of each soil series common to Camden County. All descriptions are of soils as they exist in the county. The terms used are defined in the Soil Survey Manual and Supplement (*8*). The horizonation nomenclature is in accordance with the supplement. Color notations are based on the Munsell color charts.

Aura series.—The Aura series consists of well-drained Red-Yellow Podzolic soils that have a moderately fine textured B horizon that is firm in the lower part. These soils developed in deposits containing much rounded quartzose gravel and coarse sand. The deposits are commonly cross-bedded, an indication that they were laid down by shallow, fast-flowing water. They are thought to be of glaciofluvial origin.

The Aura soils occur at high elevations, mostly in extensive level areas on the watershed divides. They also occur in small areas at the same elevations. These small areas are apparently remnants of much larger areas.

The Aura soils are the only member of the catena, possibly because the firm substratum does not form under conditions of excess moisture.

The Aura soils are commonly associated with Downer soils but are redder and have a heavier textured B horizon than those soils. Also, they have a firm substratum that distinguishes them from the Downer soils.

Profile of Aura sandy loam in a formerly cultivated area now in pasture, one-half mile southwest of Tansboro:

Ap—0 to 10 inches, dark grayish-brown (2.5Y 4/2) sandy loam; weak, fine, granular structure; friable; roots common; about 5 percent rounded quartzose gravel by volume; abrupt, smooth boundary. Thickness ranges from 6 to 12 inches.

A2—10 to 15 inches, yellowish-brown (10YR 5/4) sandy loam; weak, fine, granular structure; friable; roots common; about 5 percent quartzose gravel by volume; gradual, smooth boundary. Thickness ranges from 4 to 10 inches.

B1—15 to 24 inches, yellowish-brown (10YR 5/8) sandy loam; weak, medium, subangular blocky structure; friable; roots common; continuous clay films on peds; 10 to 15 percent rounded quartzose gravel by volume; gradual, smooth boundary. Thickness ranges from 4 to 12 inches.

B2—24 to 40 inches, strong-brown (7.5YR 5/8) sandy clay loam; massive but tends toward thin platy structure; firm in place when moist, friable when removed, hard when dry, plastic when wet; roots few; prominent, continuous clay films in pores; 5 to 10 percent rounded quartzose gravel by volume, some soft from decay; gradual, smooth boundary. Thickness ranges from 15 to 36 inches.

C—40 to 60 inches, strong-brown (7.5YR 5/8) stratified sandy loam and loamy sand; massive; friable; 5 to 10 percent rounded quartzose gravel by volume.

The common soil types are sandy loam and loamy sand. Much of the sand is coarse and sharp. Rounded quartzose gravel as much as 2 inches in diameter is common in Aura soils. In some areas the soil should be called gravelly, but generally these areas are not extensive and it is not feasible to map them in woodlands, pastures, hayfields, or idle lands.

The hue of the firm part of the B horizon ranges from 5YR to 10YR, the value is 5, and chroma is 6 or 8.

The clay in these soils is primarily gibbsite, and an abrupt decrease of silt in the lower part of the B horizon is a characteristic.

In woodlands, Aura soils normally have micropodzol horizons 2 to 4 inches thick, especially the loamy sand types.

The Aura soils contain small areas that are not firm, but these areas are too small to be mapped separately. The firm B horizon normally becomes less firm below 4 to 6 feet but in some places at a more shallow depth, and in others at a depth of 10 to 20 feet.

Barclay series.—The Barclay series consists of somewhat poorly drained, Low-Humic Gley soils developed in deposits of uniformly fine sand. They occur in low positions, generally lower than the Nixonton soils, in the Westphalia, Nixonton, Barclay, Pasquotank, and Weeksville drainage sequence.

The Barclay soils are finer textured than Klej and Dragston soils and lack the olive colors of the Holmdel soils.

In Camden County, the Barclay soils were mapped only with Nixonton soils as undifferentiated units.

Profile of Barclay loamy fine sand in a hayfield about one-half mile west of Lakeland Hospital:

Ap—0 to 10 inches, dark grayish-brown (2.5Y 4/2) loamy fine sand; weak, fine, granular structure; very friable; roots abundant; abrupt, smooth boundary. Thickness ranges from 7 to 12 inches.

A2—10 to 16 inches, light brownish-gray (2.5Y 6/2) fine sand with few, fine, faint mottles; single grain; loose; few roots; gradual, smooth boundary. The thickness ranges from 3 to 9 inches.

B2—16 to 30 inches, light olive-brown (2.5Y 5/4) very fine sandy loam with common, fine, distinct, yellowish-brown (10YR 5/8) mottles; very weak, subangular blocky structure; very friable; roots common; clear, smooth boundary. The thickness ranges from 12 to 30 inches.

C—30 to 60 inches, stratified light brownish-gray (2.5Y 6/2) very fine sandy loam and loamy fine sand with few to common, faint mottles; structureless; very friable or loose; roots few.

In this county the two types in the Barclay series are fine sandy loam and loamy fine sand. Normally the fine sand is more than 60 inches thick, but in some areas it is somewhat thinner where it has been redeposited over coarser material.

The structure of the B horizon is weakly developed, and the increase in clay from the A to the B horizon is generally low. The hue of the B horizon is 2.5Y, the value 5 to 7, and the chroma 2 to 4. Mottling normally is distinct in the upper B and faint in the A2 horizon. In places, pieces of rounded quartzose gravel occur throughout the Barclay soils or in the upper horizons as remnants of overlying geologic deposits.

Colemantown series.—The Colemantown series consists of poorly drained Low-Humic Gley soils that have developed in highly glauconitic deposits. These soils are generally on extensive low flats or on the bottoms of closed circular depressions. They are the poorly drained members of the Marlton, Kresson, and Colemantown drainage sequence.

The Colemantown soils can be distinguished from the Marlton and Kresson soils by a prominently mottled A horizon that has a low value and chroma, as 2/2, 3/1, or 3/2, and by a B horizon that has a higher chroma.

Profile of Colemantown loam in an area that is now in sweetgum forest but was formerly cultivated, about 2 miles northwest of Kresson:

Ap—0 to 10 inches, very dark gray (10YR 3/1) loam with many, fine and medium, prominent, dark reddish-brown (5YR 3/4) mottles; moderate, medium or coarse, granular structure; friable; roots abundant; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

B—10 to 36 inches, dark-olive (5Y 3/3) sandy clay with many, fine, prominent, strong-brown (10YR 5/8) mottles; blocky structure; firm when moist, very plastic when wet; glauconite content high; continuous clay films on peds; few roots; gradual, smooth boundary. The thickness ranges from 15 to 36 inches.

C—36 to 60 inches, dark-olive (5Y 3/3), stratified sandy loam and sandy clay layers with common to many, medium, prominent mottles ranging from yellowish brown (10YR 5/8) to dark red (10R 3/6); structureless, massive; friable; glauconite content high; only fine roots; 0 to 3 percent of layer is rounded quartzose gravel.

The A horizon is generally very dark, but the soils are not strongly gleyed. Consequently, the color of the A horizon ranges from 2 to 3 in value and has a chroma of 1 or 2. In contrast to the low chroma of the subsoil of most other poorly drained soils in this county, the subsoil of the Colemantown soils has a chroma of 3. Apparently the highly glauconitic material in these soils is not easily gleyed. The texture of the B horizon is generally sandy clay, though small areas of sandy clay loam occur in places.

The thickness of the solum ranges from 24 to 50 inches. Pieces of rounded quartzose gravel occur in varying amounts from place to place but generally are not abundant anywhere.

Collington series.—The Collington series consists of well-drained, Gray-Brown Podzolic soils intergrading to Red-Yellow Podzolic. These soils have a medium or moderately fine textured B horizon that contains medium amounts of glauconite (10 to 50 percent). The relief ranges from nearly level to gently rolling.

The Collington soils are the well-drained member of the drainage sequence that includes poorly drained Shrewsbury soils. The Collington soils contain more glauconite than the Freehold soils but less than the Marlton soils. They are more sandy than the Howell soils.

Profile of Collington fine sandy loam in a cultivated area northeast of the intersection of Springdale Road and Haddonfield-Kresson Road:

Ap—0 to 9 inches, very dark grayish-brown (2.5Y 3/2) fine sandy loam; weak, fine, granular structure; friable, slightly firm in lower inch; roots abundant; no coarse gravel; abrupt, wavy boundary. The thickness ranges from 8 to 10 inches.

A2—9 to 13 inches, brown (10YR 4/3) fine sandy loam with numerous worm channels; weak, fine, granular structure; friable; roots abundant; no coarse gravel; smooth, gradual boundary. The thickness ranges from 4 to 8 inches.

B21—13 to 23 inches, brown (10YR 4/3) fine sandy clay loam; moderate, medium, subangular blocky structure; slightly firm when moist, plastic when wet; roots abundant; individual glauconite grains common under 10-power lens; thin, discontinuous clay films on peds; pores common; smooth, gradual boundary. The thickness ranges from 8 to 12 inches.

B22—23 to 32 inches, olive-brown (2.5Y 4/4) fine sandy clay loam; moderate, medium, subangular blocky structure; slightly firm to friable when moist, plastic when wet, hard when dry; roots abundant; individual glauconite grains common under 10-power lens; thin, discontinuous clay films on peds; smooth, abrupt boundary. The thickness ranges from 8 to 20 inches.

C—32 to 60 inches, stratified olive-brown (2.5Y 4/4) sandy loam and loamy sand; individual dark-olive (5Y 3/2) grains of glauconite occupy almost half of mass; structureless, massive; slightly firm in place, friable when removed; roots few.

In this county only the fine sandy loam type was extensive enough to map.

Normally the B horizon has a hue of 2.5Y, 10YR, or 7.5YR, a value of 4, and a chroma of 4. The texture of the B horizon ranges from heavy sandy loam to sandy clay loam; it is slightly more clayey than the B horizon of Freehold soils. In addition, the B horizon of the Collington soils is generally more plastic and in most places has a more strongly developed structure than the B horizon of the Freehold soils.

The thickness of the solum of the Collington soils ranges from 30 to 40 inches. In places, there are thin, reddish, cemented iron layers in the C horizon. Rounded quartzose gravel occurs mostly in the A and C horizons.

Downer series.—The Downer series consists of well-drained, Gray-Brown Podzolic soils intergrading to Regosols. They have moderately coarse-textured B horizons. These soils have gentle slopes.

The Downer soils are normally associated with Aura, Lakeland, and Woodstown soils. The Downer soils lack the firm subsoil of the Aura soils.

A typical profile of a cropped area of Downer loamy sand one-half mile east of the intersection of the Berlin-Cross Keys Road and Blenheim-Erial-New Brooklyn Road:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) light loamy sand; very weak, fine, granular structure; very friable; roots abundant; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

A2—10 to 18 inches, yellowish-brown (10YR 5/6) loamy sand or sand; single grain; loose; few roots; lower 6 inches contains a few spheroidal concretions; sand grains mostly clean; gradual, smooth boundary. The thickness ranges from 4 to 20 inches.

B1—18 to 24 inches, slightly darker yellowish-brown (10YR 5/6) sandy loam; weak, fine, granular structure; very friable; some clay on sand grains; gradual, smooth boundary. The thickness ranges from 0 to 10 inches.

B2—24 to 30 inches, yellowish-brown (10YR 5/6) sandy loam that becomes lighter colored with depth; weak, medium, subangular blocky structure; very friable; sand grains bridged with clay; gradual, smooth boundary. The thickness ranges from 6 to 24 inches.

C—30 to 60 inches, yellowish-brown (10YR 5/6) loamy sand; single grain; loose.

Loamy sand and sandy loam types occur in this county.

The hue of the B horizon ranges from 10YR to 7.5YR, the value is 4 or 5, and the chroma ranges 4 to 8. Normally, the color of the Ap layer of farmed soils is grayish brown. This color results from the 2 to 4 inch micro-podzol horizon that occurs in this soil and can be observed in most woodland areas.

The thickness of the A horizon ranges from 10 to 30 inches and averages about 14 inches. Normally, the B horizon of the loamy sand type is thinner than that of the sandy loam type. In places, however, the B horizon of the sandy loam type is as thin as 10 or 12 inches. Some areas may have clay or sandy clay layers between a depth of 30 and 60 inches.

Rounded pieces of quartzose gravel up to 2 inches in diameter occur in places in small amounts in the A and B horizons and to a greater extent in the C horizon. Gravel is abundant in some areas, but these areas are too small to be mapped separately. In places, there are weakly cemented stratified layers a few inches thick in the C horizon. These layers are most common near areas that have a fluctuating water table.

Generally, the Downer soils are not mottled, but some areas that have mottles below a depth of 30 inches are included in mapping. The mottles in these areas do not have a low chroma.

Dragston series.—The Dragston series consists of somewhat poorly drained Low-Humic Gley soils having moderately coarse textured B horizons and containing no glauconite. These soils are nearly level and are in low positions. Stratification of gravelly sand and sand is common in the C horizon.

In Camden County the Dragston soils are in a drainage sequence with Downer, Woodstown, Fallsington, and Pocomoke soils.

The Dragston soils are composed of coarser material than the Barclay soils and lack the glauconite and olive colors (5Y in hue) common to the Holmdel soils.

In Camden County, the Dragston soils were mapped only with Woodstown soils in an undifferentiated unit.

A profile of a cultivated Dragston sandy loam several hundred feet east of the intersection of the Watsontown-New Freedom Road and the Berlin-Cross Keys Road:

Ap—0 to 10 inches, very dark grayish-brown (2.5Y 3/2) sandy loam, grayish brown (2.5Y 5/2) when dry; medium, weak to moderate, granular structure; very friable; less than 2 percent rounded quartz pebbles; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

A2—10 to 14 inches, light olive-brown (2.5Y 5/4) sandy loam with few, fine, faint mottles; weak, fine, granular structure; very friable; less than 2 percent rounded quartzose gravel; abrupt, smooth boundary. The thickness ranges from 4 to 8 inches.

B1—14 to 20 inches, light olive-brown, (2.5Y 5/4) heavier sandy loam; common, fine and medium, prominent, light brownish-gray (2.5Y 6/2) and yellowish-brown (10YR 5/8) mottles; weak, fine, subangular blocky structure; friable; 2 to 4 percent rounded quartzose gravel; gradual, smooth boundary. The thickness ranges from 4 to 10 inches.

B2g—20 to 30 inches, light brownish-gray (2.5Y 6/2) heavy sandy loam with common, medium, prominent mottles; moderate, medium, subangular blocky structure; friable or slightly firm; 2 to 4 percent rounded quartz pebbles; darker gray clay films in pores; abrupt, smooth boundary. The thickness ranges from 6 to 16 inches.

C—30 to 60 inches, grayish-brown (2.5Y 5/2), stratified gravelly sand and sand; single grain; loose; variable 10 to 30 percent rounded quartz gravel.

Only the Dragston sandy loam type was extensive enough to be mapped in this county.

The color of the surface soil ranges from 3 to 5 in value. The hue of the upper B horizon is 10YR or 2.5Y, the value 5, and the chroma 4. In the lower B horizon, the chroma is 2 and generally remains low to a depth of 60 inches. The mottling is most abundant in the lower B horizon but normally extends into the upper B horizon and into the A2 horizon.

The texture of the subsoil is generally sandy loam. It is normally on the sandy side and is similar to the texture of the Downer B horizon.

The thickness of the B horizon ranges from 10 to 25 inches and averages about 12 inches. Rounded pieces of quartzose gravel occur in small amounts in some spots; they are most abundant in the C horizon.

Fallsington series.—The Fallsington series consists of poorly drained Low-Humic Gley soils having a moderately coarse textured B horizon. They contain no glauconite. There is considerable stratification of sand and quartzose gravel in the C horizon. The soils have nearly level slopes and occur in low positions. In Camden County, the drainage sequence from well drained to very poorly drained is: Downer, Woodstown, Dragston, Fallsington, and Pocomoke.

Fallsington soils contain more medium and coarse sand than the Pasquotank soils and lack the glauconite and the olive colors common to the Shrewsbury soils.

A typical cropped area of Fallsington sandy loam three-fourths of a mile northeast of Sicklerville:

Ap—0 to 10 inches, dark-gray (10YR 4/1) sandy loam with common, fine, distinct, dark yellowish-brown mottles; weak, fine, granular structure; friable in upper 8 inches, slightly firm in lower 2 inches; roots numerous; 0 to 2 percent rounded quartz gravel; abrupt, smooth boundary. The thickness ranges from 9 to 12 inches.

B2g—10 to 24 inches, grayish-brown (2.5Y 5/2) sandy loam that is slightly heavier than that in the layer above; many, fine, distinct, dark yellowish-brown mottles around the roots; weak, medium, subangular blocky structure; friable; roots numerous; 2 to 5 percent rounded quartzose gravel, 10 to 20 percent in scattered pockets; thin, discontinuous clay films; abrupt, smooth boundary. The thickness ranges from 12 to 24 inches.

Cg—24 to 60 inches, stratified light brownish-gray (2.5Y 6/2) sand; single grain; loose; roots few; 5 to 10 percent rounded quartzose gravel.

Only the Fallsington sandy loam type was extensive enough to map in this county.

The hue of this soil ranges from 10YR to 2.5Y; the value ranges from 3 in the A horizon to 6 in the C; the chroma is generally 1 or 2 in the A horizon and 2 or 3 in the B and C horizons.

The thickness of the B horizon averages 14 inches, which is somewhat less than the average thickness of the more clayey B horizons of Fallsington soils in adjoining counties. The clay increase in the B horizon of this soil averages about 10 percent. Rounded pieces of quartzose gravel occur in small amounts in places, mainly in the A and C horizons and most abundantly in the C horizon.

Freehold series.—The Freehold series consists of well-drained Gray-Brown Podzolic soils having a moderately coarse textured or medium textured B horizon and a low glauconite content. These soils were derived from marine deposits that were dominantly sandy. They are mainly gently sloping but have steep slopes adjacent to the streams. The Freehold soils are the well drained members of the Freehold, Holmdel, Shrewsbury drainage sequence.

The Freehold soils contain less glauconite than the Collington soils and are coarser textured than the Howell soils. Base exchange capacities are twice as high in Freehold soils as in Sassafras soils in most horizons, and three times as high in the C horizon (*11*). This is tentatively correlated with glauconite content. The Sassafras soils are not mapped in this county but are mapped nearby.

A profile of a cropped Freehold fine sandy loam east of Marlkress Road and north of the North Branch of Cooper River:

A—0 to 9 inches, dark grayish-brown (2.5Y 4/2) fine sandy loam; weak, fine, granular structure; very friable; few glauconite grains; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

A2—9 to 15 inches, yellowish-brown (10YR 5/4) fine sandy loam; single grain; loose; abrupt, smooth boundary. The thickness ranges from 4 to 8 inches.

B1—15 to 20 inches, slightly darker yellowish-brown (10YR 5/4) heavy fine sandy loam; weak, fine, granular structure; very friable; abrupt, smooth boundary. The thickness ranges from 4 to 8 inches.

B2—20 to 30 inches, dark yellowish-brown (10YR 4/4) heavy fine sandy loam or fine sandy clay loam; moderate, medium, subangular blocky structure; friable; slightly plastic; sand grains bridged with clay within peds, and peds thinly coated with clay and silt; glauconite grains common; gradual, smooth boundary. The thickness ranges from 8 to 15 inches.

B3—30 to 42 inches, dark yellowish-brown (10YR 4/4) fine sandy loam becoming paler and more olive with depth; weak, medium, subangular blocky structure; very friable; glauconite common; gradual, smooth boundary. The thickness ranges from 0 to 15 inches.

C—42 to 60 inches, light olive-brown (2.5Y 5/4) stratified loamy sand that is single grain and loose, and fine sandy loam that is massive; glauconite abundant.

The types of the Freehold series mapped in this county are fine sandy loam, loamy fine sand, and sand (thick surface variant). The Freehold soils normally range from 30 to 40 inches in thickness but are thicker in places. In this county the sands are predominantly fine, and consequently the soils have a high water-holding capacity.

The hue of the B horizon ranges from 7.5YR to 10YR, the value is 4 or 5, and the chroma ranges from 4 to 8. In the C horizon, the range in hue is wider—from 2.5Y through 10YR, 7.5YR, and 5YR. The 2.5Y hues come from the glauconite grains. The 5YR hues are from iron coating that probably came from the glauconite, as these hues are much more common in glauconitic than in nonglauconitic soils.

As a rule, Freehold soils contain little or no rounded quartzose gravel. If found only in the A horizon, the gravel is probably a remnant of more recent surficial deposits. In places there is a stone line of rounded quartzose gravel (fig. 16) over the B horizon. It is possible that the gravel is a remnant of geologic erosion, and the sand is a more recent deposit, possibly windblown.

Holmdel series.—The Holmdel series consists of moderately well drained and somewhat poorly drained soils having a moderately coarse textured or medium textured subsoil and containing small amounts of glauconite. These are Gray-Brown Podzolic soils intergrading to Red-Yellow Podzolic. The soils developed from glauconitic marine deposits. They have little slope and occur at intermediate elevations. Most areas of the Holmdel soils are moderately well drained, but because of limited acreage, some areas are somewhat poorly drained. Other soils in the drainage sequence are the well-drained Freehold and poorly drained Shrewsbury.

Generally, the glauconite content of the Holmdel soils is 5 to 15 percent. As a result, some of the lower horizons are olive colored and normally become more so in the C horizon. This characteristic distinguishes them from Woodstown and Dragston soils of similar texture and drainage ranges. The Holmdel soils are not so fine-textured nor so glauconitic as the Kresson soils.

A profile of a cultivated area of Holmdel fine sandy loam east of Marlkress Road and north of the North Branch of Cooper River:

Ap—0 to 10 inches, dark grayish-brown (2.5Y 4/2) fine sandy loam; weak, fine, granular structure; very friable; very dark glauconite grains common; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

B21—10 to 20 inches, yellowish-brown (10YR 5/8) heavier fine sandy loam with many, medium, prominent, light olive-brown (2.5Y 5/4) mottles; weak, fine, granular structure; friable; thin, discontinuous clay films on peds; glauconite content low; gradual, smooth boundary. The thickness ranges from 4 to 12 inches.

B22—20 to 34 inches, light olive-brown (2.5Y 5/4) fine sandy clay loam with common, medium, prominent mottles diminishing in number with depth; moderate, medium, subangular blocky structure; friable when moist, plastic when wet; thin clay films on peds; glauconite content low; abrupt, smooth boundary. The thickness ranges from 10 to 20 inches.

C1—34 to 48 inches, olive (5Y 5/3), stratified, light fine sandy loam and heavy fine sandy loam; common, medium, prominent, yellowish-brown (10YR 5/8) mottles; massive; friable; glauconite abundant.

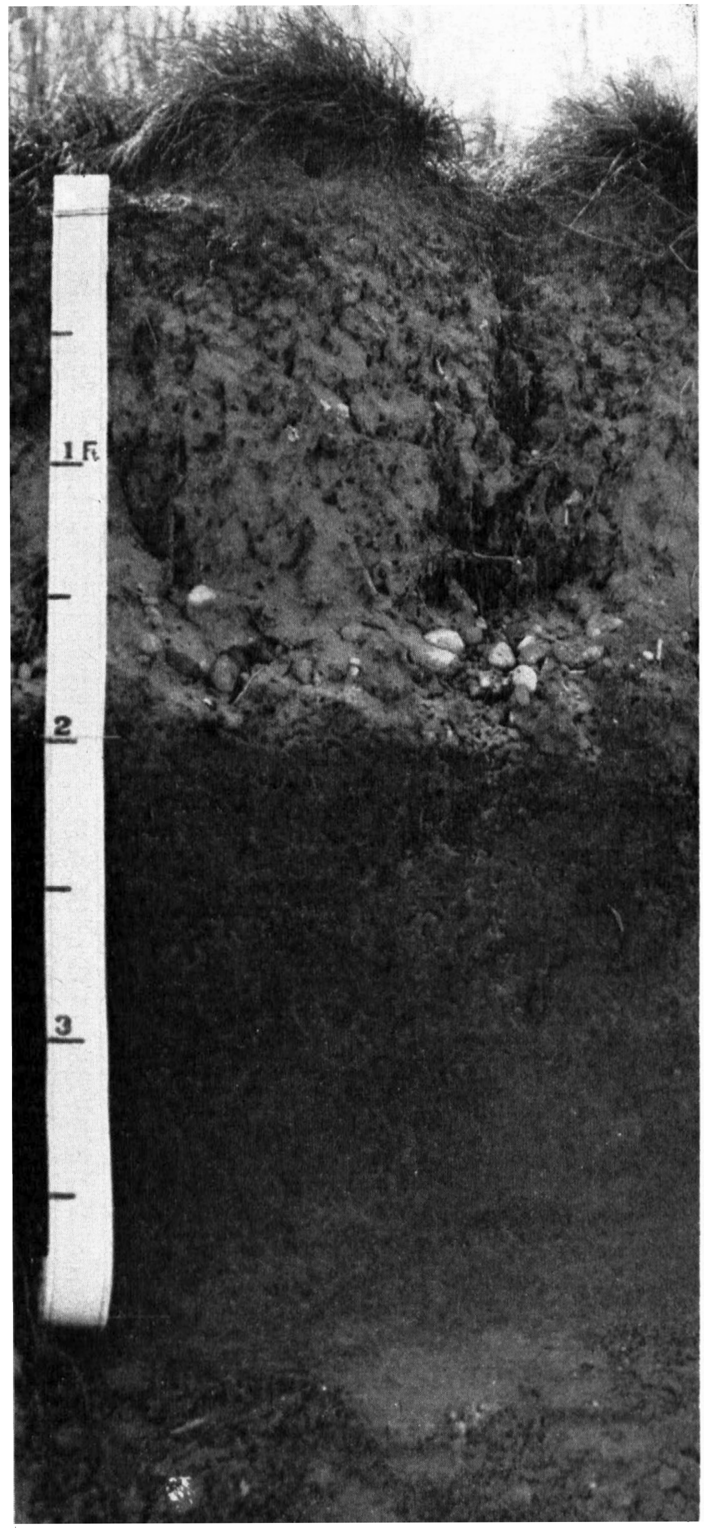

Figure 16.—**Stone line of rounded quartzose pebbles over the B horizon.**

C2—48 to 60 inches, stratified thin layers of dark-olive (5Y 3/3) and olive-gray (5Y 5/2) sand, which resembles a mixture of salt and pepper; single grain; loose; glauconite abundant.

The Holmdel types mapped in this county are fine sandy loam and loamy fine sand. A clayey substratum phase was also mapped.

The hue of the B horizon ranges from 2.5Y to 10YR, the value is 5, and the chroma ranges from 4 to 8. The chroma of the C horizon ranges from 2 to 4. Mottling occurs only in the lower B horizon in the moderately well drained areas but extends into the A2 in the somewhat poorly drained areas. There is wide range in abundance, size, and prominence of mottles.

Normally, the solum of the Holmdel soils is 30 to 36 inches thick. The texture of the B horizon ranges from heavy sandy loam to light sandy clay loam. In this county most of the sand is fine. Generally, Holmdel soils contain little rounded quartzose gravel. If present, gravel is most abundant in the A and C horizons.

Howell series.—The Howell series consists of well drained and moderately well drained Gray-Brown Podzolic soils intergrading to Red-Yellow Podzolic. These soils formed in moderately fine or fine textured materials from silty clay marine deposits containing no glauconite or very little. In this area the clay deposits contain some montmorillonite clay (*2*). The soils mostly have gentle slopes, but some have short steep slopes, commonly on the south bank of streams.

The Howell soils are associated with Moderately wet land. They contain less glauconite than the Marlton soils and are finer textured than the Freehold and Collington soils.

Because the small acreage of the Howell soils in this county has been nearly all converted to urban uses, these soils have been mapped only in a complex with Urban land.

A profile of Howell loam in a formerly cropped area one-half of a mile southeast of the intersection of the Haddonfield-Sorrell Horse Road and N.J. Highway 38:

Ap—0 to 10 inches, yellowish-brown (10YR 5/4) loam; weak, fine, granular structure; very friable; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

B1—10 to 15 inches, yellowish-brown (10YR 5/8) heavy loam; weak, medium, subangular blocky structure; firm when moist, plastic when wet; micaceous; gradual, smooth boundary. The thickness ranges from 4 to 8 inches.

B2—15 to 25 inches, yellowish-brown (10YR 5/8) clay loam or silty clay loam; moderate, medium, subangular blocky and blocky structure; friable to firm when moist, plastic when wet; thin clay films on peds; gradual, smooth boundary. The thickness ranges from 6 to 14 inches.

B3—25 to 32 inches, yellowish-brown (10YR 5/8) clay loam with few, fine, distinct mottles; weak, medium, subangular blocky structure; friable when moist, plastic when wet; abrupt, smooth boundary. The thickness ranges from 3 to 6 inches.

C—32 to 60 inches, dark-gray (10YR 4/1) silty clay with many, fine, distinct mottles of dark yellowish brown (10YR 4/4); moderate, medium, blocky structure; blocks coated brown on the outside; very firm when moist, very plastic when wet; micaceous.

The hue of the subsoil is 10YR or 7.5YR, the value is 4 or 5, and the chroma ranges from 6 to 8. Mottles occur in places, generally below 24 inches.

The solum generally extends to 30 or 40 inches, though in places it is deeper. The presence, in places, of thin sandy C1 horizons containing gravel seems to suggest a redeposit of the source material. This sandy C horizon does not generally occur on steep slopes.

The texture of the subsoil ranges from clay loam to silty clay and silty clay loam. Normally, the lower C horizon consists of slightly weathered, compact, very dark gray silty clay deposits.

Klej series.—The Klej series consists of moderately well drained and somewhat poorly drained, coarse-textured soils without B horizons. The Klej soils are Regosols. The parent material was either water- or wind-deposited sand. These soils have nearly level slopes and occur in intermediate positions. The Klej soils occur as moderately well drained and somewhat poorly drained members of the same drainage sequence as the excessively drained Lakeland soils. The moderately well drained areas are more extensive. The Klej can be distinguished from the Lakeland soils by mottling in the C horizon, and from the Lakewood and Lakehurst by the absence of a prominently bleached A2 horizon. The Klej soils can be distinguished from the Woodstown by the absence of a B horizon.

A profile of a Klej loamy sand in an area under cultivation 1¼ miles east of Winslow and ½ mile south of Cedar Brook Road:

Ap—0 to 10 inches, very dark grayish-brown (2.5Y 3/2) loamy sand; very weak, fine, granular structure; very friable; 3 to 5 percent rounded quartzose gravel; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

C1—10 to 16 inches, light yellowish-brown (2.5Y 6/4) loamy sand; single grain; loose; gradual, smooth boundary.

C2—16 to 30 inches, yellowish-brown (10YR 5/6) loamy sand; few, medium mottles, faint in upper part and distinct in lower part; single grain or very weak, fine, granular structure; loose or very friable; ⅛-inch to ½-inch concretions common.

C3—30 to 60 inches, brown (10YR 5/3) sand; single grain; loose.

Only the loamy sand type was extensive enough to map in this county. In moderately well drained areas, the hue is 5Y, 2.5Y, or 10YR, and the value is 3 or 4 in the Ap layer, and 5 or 6 below. The chroma is 2 or 3 in the Ap layer, 4 to 6 in the upper C horizon, and 2 to 4 in the lower C horizon. In somewhat poorly drained areas, the chroma in the C horizon is lower.

Rounded pieces of quartzose gravel occur in small amounts in these soils. Micropodzol horizons, generally 1 to 3 inches thick but as much as 4 to 6 inches thick, occur in many wooded areas.

Kresson series.—The Kresson series consists of somewhat poorly drained soils with a fine-textured subsoil. The subsoil contains large amounts of glauconite that is strongly olive colored. The Kresson are Gray-Brown Podzolic soils that intergrade to Low-Humic Gley soils. The parent material consists of highly glauconitic marine deposits. The soils occur in intermediate to low positions, often in the nearly level bottom of circular depressions. They are members of the same drainage sequence as the Marlton and Colemantown soils.

The Kresson soils can be distinguished from the Marlton soils by mottling in the lower A horizon or upper B horizon and lower values and generally lower chromas (3 or lower) in the C horizon. They lack the prominent mottles in the A horizon that are common to the Colemantown soils.

A description of a cropped area of Kresson sandy loam three-fourths of a mile southwest of Ashland:

Ap—0 to 10 inches, very dark grayish-brown (2.5Y 3/2) sandy loam with few, medium, faint mottles in lower half; weak, fine, granular structure; friable; roots abundant; glauconite abundant; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

B2—10 to 32 inches, dark-olive (5Y 3/3) sandy clay; many, fine, prominent, yellowish-brown (10YR 5/8) mottles in the upper half and olive-brown mottles (2.5Y 4/4) below; strong, medium, blocky structure; very firm when moist, very plastic when wet; roots common; many clay films; glauconite abundant; abrupt, smooth boundary. The thickness ranges from 15 to 36 inches.

C—32 to 60 inches, dark-olive (5Y 3/3) sandy loam repeatedly stratified with olive-brown (2.5Y 4/4) sandy clay; massive; glauconite abundant.

Only the sandy loam type was extensive enough to map in this county.

The hue of the B and C horizon is 5Y, the value is 3, and the chroma is 3 or 4. The solum generally ranges from 30 to 40 inches in thickness, but it is thicker in places. The texture of the B horizon is generally sandy clay, though heavy sandy clay loam to clay is within the range of the series as mapped. Pieces of rounded quartzose gravel occur in these soils where the source material has been eroded and redeposited. Normally, no gravel occurs in the undisturbed parent material.

Lakehurst series.—The Lakehurst series consists of moderately well drained and somewhat poorly drained Podzols developed in coarse-textured materials. These soils occur in depressed areas in intermediate positions where slopes are low. They are members of the same drainage sequence as the Lakewood, Leon, and St. Johns soils.

The Lakehurst soils can be distinguished from Lakewood soils by mottles in the lower B horizon and from the Lakeland soils by the strongly bleached horizon 6 or more inches thick. This horizon normally is not destroyed by plowing.

A profile in a wooded area of Lakehurst sand in Wharton State Park on Burnt Mill Road about three-fourths of a mile northwest of the New Jersey Central Railroad:

A1—0 to 3 inches, dark-gray (10YR 4/1) sand; many light-gray sand grains; single grain; loose; roots common; less than 2 percent rounded quartz gravel; abrupt, wavy boundary. The thickness ranges from 0 to 4 inches.

A2—3 to 11 inches, light-gray (10YR 6/1) clean sand; single grain; loose; roots few; less than 2 percent rounded quartz gravel; abrupt, irregular boundary. The thickness ranges from 6 to 24 inches.

B2—11 to 13 inches, brown (10YR 4/3) sand or loamy sand; loose or weakly cemented concretions in places; roots abundant; abrupt, irregular boundary. The thickness ranges from 0 to 6 inches.

B3—13 to 30 inches, yellowish-brown (10YR 5/6) sand; few, faint mottles in the lower part; single grain; loose; roots few; less than 2 percent rounded quartz gravel; gradual, smooth boundary. The thickness ranges from 10 to 24 inches.

C1—30 to 60 inches, pale-brown (10YR 6/3) sand; few, medium mottles; single grain; loose; roots very few; less than 2 percent rounded quartzose gravel.

The Lakehurst soils are mostly 10YR in hue, but hues of 7.5YR and 5YR are in the B horizons in places. The value is 4 or 5 in the A1 and 6 in the A2; it ranges from 3 to 5 in the B horizons and is 5 or 6 in the C horizon. The chroma is 1 in the A horizon and ranges from 2 to 6 in the B horizons and from 2 to 4 in the C horizon. In places variable amounts of quartzose gravel are mixed with the sand.

Lakeland series.—The Lakeland series consists of excessively drained Regosols developed in coarse-textured sandy soils. The soils mostly have slopes ranging from gentle to steep. The parent material is a thick deposit of sand, possibly of marine origin. However, wind is believed to have redeposited some of the material at higher elevations. These soils are in the same drainage sequence as the somewhat poorly drained Klej.

In unplowed areas, the A2 horizons of the Lakeland soils are not so strongly or deeply bleached as those of the Lakewood and Lakehurst soils. Unlike the Klej soils, they are not mottled and pale in the lower part.

A profile of a cropped area of Lakeland sand about 2 miles east of Elm:

Ap—0 to 10 inches, very dark grayish-brown (2.5Y 3/2) loamy sand or sand; very weak, fine, granular structure; very friable; 1 to 3 percent rounded quartzose gravel. The thickness ranges from 8 to 12 inches.

C1—10 to 30 inches, yellowish-brown (10YR 5/6) loamy sand; very weak, fine, granular structure or single grain; very friable; clear, smooth boundary. The thickness ranges from 10 to 30 inches.

C2—30 to 60 inches, light yellowish-brown (10YR 6/4) sand, mostly clean and angular; single grain; loose; 5 to 10 percent rounded quartzose gravel up to 1 inch in diameter.

Lakeland sand and fine sand types occur in this county.

The hue is 2.5Y at the surface and 10YR below. The value is 3 or 4 at the surface and 5 or 6 below. The chroma is 2 in the Ap horizon and 4 to 6 in the C horizon.

Rounded quartzose pebbles occur in various amounts in the profile but generally are not abundant. In wooded areas there is generally a micropodzol horizon 2 to 5 inches thick.

Lakewood series.—The Lakewood series consists of excessively drained soils developed in coarse-textured sand. They are classified as Podzols, but are considered by some as intergrading to Regosols. The parent material is a thick bed of sand that is believed to be of marine origin. The soils have slopes that range from nearly level to steep. They are the excessively drained member of the Lakewood, Lakehurst, Leon, St. Johns drainage sequence.

The Lakewood soils can be distinguished by the strongly bleached sand of the A2 horizon, which has a high value and low chroma (6/1), and the underlying light yellowish-brown mottled sand, which has a high value and high chroma (6/4). The Lakehurst soils have faint mottling in the lower B and C horizons. The Lakeland soils are not so strongly nor as deeply bleached as the Lakewood soils.

A profile of a Lakewood sand under forest cover 2 miles southwest of Winslow:

A1—0 to 3 inches, dark-gray (10YR 4/1) sand; single grain; loose; roots abundant; individual grains of sand are light gray; abrupt, smooth boundary. The thickness ranges from 1 to 4 inches.

A2—3 to 10 inches, light-gray (10YR 6/1) sand; single grain; loose; roots common; gradual or abrupt, irregular boundary. The thickness ranges from 6 to 13 inches.

B21—10 to 11 inches, discontinuous dark yellowish-brown (10YR 4/4) sand; single grain; loose; roots common; few spheroidal concretions ½ inch in diameter; abrupt, irregular boundary. The thickness ranges from 0 to 2 inches.

B3—11 to 30 inches, yellowish-brown (10YR 5/6) clean sand; single grain; loose; roots few; few spheroidal concretions confined to upper few inches; gradual, smooth boundary. The thickness ranges from 10 to 30 inches.

C—30 to 60 inches, light yellowish-brown (10YR 6/4) clean sand; single grain; loose; roots few.

Lakewood sand and fine sand types occur in this county. The A1 horizon is discontinuous in this area, especially where there have been repeated wildfires. In places the B21 horizon is also discontinuous and is represented only by a very thin, dark line around the main tree roots.

In this county the A2 horizon is mainly about 8 inches thick, though it is 15 or more inches thick in some small areas. Normally, the texture is sand in the A, B, and C horizons. Where the sand is fine, however, some small areas have a textural B horizon that is approximately a fine sandy loam.

Rounded pieces of quartzose gravel occur in varying amounts in these soils, especially in the lower positions where the soil material has been redeposited.

Leon series.—The Leon series consists of poorly drained Ground-Water Podzols developed from coarse-textured sandy material. The parent material is believed to be a thick bed of sand of marine origin. In many places it has apparently been redeposited. The soil occurs in relatively low positions in nearly level areas. Some areas make up a swamp border, but other areas make up isolated circular depression that apparently formed during the Pleistocene periglacial frost thaw (*13*).

The Leon soils are members of the Lakewood, Lakehurst, Leon, and St. Johns drainage sequence. The A horizon in the Leon soils is not so dark as that in the St. Johns soils. The Leon soils, however, are wetter than the Lakehurst and Klej soils and contain a distinct organic hardpan that is lacking in the other two soils (fig. 17).

A profile of a Leon sand in a cultivated blueberry field in eastern Waterford Township 1¼ miles southwest of the most eastern corner of the county:

Ap—0 to 10 inches, dark-gray (10YR 4/1) coarse sand; single grain; loose; roots common; less than 2 percent gravel; loose sand grains at surface are light gray. The thickness ranges from 7 to 12 inches.

A2—10 to 15 inches, gray (10YR 5/1) coarse sand; single grain; loose; roots common; less than 2 percent gravel; irregular boundary. The thickness ranges from 5 to 18 inches.

B2h—15 to 19 inches, very dark brown (10YR 2/2) loamy sand or sandy loam; massive; friable, in places firm; roots common; less than 2 percent gravel; wavy boundary. The thickness ranges from 3 to 8 inches.

B3—19 to 24 inches, dark-brown (10YR 3/3) loamy sand; weak, fine, granular structure; friable, in places slightly firm. The thickness ranges from 3 to 10 inches.

C—24 to 50 inches, gray (10YR 5/1) coarse sand becoming light brownish gray (10YR 6/2) at about 40 inches; single grain; loose; contains pieces of rounded quartzose gravel.

Sand is the only soil type mapped in this county.

The hue of Leon sand ranges from 10YR through 2.5Y to 5Y. The value ranges from 3 to 5 in the A1 and Ap horizons; it is 5 or 6 in the A2 horizon; 2 or 3 in the B, and 5 or 6 in the C. The chroma is generally 1, but in places it is 2 in the A1, Ap, A2, and Bh horizons; 1 to 3 in the lower B; and 1 or 2 in the C.

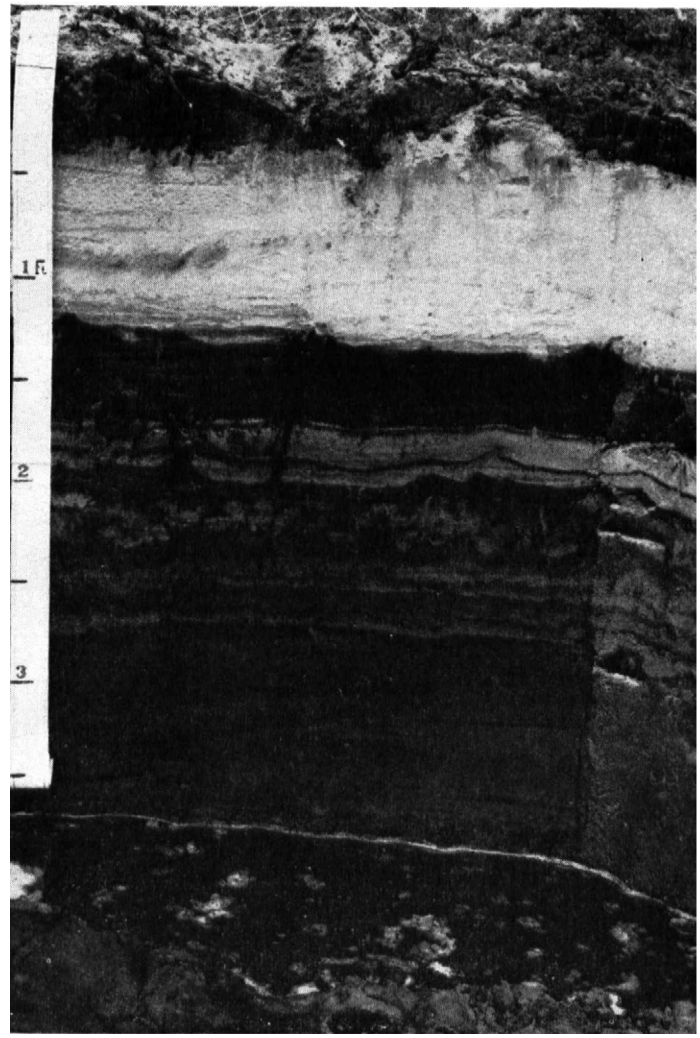

Figure 17.—**Profile of Leon sand showing a light-colored A2 horizon and dark-colored organic hardpan as the B horizon.**

The thickness of the A1 horizon ranges from 3 to 7 inches. If the soil is cultivated, this horizon is mixed with the A2 to a depth of 10 inches. In plowed areas, the remaining A2 horizon averages about 8 inches in thickness. In places Leon soils have several dark-brown B horizons. The consistence of the B horizon ranges from friable to very firm. Generally, it becomes more firm as it dries.

Rounded pieces of quartzose gravel occur in varying amounts, but they are not generally abundant except where this soil occurs as a stream terrace. In places the soil is underlain by discontinuous sandy clay or clay strata.

Marlton series.—The Marlton series consists of well drained and moderately well drained Gray-Brown Podzolic soils intergrading to the Red-Yellow Podzolic. These soils have a fine-textured subsoil that contains a large amount of glauconite and is strongly olive colored. The

Marlton soils were derived from marine deposits that contained a larger amount of glauconite (more than 50 percent). They have slopes ranging from gentle to steep. The drainage sequence consists of soils of the Marlton, Kresson, and Colemantown series.

The Marlton soils can be distinguished from Howell soils by the strong olive colors. The Ap horizon of these soils has a higher color value than the Ap horizon of the Kresson soils. If Marlton soils are mottled, the mottles occur in the lower B horizon. In contrast, the Kresson soils are mottled throughout the B horizon.

A typical cropped area of Marlton sandy loam one-fourth of a mile east of the intersection of Springdale Road and the Haddonfield-Kresson Road:

Ap—0 to 8 inches, olive-gray (5Y 4/2) heavy sandy loam; weak, fine, granular structure; friable; roots numerous; glauconite grains abundant; abrupt, smooth boundary. The thickness ranges from 4 to 12 inches.

B21—8 to 14 inches, olive (5Y 4/4) sandy clay; moderate, medium, blocky structure; very firm when moist, very plastic and sticky when wet; roots common; clay films on peds; glauconite abundant; clear, smooth boundary. The thickness ranges from 0 to 10 inches.

B22—14 to 30 inches, sandy clay that is greener than olive (5Y 4/4) and has many, fine and medium, prominent, dark reddish-brown (5YR 3/4) mottles in the lower half; strong, medium blocky structure with some columnar features; very firm when moist, very plastic and sticky when wet; roots common; clay films on peds; glauconite abundant; abrupt, smooth boundary. The thickness ranges from 12 to 30 inches.

C—30 to 60 inches, stratified, homogeneous layers of individual grains of olive (5Y 4/4) and olive-gray (5Y 5/2) sandy loam and sandy clay loam; many, medium, prominent, reddish-brown mottles; massive; mostly friable but some layers firm, sticky when wet; few roots; 0 to 5 percent rounded quartzose gravel; glauconite abundant.

Only the sandy loam type was mapped in this county.

The hue is generally 5Y in all horizons, but in places it is 2.5Y or 10YR in the Ap horizon. The value ranges from 3 to 4, and the chroma from 2 in the Ap horizon to 3 or 4 in the B and C horizons.

The thickness of the A horizon ranges from 6 to 12 inches, depending primarily on past erosion. The thickness of the B horizon averages 24 inches but in spots is as much as 36 inches. The texture of the subsoil ranges from clay and sandy clay to sandy clay loam. The texture of the substratum ranges from sandy loam to sandy clay loam.

Rounded pieces of quartzose gravel occur in varying amounts, especially in the lower positions where redeposition has been more extreme. Micropodzol horizons 2 or 3 inches thick occur in places in wooded areas.

The Marlton soils range from well drained to moderately well drained. These soils are not extensive and it would be difficult to map the two drainage classes separately.

Matawan series.—The Matawan series consists of well drained and moderately well drained to well drained soils having a sandy A horizon over a fine-textured B horizon. In places the B horizon is underlain by sandy strata. These soils are classified as Gray-Brown Podzolic soils intergrading to the Red-Yellow Podzolic. Slopes are mostly nearly level to gentle.

The soils have sandier A horizons than the Howell soils, and more clayey B horizons than the Woodstown soils.

A typical profile of Matawan loamy sand in a cultivated area one-half of a mile southwest of Waterford:

Ap—0 to 10 inches, dark grayish-brown (2.5Y 4/2) loamy sand; weak, fine, granular structure; very friable; roots abundant; 2 to 5 percent rounded quartzose gravel; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

A2—10 to 16 inches, light yellowish-brown (10YR 6/4) loamy sand; weak, fine, granular structure; very friable; roots common; 2 to 5 percent rounded quartzose gravel; clear, smooth boundary. The thickness ranges from 3 to 8 inches.

B1—16 to 20 inches, yellowish-brown (10YR 5/6) sandy loam; weak, medium, subangular blocky structure; friable; common roots; 0 to 2 percent rounded quartzose gravel; abrupt, smooth boundary. The thickness ranges from 0 to 8 inches.

IIB2—20 to 42 inches, pale-brown (10YR 6/3) sandy clay; moderate, medium and fine, blocky structure; firm when moist, sticky and plastic when wet, hard when dry; thin clay films on peds; abrupt, smooth boundary. The thickness ranges from 18 to 36 inches.

IIIC—42 to 60 inches, yellowish-brown (10YR 5/4) coarse sand; color ranges from yellowish red (5YR 5/8) to pale brown (10YR 6/3); single grain; loose, stratified with layers ranging in texture from sandy loam to sandy clay.

Loamy sand and sandy loam are the two types of Matawan soils in the county.

The hue of the soils is 10YR. The value ranges from 3 to 6 in the A horizon and from 5 to 7 in the B and C horizons. The base chroma ranges from 2 to 4 in the A horizon, 3 to 6 in the B, and 3 to 8 in the C. In the higher positions, the soils are not mottled. In low positions, mottles range from few, faint, and fine to common, medium, and prominent; the more prominent mottling is in the lower B horizon.

The normal thickness of the A horizon ranges from 14 to 18 inches, but eroded areas have a thinner A horizon. The B horizon normally extends to 32 inches, but thicker and thinner horizons occur in places. The texture of the subsoil ranges from heavy sandy clay loam, through sandy clay, to clay. The substratum is composed of stratified layers that range from sand to clay in texture. In places rounded pieces of quartzose gravel occur in some layers, though they are not abundant. The gravel and even the cobbles commonly occur in the A horizon or upper B horizon as remnants of eroded deposits. Micropodzol horizons 2 to 5 inches thick occur in wooded areas, especially those with loamy sand texture.

Nixonton series.—The Nixonton series consists of moderately well drained soils having a medium-textured B horizon. They are classified as Gray-Brown Podzolic soils integrading to Regosols. In this county the parent material consists of a thick bed that is mainly very fine sand, fine sand, and silt. This material is believed to be marine deposits. The particle size is uniform in the A and B horizons of these soils but becomes slightly coarser in the C horizon.

The soils are nearly level and occur in an intermediate position that is just downslope from the Westphalia soils. They are in the Westphalia, Nixonton, Barclay, Pasquotank, and Weeksville drainage sequence.

The Nixonton soils can be distinguished by the dominant uniformly fine sand component and by the mottles that are only in the lower subsoil. They are more uniform in texture than the Woodstown soils and lack the glauconite and the olive colors common in the Holmdel soils.

A typical profile of Nixonton loamy fine sand in a cropped area on the Camden County Institutional Farm at Lakeland:

Ap—0 to 10 inches, dark grayish-brown (2.5Y 4/2) loamy fine sand; weak, fine, granular structure; very friable; about 3 percent rounded quartz pebbles; few, small, dark reddish-brown concretions; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

A2—10 to 18 inches, light yellowish-brown (2.5Y 6/4) loamy fine sand mixed with dark grayish-brown (2.5Y 4/2) material from above; single grain; loose; mica common; 3 to 5 percent rounded quartz pebbles up to 1½ inches in diameter; abrupt, smooth boundary. The thickness ranges from 4 to 8 inches.

B1—18 to 24 inches, pale-brown (10YR 6/3) very fine sandy loam; very weak, medium, subangular blocky structure; friable when moist, nonsticky when wet; few quartz pebbles; mica common; gradual, smooth boundary. The thickness ranges from 0 to 10 inches.

B2—24 to 34 inches, yellowish-brown (10YR 5/4) very fine sandy loam with few to many, medium, faint to prominent mottles; very weak, subangular blocky structure; very friable; micaceous; few pebbles; abrupt, smooth boundary. The thickness ranges from 8 to 24 inches.

C—34 to 60 inches, yellowish-brown (10YR 5/8) fine sand; single grain; loose; stratified with thin layers of gravelly fine sand.

In this county Nixonton fine sandy loam and loamy fine sand were mapped.

The hues of the Nixonton soils are 10YR, 2.5Y, and 5Y. The value ranges from 3 or 4 in the Ap horizon to 5 or 6 in the A2, B, and C. The 2.5Y and 5Y hues are in the A horizon; the 10YR hue is in the B and C horizons. The chroma ranges from 2 to 4 in the A horizon, 3 to 6 in the B, and 2 to 8 in the C.

Normally, the B horizon extends to 40 inches, but it reaches to about 10 inches in places. The substratum is most commonly loamy fine sand, but in places it includes stratified layers ranging from loamy sand to clay loam. Areas of fine sand that have been redeposited through erosion are generally mixed with coarser sand and gravel.

Normally, micropodzol horizons 2 to 4 inches thick occur in wooded areas of Nixonton soils.

Pasquotank series.—In the Pasquotank series are poorly drained Low-Humic Gley soils having a moderately coarse textured subsoil. In this county the parent material is made up of a thick bed consisting mainly of very fine sand, fine sand, and silt that is believed to be a marine deposit. The particle size is uniform in the A and B horizons of these soils and only slightly coarser in the C horizon. The parent material is nearly level and occurs in low positions. These soils are in the Westphalia, Nixonton, Barclay, Pasquotank, and Weeksville drainage sequence.

The Pasquotank soils can be identified by the uniform texture and the dark-gray A horizon over the gleyed B horizon (chroma 1 and 2). The sand is uniformly finer than in the Fallsington soils and lacks the olive colors common in the Shrewsbury soils.

A typical Pasquotank fine sandy loam in a cropped area on the Camden County Institutional Farm at Lakeland:

Ap—0 to 10 inches, dark-gray (10YR 4/1) fine sandy loam; weak, fine, granular structure; very friable; roots abundant; less than 1 percent rounded quartzose pebbles; abrupt, smooth boundary. The thickness ranges from 9 to 11 inches.

A2—10 to 15 inches, light brownish-gray (10YR 6/2) light fine sandy loam; single grain; loose; few roots; mica common; abrupt, smooth boundary. The thickness ranges from 3 to 8 inches.

B2g—15 to 30 inches, light brownish-gray (10YR 6/2) very fine sandy loam; fine and medium, distinct yellowish-brown (10YR 6/3) mottles that are few in upper part but become common to abundant in the lower part; weak, subangular blocky structure; friable; few roots; gradual, smooth boundary. The thickness ranges from 10 to 20 inches.

C—30 to 60 inches, stratified, yellowish-brown (10YR 5/4) fine sand and fine sandy loam; few to common, medium, distinct mottles of light gray (10YR 6/1); structureless; very friable.

Fine sandy loam is the only type in this county.

The hue of Pasquotank soils is 10YR. The value ranges from 3 to 4 in the Ap horizon to 5 or 6 in the A2, B, and C horizons. The chroma is 1 or 2 in the A horizon and generally 2 to 4 in the B and C horizons. In rare instances, the chroma is as high as 8 in the lower part of the C horizon.

The substratum is normally fine sandy loam, but because it is stratified it contains layers of loamy fine sand or loam in places. Where the fine sand has been redeposited, it is stratified with layers of gravel and coarse sand.

Pocomoke series.—The Pocomoke series consists of Humic Gley soils with moderately coarse to moderately fine textured B horizons over a stratified sandy and gravelly substratum. The parent material consists of water-laid sandy deposits. These soils are nearly level and occur in relatively low positions. They are in the Downer, Woodstown, Dragston, Fallsington, and Pocomoke drainage sequence. They can be distinguished from the Weeksville soils by their coarser texture, and from Shrewsbury soils by their lack of olive color.

A typical profile of Pocomoke sandy loam 1½ miles east of Winslow:

Ap—0 to 10 inches, very dark-gray (10YR 3/1) sandy loam; moderate, fine, granular structure; friable when moist, slightly plastic when wet; roots numerous; less than 2 percent rounded quartz pebbles; abrupt, smooth boundary. The thickness ranges from 6 to 14 inches.

A2—10 to 14 inches, dark-gray (10YR 4/1) sandy loam with few, medium, distinct mottles of light gray (10YR 6/1); moderate, fine, granular structure; friable when moist, slightly sticky when wet; roots common; less than 2 percent rounded quartz pebbles; gradual, smooth boundary. The thickness ranges from 0 to 6 inches.

B2g—14 to 24 inches, gray (10YR 6/1) heavy sandy loam or sandy clay loam with many, medium, distinct, dark-gray (10YR 4/1) mottles; moderate, medium, subangular blocky structure; firm; discontinuous clay films on peds; roots common; less than 2 percent rounded quartz pebbles; abrupt, smooth boundary. The thickness ranges from 10 to 30 inches.

Cg—24 to 60 inches, gray (10YR 6/1) loamy sand with many, medium, distinct mottles; structureless, massive; loose; roots few; 2 to 10 percent rounded quartz pebbles; stratified with light yellowish-brown (10YR 6/4) sandy loam that is structureless, massive, and friable.

Sandy loam is the only soil type of the Pocomoke series in this county.

The hue is generally 10YR. The value is 2 or 3 in the Ap horizon, 3 or 4 in the A12, and 5 or 6 in the B and C. The chroma is 1 in the A and B horizons, and 1 to 4 in the C horizon. In unplowed areas the A horizon is black or very dark gray for at least 6 inches. In plowed areas the color is mostly very dark gray to the depth plowed, generally 9 or 10 inches in this area. The B horizon generally extends to 24 inches, though in places it is thicker. Where the B horizon is thin, it contains only a little more clay than the A horizon. Because the C horizon is stratified, textures finer than sandy loam occur in places.

St. Johns series.—The St. Johns series consists of very poorly drained Ground-Water Podzols that developed in coarse-textured materials. These soils are nearly level and occur in low positions. They are in the Lakewood, Lakehurst, Leon, and St. Johns drainage sequence.

The St. Johns soils can be distinguished from the Leon soils by the darker A horizon and by a thicker organic hardpan that is closer to the surface than the one in the Leon soils.

A typical profile of a St. Johns sand 1¼ miles southwest of the southeastern corner of the county:

A1—0 to 8 inches, black (10YR 2/1) sand; single grain; loose; roots common; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

A2—8 to 11 inches, gray (10YR 5/1), clean sand; single grain; loose; roots common; abrupt, smooth boundary. The thickness ranges from 0 to 8 inches.

B2h—11 to 15 inches, very dark brown (10YR 2/2) loamy sand, paler in the lower 2 inches; massive; firm; weakly to strongly cemented; roots common; abrupt, smooth boundary. The thickness ranges from 0 to 8 inches.

B3—15 to 30 inches, pale-brown (10YR 6/3) sand with several thin, darker colored bands; single grain; loose; 3 to 5 percent rounded quartzose gravel; gradual, wavy boundary. The thickness ranges from 6 to 18 inches.

Cg—30 to 60 inches, alternating layers of stratified coarse sand and gravelly sand ranging in color from very dark brown (10YR 2/1) to gray (10YR 5/1); massive or single grain; mostly loose but some dark layers are slightly firm.

Sand is the only type in this county.

The hue is 10YR. The value is 2 or 3 in the A1 horizon, 5 in the A2, 2 in the Bh, and 2 to 6 in the C. The chroma is 1 in the A1, A2, and B horizons, and 1 to 3 in the C horizon. The thickness of the A1 horizon is 8 or more inches; generally where the A1 is much thicker than 8 inches, there is no A2 horizon. The B2h horizon, commonly known as the hardpan, varies in thickness and firmness from place to place. In some places it is irregular in depth, and in other places there are several Bh horizons separated by loose sand.

Shrewsbury series.—The Shrewsbury series consists of poorly drained Low-Humic Gley soils that have moderately coarse textured to moderately fine textured or medium textured B horizons containing glauconite. The C horizon is moderately coarse textured or coarse textured. Sandy glauconitic marine deposits were the parent material of these soils. The soils have nearly level slopes and occur in relatively low positions.

The Shrewsbury soils form a drainage sequence with the well drained Freehold and Collington soils, and the moderately well drained and somewhat poorly drained Holmdel soils. The Shrewsbury soils can be distinguished by their gray or dark-gray A1 and Ap horizons over a sandy, olive-gray subsoil. Normally, mottling is distinct or prominent throughout the profile. The Fallsington soils lack the olive colors of the Shrewsbury, and the Pasquotank soils have weakly developed B horizons of uniformly fine textures. The Shrewsbury soils are not so fine textured as the Colemantown soils, nor do they contain so much glauconite.

A typical profile of Shrewsbury fine sandy loam east of Marlkress Road and north of North Branch of Cooper River:

Ap—0 to 10 inches, dark-gray (10YR 4/1) fine sandy loam with many, fine, distinct, yellowish-brown mottles; weak, fine, granular structure; very friable; roots numerous; glauconite content low; abrupt, smooth boundary. The thickness ranges from 8 to 10 inches.

A2—10 to 16 inches, olive-gray (5Y 5/2) fine sandy loam with common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, granular structure; very friable; roots common; micaceous; glauconite content low; abrupt, smooth boundary. The thickness ranges from 0 to 8 inches.

B2g—16 to 32 inches, olive-gray (5Y 5/2) heavy sandy loam or sandy clay loam with common, fine, prominent, yellowish-brown (10YR 5/8) mottles that decrease in number with depth; moderate, medium, subangular blocky structure; friable when moist, plastic when wet; roots common; sand grains coated with clay; glauconite content low; gradual, smooth boundary. The thickness ranges from 10 to 30 inches.

Cg—32 to 60 inches, stratified layers of olive-gray (5Y 5/2) fine sandy loam with common, medium, prominent mottles of yellowish brown; single grain; loose; glauconite content moderate; 1 to 3 percent rounded quartzose gravel.

The fine sandy loam type was mapped in the farmlands, but the surface texture was not differentiated in the urban areas.

The hue of the moist soil ranges from 10YR to 5Y in the A1, Ap, and A2 horizons through 5Y or 5G in the B and C horizons. The value ranges from 3 to 5 in the Ap horizon, is 5 or 6 in the A2, and is 4 or 5 in the B and C. The chroma is generally 1 or 2. In places, however, between the two horizons with a low chroma, there is a 4- to 10-inch layer with a high chroma ranging from 4 to 8. In places this layer is not mottled, because this layer occurs locally and only in association with glauconitic soils. The high chroma is believed to be caused by iron that comes from the glauconite. Partial clogging of tile lines by iron has been observed in such poorly drained glauconitic soils as the Shrewsbury. In places iron-cemented sandstone forms close enough to the surface of these soils to interfere with plowing. According to some reports, corrosion is more severe in wet glauconitic soils than in wet soils that lack glauconite.

The texture of the B horizon is sandy loam in most places but is fine sandy clay loam or loam in some. Rounded pieces of quartzose gravel occur in mixture with the glauconitic sand in places, especially where the original sediments have been redeposited through erosion.

Normally, the B horizon is about 15 inches thick, but in places it is deeper or shallower. Where the original sediments have been redeposited through erosion, rounded pieces of quartzose gravel occur with the glauconitic sand. These deposits are low in glauconite and less olive in color.

Weeksville series.—The Weeksville series consists of Humic Gley soils having moderately coarse textured, weakly developed B horizons. The parent material is a thick bed of fine sand believed to be a marine deposit. The Weeksville soils are nearly level and occur in relatively low positions. The drainage sequence includes the Westphalia, Nixonton, Barclay, Pasquotank, and Weeksville soils.

The Weeksville soils can be distinguished from the other Humic Gley soils by the weakly developed B horizon of very fine sandy loam.

A typical profile of Weeksville fine sandy loam three-fourths of a mile north of Grenloch Lake:

Ap—0 to 12 inches, black (10YR 2/1) fine sandy loam; weak, fine, granular structure; very friable; abundant roots; 0 to 2 percent rounded quartzose gravel; abrupt, smooth boundary. The thickness ranges from 8 to 16 inches.

B2g—12 to 32 inches, gray (10YR 5/1) very fine sandy loam with many, fine, prominent mottles; very weak, subangular blocky structure; very friable; common roots; mica common; 0 to 2 percent rounded quartzose gravel; gradual, smooth boundary. The thickness ranges from 10 to 30 inches.

Cg—32 to 60 inches, light-gray (10YR 6/1) stratified fine sandy loam and loamy fine sand; structureless, massive; very friable to loose; very few roots; mica common.

Fine sandy loam is the only type mapped in Camden County.

The hue is 2.5Y and 10YR. The value ranges from 2 or 3 in the A1 or Ap, 5 in the B, and 4 to 6 in the C. The chroma of base colors generally are 0 or 1 throughout, though in places they are as high as 6 or 8 in the lower B or C horizon. Where the soil is oxidized, the chroma is 8.

The normal thickness of the A horizon is about 10 inches—somewhat thicker than in the other Humic Gley soils. The B horizon normally extends to about 30 inches but is more shallow in places. Rounded pieces of quartzose gravel occur in the soil in places, particularly in areas where the fine sandy material has been redeposited.

Westphalia series.—The Westphalia series consists of well-drained soils having moderately coarse textured, weakly developed B horizons. They are classified as Gray-Brown Podzolic soils intergrading to Red-Yellow Podzolic soils. In this area the parent material is a thick bed of slightly micaceous mostly fine and very fine sand. The particle size is quite uniform in the A and B horizons and only slightly coarser in the C horizon. The soils have mainly gentle slopes but also have rolling and steep slopes.

Associated with the Westphalia soils are less well-drained soils that have a high content of fine and very fine sand. The associated soils are the Nixonton, Barclay, Pasquotank, and Weeksville.

The Westphalia soils are distinguished from the Downer soils by the uniform fine sand throughout the profile. They are distinguished from the Freehold and Collington soils by the lack of glauconite and the olive colors in the lower horizons.

A typical profile of Westphalia loamy fine sand in a cultivated area 2½ miles east of Blackwood:

Ap—0 to 10 inches, very dark grayish-brown (2.5Y 3/2) loamy fine sand; weak, fine, granular structure; very friable; numerous roots; few earthworms; 3 to 5 percent rounded quartzose gravel; some glauconite; abrupt, smooth boundary. The thickness ranges from 7 to 11 inches.

A2—10 to 18 inches, pale-brown (10YR 6/3) loamy fine sand; weak, medium, granular structure; very friable; common roots; mica common; less than 1 to 3 percent rounded quartzose gravel up to 2 inches in diameter; contains irregular bands ⅛ inch thick and several spheroidal balls of material colored like the B horizon; abrupt, smooth boundary. The thickness ranges from 5 to 10 inches.

B1—18 to 22 inches, yellowish-brown (10YR 5/4), mixed with pale-brown (10YR 6/3), very fine sandy loam; weak, medium, granular structure; very friable; numerous roots; mica common; 3 to 8 percent quartzose gravel; clear, wavy boundary. The thickness ranges from 3 to 5 inches.

B2—22 to 28 inches, yellowish-brown (10YR 5/6) very fine sandy loam; weak, medium, subangular blocky structure; friable; numerous roots; mica common; 0 to 3 percent quartzose gravel; few cobbles; clear, wavy boundary. The thickness ranges from 3 to 10 inches.

B3—28 to 33 inches, yellowish-brown (10YR 5/6) very fine sandy loam; weak, fine, granular structure; very friable; numerous roots; mica common; abrupt, wavy boundary. The thickness ranges from 3 to 8 inches.

C—33 to 80 inches, pale-brown (10YR 6/3) banded loamy fine sand stratified with one or more discontinuous layers of yellowish-brown (10YR 5/4) fine sandy loam 0 to 3 inches thick; single grain; loose; common roots; mica common; 0 to 5 percent rounded quartzose gravel concentrated in a few pockets.

Fine sandy loam and loamy fine sand types were mapped in Camden County. In addition, several units of undifferentiated textures were mapped in urban and eroded areas.

The hue is 10YR or 2.5Y. The value is 3 or 4 in the Ap horizon and 5 or 6 in all other horizons. The chroma is 1 or 2 in the A1, 2 or 3 in the Ap, 3 to 6 in the A2 horizon, 4 to 8 in the B but mostly 8, and 2 to 8 in the C. A low chroma in the C horizon is an indication of seasonal wetness.

The B horizon generally extends to 32 inches, but to 42 inches in places. In areas where the soil material has apparently been transported by wind, the B horizon is thinner and possibly coarser in texture. In areas where the material has been redeposited through erosion, thin layers of coarser textured sand and gravel are mixed with the fine sand.

In places in wooded areas there are micropodzol horizons up to 5 inches thick, especially in areas of the loamy fine sand type.

Woodstown series.—The Woodstown series consists of moderately well drained Gray-Brown Podzolic soils intergrading to Red-Yellow Podzolic soils. They have moderately coarse to moderately fine textured B horizons. The parent material of these soils consists of sandy water-laid deposits. The soils have nearly level or gentle slopes and occur in intermediate positions just below the Downer soils. They are in the Downer, Woodstown, Dragston, Fallsington, and Pocomoke drainage sequence.

The Woodstown soils are mottled in the lower B horizon. They can be distinguished from the Nixonton soils by their lack of uniform fine sands, and from the Holmdel soils by the absence of glauconite and lack of olive colors (5Y) in the C horizon.

A typical profile of Woodstown sandy loam in a cropped area three-fourths of a mile northeast of Sicklertown:

Ap—0 to 9 inches, very dark grayish-brown (2.5Y 3/2) sandy loam; weak, fine, granular structure; very friable; roots numerous; less than 1 percent rounded quartz pebbles; abrupt, smooth boundary. The thickness ranges from 8 to 12 inches.

A2—9 to 14 inches, pale-brown (10YR 6/3) sandy loam; weak, fine, granular structure; very friable; in places slightly firm in upper few inches; roots common; less than 1 percent rounded quartzose gravel; abrupt, smooth boundary. The thickness ranges from 3 to 7 inches.

B1—14 to 23 inches, light olive-brown (2.5Y 5/4) sandy loam with few, medium, distinct mottles of yellowish brown (10YR 5/4); weak, medium, subangular blocky structure; friable or slightly firm; roots common; gradual, smooth boundary. The thickness ranges from 4 to 12 inches.

B2—23 to 32 inches, light olive-brown (2.5Y 5/4) sandy loam that is slightly more clayey than layer above; many, medium, prominent mottles of gray (2.5Y 6/0) and dark yellowish brown (10YR 5/8); moderate, medium, subangular blocky structure; slightly firm, friable when removed; roots few; thin, discontinuous silt or clay films on some peds; abrupt, smooth boundary. The thickness ranges from 12 to 28 inches.

C—32 to 40 inches, yellowish-brown (10YR 5/6) sand; single grain; loose; 2 to 5 percent rounded quartz gravel.

Both sandy loam and loamy sand types were mapped. Also mapped were three undifferentiated units.

The hue is 2.5Y or 10YR. The value is 3 or 4 in the Ap horizon and 5 or 6 below that horizon. The chroma is 2 in the Ap horizon, 3 in the A2, 4 in the B, and 2 to 6 in the C.

The solum is normally about 30 inches thick but is deeper and shallower in places.

The texture of the B horizon ranges from sandy loam to light sandy clay loam. Rounded pieces of quartzose gravel occur in varying amounts but are not abundant in most places. In some wooded areas, the soils have micropodzol horizons that have a total thickness of about 5 inches.

General Information About the County

This section contains information about the climate, water supply, and history of Camden County.

Climate[6]

The climate of Camden County is humid and temperate. The coastal influence on the climate is considerable. Temperature and precipitation data are given in table 12. The data are mainly from the U.S. Weather Bureau Station at Audubon.

Summer temperatures rarely exceed 100° F. but are above 90° long enough to interfere with the setting of tomatoes. Winter temperatures are generally not below 10° for long periods but are low enough that agricultural drainage tile must be placed below a depth of 30 inches for protection against freezing.

On the average, annual rainfall is about 44 inches, and the monthly averages show that rainfall is well distributed over the year. Nearly every year, however, there are periods when rainfall is not enough for high-value crops. Consequently, the acreage irrigated has increased considerably in recent years. Rainfall is heaviest in

[6] Data supplied by DONALD V. DUNLAP, State climatologist.

TABLE 12.—*Temperature and precipitation data*

[All data from the Audubon Weather Bureau Station, Camden County, N.J., except days with snow cover, which are from the Philadelphia Weather Bureau Station]

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
			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
January	39	24	53	10	2.9	1.6	4.8	2
February	44	27	60	12	3.0	1.5	4.9	1
March	50	32	67	21	4.5	3.4	5.9	1
April	65	43	84	32	3.6	2.2	5.1	([1])
May	74	52	87	42	3.8	1.5	5.1	0
June	83	61	94	51	3.6	1.8	5.8	0
July	88	66	97	57	4.2	.5	6.2	0
August	85	65	95	55	4.1	2.1	7.8	0
September	80	59	92	45	3.3	1.1	4.2	0
October	69	47	84	36	3.4	2.2	5.2	([1])
November	56	37	70	26	3.7	1.9	5.5	([1])
December	44	27	59	15	3.4	1.4	5.2	1
Year	65	45	[2] 99	[3] 8	43.5	35.8	50.0	5

[1] Less than 1 inch.
[2] Average annual highest temperature for any month of the year.
[3] Average annual lowest temperature for any month of the year.

March, July, and August. As most fields are plowed by March, they are highly susceptible to erosion. Most of the rainfall in July and August comes as thunderstorms—about 30 occur annually in the county. Rainfall is occasionally intense. It may reach a maximum of 3.5 inches in 1 hour, 6 inches in a 24-hour period, and 10 to 15 inches in a month. Low, poorly drained fields must be drained artificially to prevent the intense rainfall from damaging crops. Erosion control practices are needed on high, sloping fields to keep the soils productive.

The length of the growing season in the county is about 180 days, though the growing season for vegetables has been extended considerably by the use of frost-tolerant varieties. The average date of the last killing frost in spring is April 30, and that of the first in fall is October 13. Probabilities for the last damaging cold temperature in spring and first in fall are listed in table 13.

As a rule, temperature in winter is not low enough to keep the ground frozen throughout the winter. Rainfall during the winter frequently warms the soils enough to thaw them. Heavy rainfall on partially thawed soils, however, is very erosive.

Winds affect crop production in the county. The prevailing wind during each month and data on monthly wind velocity are given in table 14.

The critical period for wind erosion is from November to April. On the average, duration and velocity of the wind are greatest in March. Most of the wind blows from the northwest. By March, cover crops have been plowed down in fields that are to be used for early crops. Sand blown by high winds cuts young, unprotected plants, such as lettuce and corn. High winds also remove organic matter, which is a valuable constituent in very sandy soils.

Hail does not occur frequently, but it can be destructive to high-value crops. Fog occurs on 10 to 20 days a year. The weather each year is almost evenly divided; that is about 120 days are clear, about 120 are cloudy, and about 120 have rain or snow. At noon the relative humidity on the average is 65 to 70 percent in January and 55 to 60 percent in July. The high humidity and cloudy days are conducive to the growth and spread of plant disease organisms.

TABLE 14.—*Prevailing wind direction and average number of hours per month that wind blows at stated velocities*

[All data from U.S. Weather Bureau Station at Philadelphia, Pa.]

Month	Prevaling wind direction	Winds of 15 miles or more per hour	Winds of 25 miles or more per hour
		Number of hours	*Number of hours*
January	Northwest	184	12
February	Northwest	190	19
March	Northwest	263	32
April	Northwest	210	9
May	South	126	4
June	South	102	3
July	South	70	1
August	South	57	1
September	North	75	2
October	North	101	5
November	Northwest	145	11
December	Northwest	163	14

Water Supply

Only a very small part of the total water supply needed by the people and industries of Camden County comes directly from surface water. By far the larger part of the water comes from underground water-bearing strata, which is reached by seepage through the soil. Sandy soils may permit water to seep through them as fast as several inches per hour. Clayey soils, by contrast, may be nearly impervious to water.

The area occupied by each kind of soil is as important as its rate of water intake. Both factors determine how much water reaches the water-bearing layers and how much the layers will yield. Both are being modified by encroaching urban development. Good recharge areas are being roofed over, paved, or compacted by bulldozers. As this continues, the yields of ground water are reduced just when they are most needed. Planning should take into account the preservation, management, and replacement of recharge areas. In the following paragraphs, a summary of the water-intake conditions in each soil association shown on the general soil map is given.

TABLE 13.—*Probabilities of last freezing temperature in spring and first in fall, Camden County, N.J.*

[All data from the Philadelphia-Shawmont Weather Bureau Station]

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 14	March 25	April 5	April 18	April 30
2 years in 10 later than	March 7	March 18	March 29	April 13	April 27
5 years in 10 later than	February 24	March 9	March 17	March 31	April 18
Fall:					
1 year in 10 earlier than	November 14	November 10	November 6	October 25	October 13
2 years in 10 earlier than	December 2	November 22	November 12	October 30	October 17
5 years in 10 earlier than	December 11	December 6	November 22	November 9	October 27

In the western part of the county, the sandy soils of the Downer-Woodstown-Dragston association form a strip 1 to 2 miles wide bordering the Delaware River. The underlying Raritan sand is the most productive aquifer, or water-bearing formation, in the county. These soils are rapidly permeable to moderately permeable, but urbanization and industrialization are well advanced in this area. As much as 20 to 30 percent of the area is covered by roofs, streets, or parking lots. Thus, the area of possible recharge has been reduced by the same percentage. As a result of heavy pumping, more water of poor quality is being drawn into the aquifer from the Delaware River and less pure water is filtering down into it through the soil. Yields of water can be maintained or improved by planning a suitable ratio between areas of roof and paving and areas of grass. Ponds that catch and store runoff water increase recharge. The re-use of water and the recharge of areas by pumping water back into the ground are other ways.

The finer textured, slowly permeable soils of the Howell-Urban land association form another narrow belt just east of the Downer-Woodstown-Dragston association. Little recharge water penetrates these soils or the Magothy, Merchantville, and Woodbury clays which underlie them. Nearly all of this association has been converted to urban use, and most of the water used comes from the deeper Raritan sand. Although ponds for irrigation can be built on these soils, only surface runoff can be collected in them. Recharge of dugout ponds by seepage from ground water is poor.

The moderately permeable soils of the Freehold-Holmdel-Collington association are next toward the east. They overlie outcrops of the lesser water-bearing Englishtown, Mount Laurel, and Wenonah sands. This association is rapidly being converted to housing and to commercial and industrial uses. An estimated 6 to 15 percent of this former recharge area is now roofed over or paved. The rest is threatened by contamination. Planning and zoning to preserve naturally wet areas may help save some recharge water. Surface water reservoirs can improve water yields. Digging ponds and tapping shallow ground water provide local sources of irrigation water. This water may also be used for recreation or for fire protection. Wells are drilled in this area to obtain water from the deep Raritan sands. The sands that outcrop in this area dip toward the east beneath clayey layers. Thus the loss of the recharge area in the Freehold-Holmdel-Collington association will affect the Marlton-Kresson soil association and areas farther east.

The slowly permeable soils of the Marlton-Kresson soil association are next toward the east. These soils overlie the Hornerstown and Navesink marl formations. The soils of this association and the underlying formations allow little percolation of water into the deeper sands.

In the Westphalia-Nixonton-Barclay soil association, rainwater percolates moderately well through the soils into the underlying Vincentown and Kirkwood formations. Ponds for irrigation dug below the water table are likely to refill a little slowly after pumping. In addition, pond banks are likely to slough rapidly and well screens to clog. Urban development is occurring along the arterial highways, and it is advisable to plan now to preserve the recharge areas, as areas farther east become urbanized.

The scattered areas of the Aura-Downer soil association are on the divides between the Delaware and Atlantic drainage areas. The soils are moderately permeable and permit some seepage into the underlying Cohansey sands. The soils of the Lakewood-Lakehurst-Lakeland soil association are rapidly permeable. Many large areas of wet soils of the Muck-Alluvial land soil association also extend far inland and provide for recharge of ground water into the Cohansey sands. The large eastern area of Downer-Woodstown-Dragston soil association consists of permeable soils that also allow recharge of water into the Cohansey aquifer. These three soil associations cover part of the great South Jersey underground water reservoir of which the Wharton Tract is part. As urban development is extended out into the pine woodlands, this reservoir and the soils through which it is recharged become increasingly important. Because this reservoir is not capped by an impervious layer as it dips toward the east, it is particularly susceptible to contamination from the surface. Plans are needed now to protect the reservoir from contamination and to develop it for future use.

The broad, wet strips in the Muck-Alluvial land soil association provide excellent sites for ponds. Thus, water is available for irrigation.

Generally, Camden County has a favorable supply of water, but the water must be protected and conserved. In planning methods for the protection and conservation of water, knowledge of the kind of soil through which rainwater must pass to reach the water-bearing layers is important.

History

Camden County originally was inhabited by the Lenni Lenape Indians, also called the Delawares. The first white settlement in New Jersey was made by the Dutch in 1623 at Fort Nassau, now Gloucester City, on the east bank of the Delaware River opposite Philadelphia. The fort was abandoned by the Dutch and later re-established on the same site by the English in 1677. In 1681 the first English settlement was made at old Newton, now West Collingswood. Prominent early family names of Cooper, Morgan, Haddon, Collins, Chew, and others were used in naming streams, communities, and streets.

In early times all transportation was by water, but as the forests were cleared to develop farmland, roads were built. Important stage routes crossed the county, and settlement and land clearing progressed along with the development of roads.

In 1844, Camden County was formed by separation from Gloucester County. The city of Camden grew rapidly after the railroads were built and port facilities were improved. A substantial market for vegetables was provided when a soup canning plant was established at Camden in 1865.

The acreage of crops increased with land clearing, until a peak was reached about 1920. The acreage in crops has been declining slowly since then, though more rapidly in the last decade.

Agriculture in the area has changed considerably several times. At first, it was mostly subsistence farming.

Later, flax and tobacco were produced for foreign export. Then followed an increase in the number of dairy and general farms. The source of income was from the sale of milk or of small grain and corn. Many small farms specialized in fruit and vegetables. As land values and taxes increased, however, there was a strong switch to fruit, vegetables, and nursery crops because of their higher value. The high cost of labor reduced the acreage of blackberries, raspberries, and grapes, but the acreage of blueberries increased. Tree fruit and vegetables now occupy about the same acreage as the field crops, corn, small grain, and hay, but they produce a considerably higher financial return.

Literature Cited

(1) American Association of State Highway Officials.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., illus.

(2) Groot, Johan J., and Glass, Herbert D.
1958. SOME ASPECTS OF THE MINERALOGY OF THE NORTHERN ATLANTIC COASTAL PLAIN. Seventh Natl. Conf. on Clays and Clay Min. Proc.: 271–284.

(3) Kummel, Henry B.
1940. THE GEOLOGY OF NEW JERSEY. N.J. Department of Conserv. and Devlpmt. Bul. 50, 203 pp., illus.

(4) ———
1931. GEOLOGIC MAP OF NEW JERSEY. New Jersey atlas sheet no. 40.

(5) McCormack, Robert K., Holman, William W., and Jumikis, Alfreds R.
1955. ENGINEERING SOIL SURVEY OF NEW JERSEY, REPORT NO. 17, CAMDEN COUNTY. Col. of Engin., Rutgers Univ., 64 pp., illus.

(6) Phillips, John J., and Markley, Marco L.
1963. SITE INDEX OF NEW JERSEY SWEETGUM STANDS RELATED TO SOIL AND WATER TABLE CHARACTERISTICS. Northeast Forest Expt. Sta. Research Paper NE–6, 25 pp., illus.

(7) Rogers, Franklyn C.
1955. ENGINEERING SOIL SURVEY REPORT NO. 1, SOIL ENVIRONMENT AND METHODS OF RESEARCH. Col. of Engin., Rutgers Univ., 144 pp., illus.

(8) Soil Survey Staff.
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handb. 18, 503 pp., illus. [Supplement issued in May 1962 replaces pages 173 to 188]

(9) U.S. Department of Agriculture.
1938. SOILS AND MEN. U.S. Dept. Agr. Ybk., 1232 pp., illus.

(10) U.S. Department of Health, Education, and Welfare.
1958. MANUAL OF SEPTIC-TANK PRACTICE. Pub. Health Serv. Pub. 526, 85 pp., illus.

(11) University of New Hampshire
1961. SOME MORPHOLOGICAL, PHYSICAL AND CHEMICAL PROPERTIES OF SELECTED NORTHEASTERN UNITED STATES SOILS. Univ. N.H. Agr. Expt. Sta. Misc. Pub. No. 1, 280 pp., illus.

(12) Waterways Experiment Station, Corps of Engineers.
1953. THE UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. 3–357, 3 v., illus.

(13) Wolfe, Peter E.
1956. PLEISTOCENE-PERIGLACIAL FROST-THAW PHENOMENA IN NEW JERSEY. N.Y. Acad. of Sci. Trans. 18: 507–517.

Glossary

Aggregate, soil. Many fine soil particles held in a single mass or cluster, such as a clod, crumb, granule, block, or prism.

Available moisture in soil. The part of the water in the soil that can be taken up by plants at rates significant to their growth.

Catena. A group of soils, within a specific soil zone, formed from similar parent material but with unlike soil characteristics because of differences in relief and drainage.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter (0.000079 inch) in diameter. As a soil textural class, soil material that contains 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Consistence, soil. The nature of the soil material that is expressed by the resistance of the individual particles to separation from one another (cohesion) or by the ability of a soil mass to undergo a change in shape without breaking (plasticity). The consistence varies with the moisture content. Thus, a soil aggregate or clod may be hard when dry and plastic when wet. Terms used to describe consistence are—

Hard. When dry, is moderately resistant to pressure; can be broken in the hands without difficulty but is barely breakable between thumb and forefinger.

Firm. When moist, crushes under moderate pressure, but resistance is distinctly noticeable. Firm soils are likely to be difficult to till.

Friable. When moist, easily crushed by hand and coheres when pressed together. Friable soils are easily tilled.

Loose. Noncoherent when moist or dry. Loose soils are generally coarse textured and are easily tilled.

Plastic. Wire formable; moderate pressure required for deformation of the soil mass; plastic soils are high in clay and are difficult to till.

Soft. Weakly coherent and fragile; when dry, breaks to powder or individual grains under slight pressure.

Sticky. When wet adheres to other material.

Glauconite. A dark-green mineral, essentially a potassium iron silicate, that occurs in greensand.

Gravel. Small rock fragments ranging in size from 2 millimeters (0.079 inch) to 80 millimeters (about 3 inches).

Great soil group. A broad group of soils having internal soil characteristics in common.

Greensand. A sedimentary deposit that contains various amounts of glauconite. The texture of the deposit ranges from sand to clay.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. The major soil horizons are:

Horizon A. The master horizon consisting of (1) one or more mineral horizons of maximum organic accumulation; or (2) surface or subsurface horizons that are lighter in color than the underlying horizon and that have lost clay minerals, iron, and aluminum with resultant concentration of the more resistant minerals; or (3) horizons belonging to both of these categories. If undisturbed, the upper layer is called the A1 horizon; if cultivated, it is called the Ap horizon.

Horizon B. The master horizon of altered material characterized by (1) an accumulation of clay, iron, or aluminum with accessory organic material; or (2) blocky or prismatic structure together with other characteristics, such as stronger colors, unlike those of the A horizons or the underlying horizons of nearly unchanged material; or (3) characteristics of both these categories. Commonly, the lower limit of the B horizon corresponds to the lower limit of the solum.

Horizon C. A mineral horizon or layer, excluding bedrock, that is either like or unlike the material from which the solum is presumed to have formed, relatively little affected by pedogenic processes, and lacking properties diagnostic of A or B but including materials modified by: (1) weathering outside the zone of major biological activity; (2) reversible cementation, development of brittleness, development of high bulk density, and other properties characteristic of fragipans; (3) gleying; (4) accumulation of calcium or magnesium carbonate or more soluble salts; (5) cementation by such accumulations as calcium or magnesium carbonate or more soluble salts; or (6) cementation by alkali-soluble siliceous material or by iron and silica.

Gleyed horizon. A horizon that shows prominent signs of gleying (the producing of gray and olive colors as the result of a long period of waterlogging and the presence of organic matter). In this report a gleyed horizon is indicated by the symbol "g" added to the horizon symbol; for example, "Bg."

Liquid limit. The moisture content at which a soil passes from a plastic to a liquid state.

Micropodzol horizons. Thin horizons, totaling several inches in thickness, of a Podzol soil over thicker, well-developed horizons. Micropodzol horizons normally consist of A1, A2, and B horizons, but, in places, any of these horizons may be missing.

Morphology, soil. The constitution of the soil, including the texture, structure, consistence, color, thickness, and other physical, chemical, and biological properties of the various soil horizons that make up the soil profile.

Mottled. Contrasting soil color patches that vary in number and size. Descriptive terms are as follows: Contrast—faint, distinct, and prominent; abundance—few, common, and many; size—fine, medium, and coarse.

Natural drainage. This refers to the relative rapidity and extent of natural removal of water from the soil profile as opposed to altered drainage, which is commonly the result of artificial drainage. Terms used to express natural drainage are excessively drained, somewhat excessively drained, well drained, moderately well drained, imperfectly or somewhat poorly drained, poorly drained, and very poorly drained.

Organic matter (content). Ratings used in this report have the following limits: Very low—less than 1 percent by volume; low—1 to 2 percent; moderate—2 to 4 percent; and high—more than 4 percent. (These ratings were developed for this report with a view that they could be useful generally for soils similar to those covered in the report.)

Parent material, soil. The unconsolidated mass of rock material (or peat) from which the soil is formed.

Ped. An individual natural soil aggregate produced by soil-forming processes.

Permeability. The property of a soil that enables it to transmit water or air. The permeability of a soil is governed by the least permeable horizon. Terms used to describe permeability and the estimated rates for each are as follows: Very rapid, more than 6.3 inches per hour; moderately rapid, 2.0 to 6.3 inches per hour; moderate, 0.63 to 2.0 inches per hour; moderately slow, 0.2 to 0.63 inch per hour; and very slow, less than 0.2 inch per hour.

Plasticity index. The numerical difference between liquid limit and plastic limit. (See also Liquid limit and Plastic limit.)

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.

Quartzose. A term applied to material that is composed mainly of quartz but also contains other minerals.

Reaction. The degree of acidity or alkalinity of a soil mass expressed either in pH values or in words as follows:

	pH		*pH*
Extremely acid	Below 4. 5	Mildly alkaline	7. 4–7. 8
Very strongly acid	4. 5–5. 0	Moderately alkaline	7. 9–8. 4
Strongly acid	5. 1–5. 5	Strongly alkaline	8. 5–9. 0
Medium acid	5. 6–6. 0	Very strongly alkaline	9.1 and higher
Slightly acid	6. 1–6. 5		
Neutral	6. 6–7. 3		

Runoff. Surface drainage of rain or melted snow.

Sand. Individual rock or mineral fragments having diameters ranging from 0.05 millimeter (0.002 inch) to 2.0 millimeters (0.079 inch). The larger grains feel gritty and can be seen with the naked eye. The textural class name of any soil having 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils that have genetic horizons similar, except for the texture of the surface soil, as to differentiating characteristics and arrangement in the soil profile, and developed from a particular type of parent material.

Silt. Individual mineral particles of soil that range in diameter between the upper size of clay, 0.002 millimeter (0.000079 inch), and the lower size of very fine sand, 0.05 millimeter (0.002 inch). Soil of the textural class called silt contains 80 percent or more of silt and less than 12 percent of clay.

Structure, soil. The arrangement of the primary soil particles into lumps, granules, or other aggregates. Structure is described by grade—weak, moderate or strong, that is, the distinctness and durability of the aggregates; by the size of the aggregates—very fine or very thin, fine or thin, medium, coarse or thick, or very coarse or very thick; and by their shape—platy, prismatic, columnar, blocky, subangular blocky, granular, or crumb. A soil is described as structureless if there are no observable aggregates. Structureless soils may be massive (coherent) or single grain (noncoherent).

Platy. Aggregates are arranged in thin sheets roughly paralleling the surface of the soil.

Blocky. Aggregates are shaped like blocks; they may have flat or rounded surfaces that join at sharp angles.

Blocky, subangular. Aggregates have some rounded and some flat surfaces; upper sides are rounded.

Granular. Aggregates are roughly spherical, firm, and small. They may be either hard or soft but are generally more firm and less porous than crumb and without the distinct faces of blocky structure.

Subsoil. Technically, the B horizon of soils with distinct profiles; roughly, that part of the profile below plow depth.

Substratum. Any layer below the surface layer and the subsoil; the C or R horizon or other layer.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soils, about 5 to 8 inches in thickness.

Terrace (geological). An old alluvial plain, usually flat or undulating, bordering a river, lake, or the sea.

Terracing. A conservation practice on sloping soils whereby a low embankment of earth is constructed on the contour with a designed grade to carry excess runoff water safely across the slope.

Texture, soil. The relative proportions of the various size groups of individual soil grains in a mass of soil; specifically, the proportions of sand, silt, and clay. Examples of soil textural classes, in increasing order of the content of the finer separates, are as follows: Sand, loamy sand, sandy loam, loam, silt loam, and clay. (See also Clay, Sand, and Silt).

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

Nondiscrimination Statement

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).