Series 1959, No. 8 Issued June 1962

SOIL SURVEY

Gloucester County New Jersey

OUR SOIL ★ OUR STRENGTH

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

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Gloucester County will serve several groups of readers. It will help farmers, for example, in selecting crops that are suitable for the soils, in planning for adequate drainage systems, and in conserving soil and water. It also provides information that can be used by foresters, engineers, county and town planners, suburban landowners and developers, scientists, and others interested in the soils and their use.

In making this survey, soil scientists walked over the fields and woods. They bored holes and examined the soil. They noted the color, texture, or "feel," of the soils, and the thickness of the different layers. In places they dug holes or scraped down the banks of gravel pits to learn the structure and other characteristics of the soil. The soil scientists measured the steepness of slopes and noted conditions caused by erosion. They recorded the characteristics of the soils and observed the effects that these would have on use and management. After careful study, they classified the soils into the national system of classification. The scientists plotted the boundaries of the soils on aerial photographs. Then, cartographers prepared from the photographs the detailed soil map in the back of this report. Fields, woods, roads, streams, churches, and many other landmarks can be seen on the map.

In areas where soil boundaries could be located reliably and where detailed information might be needed, the mapping was done in considerable detail. In large wooded areas where need for detail was less apparent and where accuracy of soil boundaries was difficult to determine, the mapping was more generalized. This was also true of urban areas where few soil observations could be made and where the soils had been altered greatly.

Since completion of the survey, a number of important changes have occurred. Highway construction has created borrow pits in former fields and woodlands, and river dredgings have been pumped on the soils along the Delaware River. Some former fields are now covered by houses.

Locating the soils

Turn to the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show in what part of the county each sheet of the large map is located. When the correct sheet of the large map is found, it will be seen that the boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. Suppose, for example, an area located on the map has the symbol ArB. The legend for the detailed map shows that this symbol identifies Aura sandy loam, 0 to 5 percent slopes. This soil and all others mapped in the county are described in the section "Descriptions of the Soils." The "Guide to Mapping Units and Capability Units" at the back of the report gives the map symbol for each soil, the name of the soil, and the capability unit in which it has been placed.

Finding information

The soil survey report has special sections for different groups of readers, as well as sections that may be of value to all.

Farmers and those who work with farmers can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Soils and Land Use." In this way they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. The soils are grouped by capability units; that is, groups of soils that need similar management and respond in about the same way. For instance, Aura sandy loam, 0 to 5 percent slopes, is shown to be in capability unit IIs-2. The management this soil needs will be stated under the heading "Capability Unit IIs-2" in the section "Soils and Land Use."

Foresters and others interested in woodlands can refer to the section "Use of the Soils for Woodland."

Engineers will want to refer to the section "Engineering Applications." Tables in this section show characteristics of the soils that affect engineering.

Suburban landowners, planners, and developers can refer to the section "Soils and Suburban Development."

Soil scientists will find information about how the soils were formed and how they are classified in the section "Formation and Classification of Soils."

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

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This soil survey is part of the technical assistance furnished by the Soil Conservation Service to the Gloucester County Soil Conservation District. Fieldwork on this survey was completed in 1958. Unless otherwise indicated, all statements refer to conditions at the time the survey was in progress.

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SOIL SURVEY OF GLOUCESTER COUNTY, NEW JERSEY

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

SOILS SURVEYED BY FRANK Z. HUTTON, JR., REESHON FEUER, MARCO MARKLEY, AND IRWIN SHERMAN, SOIL CONSERVATION SERVICE

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

GLOUCESTER COUNTY is in southern New Jersey. It lies along the Delaware River south of Camden (fig. 1) and comprises 210,560 acres, or 329 square miles. The county is on the Atlantic Coastal Plain. It extends across nearly all of the geologic formations of sand, clay, and marl that primarily constitute the Atlantic Coastal Plain in the State. In some areas the geologic formations are overlain by sand and gravel that were deposited at different times. These deposits and the underlying formations vary in characteristics, and, as a result, the soils that have developed over them vary considerably.

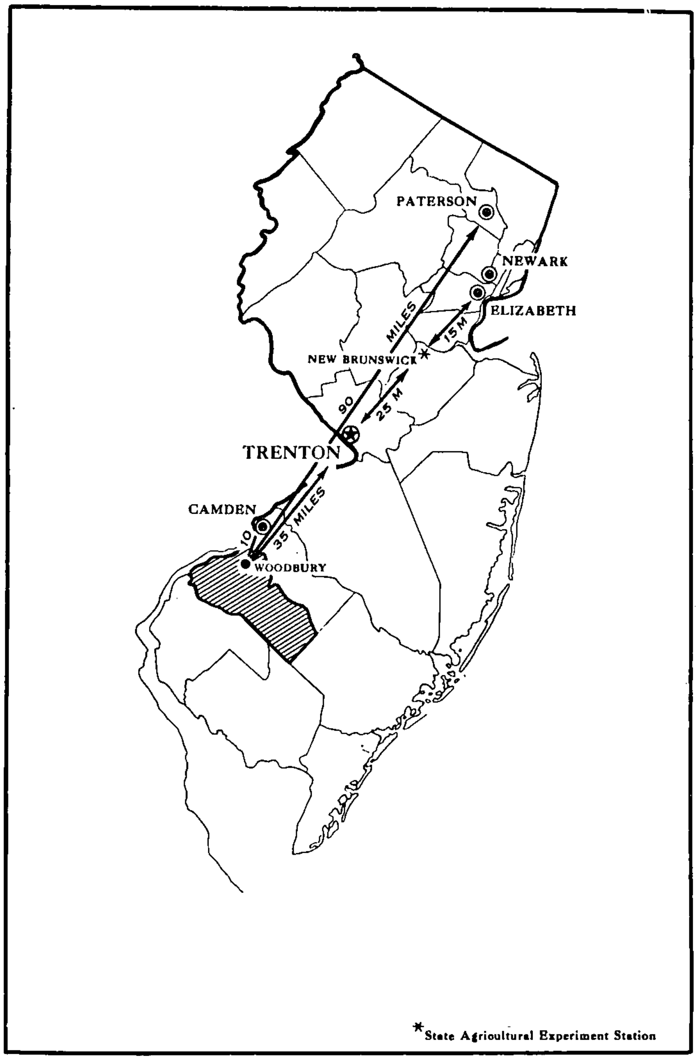

Figure 1.—**Location of Gloucester County in New Jersey.**

In 1960, Woodbury, the county seat, had a population of 12,453. The population of the county was 134,840. As the result of recent increases in population, some areas are changing from rural to suburban. Nearly two-thirds of the people live in suburban areas and are employed in nearby Camden and Philadelphia.

Only 6 percent of the people live on farms, but farms occupy about 43 percent of the total land area. The chief agricultural products are vegetables, peaches and apples, poultry, dairy products, and nursery stock and flowers. About 36 percent of the county is in forest.

General Soil Areas

The county is divided naturally into nine general areas. Each area contains a characteristic pattern of soils, although some soils occur in more than one area. These general areas of associated soils are useful for broad planning of land use.

A colored map of the general areas is in the back part of this report. Each general area is identified on the map by a specific color and an alphabetic symbol. The letters in the symbol indicate the dominant soils or miscellaneous land types in the general area. For example, in an area shown on the map as MK, the dominant soils are Marlton and Kresson.

Three of the general areas, shown on the map by symbols DWSK, MAFP, and LLL, conform to the drainage systems within the county. Like the geologic formations that underlie them, the other six areas roughly parallel the Delaware River.

Tidal marsh and Made land (TM)

This general soil area lies along the Delaware River and its tributaries. It is more than a mile wide in places near the river and also extends in narrow bands for several miles along tributary streams. It occurs as far as 7 to 9 miles inland along Mantua and Raccoon Creeks.

The marshes are flat and are regularly flooded by slightly brackish tides. They provide habitats for muskrats, ducks, and geese. At times, muskrats have been trapped extensively. Some large areas had been diked and farmed before the 1930's. Floods that accompanied hurricanes broke the dikes, and all farming was eventually abandoned.

The area is perpetually saturated, except for Made land, which consists of river dredgings that have been deposited 10 to 20 feet above the level of the marshes. After proper treatment, some areas of Made land have been used for growing small grains and vegetables.

Sandy flats along the Delaware River: Downer-Woodstown-Sassafras-Klej association (DWSK)

This general soil area occurs as a discontinuous belt, 1½ to 4 miles wide, along the Delaware River. In places it is separated from the river by Tidal marsh and Made land (TM). It is crossed by many tidal streams and wet areas that extend inland from the river. Most areas are flat; elevations range from 10 to 40 feet. In the lower parts, the water table is likely to be within 10 feet of the surface throughout the year. The towns of Bridgeport, Paulsboro, and Thorofare are in this general soil area.

The soils have formed in what is believed to be a marine or river deposit laid down at a time when the level of the ocean was higher than it is now. This deposit, composed chiefly of sand, overlies other sand and clay strata of the main geologic formation of the area.

The dominant soils have a thick, loose, sandy surface layer over slightly more clayey subsoil and very sandy substratum. About 70 percent of the area is composed of Downer soils. Woodstown, Sassafras, Klej, and other soils make up the remaining 30 percent.

The Downer and Sassafras soils are well drained. The water table in the Woodstown and Klej soils rises to within 20 to 30 inches of the surface in winter. Because tidal streams control the drainage outlets, improvement of drainage may be restricted in places.

Nearly all of the area has been cleared. A large part is used to grow vegetables. Asparagus, sweetpotatoes, early tomatoes, peppers, and eggplants are the most important crops. Many acres are irrigated with water from the tidal streams. Wind erosion is a problem.

Because it is favorably situated, much of the land along the river is being held for industrial development.

Gently sloping, brown clay soils: Keyport-Lenoir-Elkton association (KLE)

This general soil area occurs in three separate tracts. One lies southwest of Repaupo, another west of Swedesboro, and the third south of Cedar Grove. Most areas of these soils are gently sloping, but some are steep. If the soils with steeper slopes are farmed, they are subject to severe erosion.

The brown clay soils have developed on several different deposits of clay that are exposed at the surface. Keyport soils make up about 60 percent of the acreage of this area. Lenoir and Elkton soils make up the rest. The Keyport, Lenoir, and Elkton soils are successively wetter in the order named. As the result of excessive wetness, the Elkton soil has a gray surface layer and a brightly mottled subsoil. It occupies nearly level or depressed sites.

Water passes slowly through the soils of this general area, and they dry slowly. They are hard to work because they are either too wet or too dry most of the time. A limited number of crops are suitable, and crop production is also limited. The soils are used mainly for general crops and pasture. Small areas next to sandier soils are used for vegetables. Several large dairies are located in this general area.

Gently to strongly sloping soils from greensand: Freehold-Colts Neck-Collington association (FCC)

This general soil area occupies a strip of land, known as the greensand belt, which stretches from the southern to the northern boundary of the county. The area is from 2 to nearly 4 miles wide and extends through Swedesboro, Clarksboro, Wenonah, Woodbury, and Almonesson.

Relief is gently sloping to slightly hilly. The slopes generally range from 2 to 10 percent, but there are some short, steeper slopes along the streams. The altitude ranges from about 40 feet, next to areas of sandy flats along the Delaware River (DWSK), to as much as 120 feet. Drainage is toward the Delaware River. In most places the water table is well below a depth of 10 feet. Wind erosion is severe on very sandy exposed areas, and water erosion is serious on long slopes.

Soils from greensand contain glauconite, an olive-green, potash-bearing mineral that weathers to dark brown. An undecomposed grain of this mineral makes a green smear when crushed. Glauconite is most commonly observed as pellets that are about the size of sand grains. It is not distributed uniformly through the soil but is most abundant in the lower part of the subsoil and in the substratum. In some areas it occurs only in one part of the soil profile. A thick, sandy surface soil contains little or no glauconite.

Greensand soils have long been highly productive. It was assumed for a time that glauconite supplied needed potash. The potash, however, is made available to plants very slowly. It is now thought that glauconite contributes chiefly to the moisture-supplying capacity and other physical properties of the soil.

In this general area, the soils that are not severely eroded are mostly of sandy loam or loamy sand texture to depths of 10 to 20 inches. These soils have distinctly clayey subsoil underlain by a looser, sandier substratum.

The Freehold soils comprise 60 percent of the acreage of this general area. These soils contain small amounts of glauconite—estimated at 5 to 15 percent of the soil mass. The Colts Neck soils are red and contain little glauconite. The Collington soils contain more glauconite than either the Freehold or Colts Neck soils, generally enough to give an olive tone to the subsoil. All of these soils are well drained.

Minor soils in this general area are the Woodstown, Dragston, Fallsington, and Pocomoke, which occupy more or less depressed areas. These soils are listed as to degree of wetness; the Woodstown is the least wet and the Pocomoke the wettest. All of the minor soils are sandy but not extremely sandy; they are more or less permeable and are underlain by loose sandy strata.

The soils in this general area respond to fertilization, but the very sandy ones, of course, need frequent applications. Moisture relations are good except in areas where an underlying layer keeps the soil wet or in areas where the soil is so sandy that it is likely to be droughty.

Nearly all the soils that have a thick, very sandy surface layer are used for apples, peaches, or vegetables. Asparagus is the most extensive crop. Sweetpotatoes, tomatoes, peppers, eggplants, and pumpkins are other important crops.

The less sandy soils, which are more fertile and have better moisture relationships, are used for vegetables and fruits and for small grains, alfalfa hay, corn, soybeans, and pasture. Flowers and nursery stock are also grown.

If adequately drained, the naturally wet soils can be used for vegetables, soybeans, and other crops. About half the wet acreage is in forest.

Gently sloping to steep, olive clay soils: Marlton-Kresson association (MK)

This general area occurs in a broken, wavy belt, ½ to 2 miles wide. It extends from Harrisonville station in the southern part of the county northward through Mullica Hill to Blackwood Terrace. Slopes are gentle on the broad uplands between the streams that cross the area. Adjacent to the streams, the slopes are short and steep to very steep.

The soils in this general area are distinguished by the very high content of glauconite, which makes the soils and underlying material olive green or dark olive in color. The soils also have a comparatively high content of clay, although their parent materials and underlying substrata generally are somewhat friable.

The soils are moderately fertile, but water moves through them slowly. During much of the time, they are either too moist or too dry to be worked. Runoff is rapid, and the hazard of erosion is severe on cultivated slopes.

The Marlton soils occupy almost 90 percent of the area. The Kresson soil, which is wetter and more mottled, occupies most of the remaining 10 percent; it is on nearly level and depressed areas.

Where they form extensive unbroken areas, the Marlton and Kresson soils are used mainly for general crops and pasture. Smaller tracts of these soils, as well as adjacent sandy soils, are used for tomatoes, peppers, and eggplants.

This general area and the adjacent general area—gently to strongly sloping soils from greensand (FCC)—comprise the greensand belt in Gloucester County. The soils in these two general areas contain glauconite.

From 1800 to 1920, it was common for farmers to spend the winters digging, hauling, and spreading the olive clay, locally called marl, for use as fertilizer (*5*). This practice was started, of course, before soluble commercial fertilizers were generally available. The glauconite in the clay contains potash, but, because it is very slowly soluble, plants cannot obtain it easily.

Nearly level to steep, fine sandy soils: Westphalia-Nixonton-Barclay association (WNB)

The soils of this general area lie in a broken, irregular belt, 4 to 6 miles wide. This belt extends from the southern boundary of the county northward through Harrisonville, Cedar Grove, Barnsboro, and Hurffville. It is spotted by hills capped with gravelly soils.

Drainage of the area is toward the Delaware River. Many of the tributaries of the river rise in this area. Slopes generally are gentle to moderate, but, near the headwaters of streams and in other local areas, they are as much as 10 to 20 percent. The elevation ranges from 90 to 120 feet. In the higher places, the water table is below depths of 10 to 20 feet; in the lower places, it is at the surface. The high water table is a result of the slowly permeable layer of clay that, in places, underlies the fine sandy stratum from which most of the soils have formed.

The Westphalia soils occupy about 60 percent of this general soil area. Nixonton and Barclay soils, composed mainly of fine sand, are the dominant soils on the remaining 40 percent. The Westphalia, Nixonton, and Barclay soils are progressively wetter in the order named.

The soils are generally used for vegetables, fruits, and general crops. Asparagus, sweetpotatoes, and tomatoes are the most common crops. Almost half of the nurseries of the county are located in this area.

About 70 percent of the area has been cleared for farming, but forests remain on wet sites and on steep slopes along streams. The forests produce good stands of yellow-poplar, which is used locally to make produce baskets. Holly is abundant.

Gravelly soils on the higher divides: Aura-Sassafras-Downer association (ASD)

This general soil area occupies the southeastern half of the county, except where other general soil areas are interspersed. Those interspersed are inland wet soils (MAFP) along streams, and the gray sands (LLL) in the eastern corner. In addition, isolated tracts of this general area cap the higher hills in the western part of the county.

This general area constitutes the drainage divide that separates streams that flow northwestward to the Delaware River from those that flow southward and eastward. Only a very small part of the area, along its western boundary, drains to the Delaware River.

In general, the elevation ranges from 120 to 170 feet. Most of the slopes are broad and gentle. Nevertheless, along the western border and on isolated hills at the edges of the gravel deposits, there are slopes that are up to 10 percent or more.

The well-drained Aura soils occupy about 70 percent of this general soil area. The Sassafras, Downer, and other soils occupy the rest. The Aura soils have an especially firm layer, normally at depths of 24 to 36 inches, through which few roots penetrate. Sassafras and Downer soils, which are also well drained, lack this firm layer.

The Woodstown, Dragston, Fallsington, and Pocomoke soils occur less extensively in this general area. These are wet soils that have a high water table in winter.

Approximately 55 percent of the area has been cleared and is used mainly for general crops, vegetables, and fruits. This general area has broad areas of generally well-drained soils and a comparatively high altitude that favors air drainage. It is, therefore, well suited to apples and peaches. An estimated 4,000 of the more than 5,000 acres of apple and peach trees in the county occurs in this general area. Flowers are grown commercially. The main vegetables are tomatoes, asparagus, peppers, and egg-

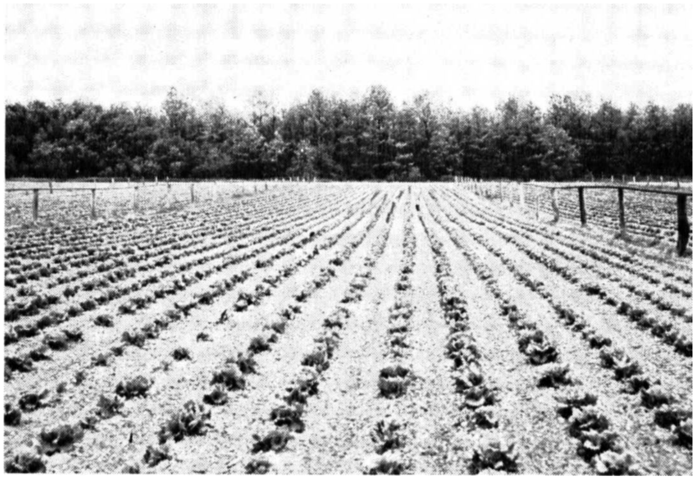

Figure 2.—Irrigated lettuce on Aura sandy loam.

plants. In addition, lettuce, spinach, radishes, scallions, dandelions, fennel, and many other high-value crops are raised (fig. 2). Many of these crops are produced on small farms equipped with overhead irrigation.

Forests have been cut frequently for firewood and have been damaged by wildfires. The poor condition of the forests, however, does not reflect the capacity of the soils to grow trees. Pines have survived the fires in areas that formerly supported fairly good stands of oak.

Gray sands: Lakeland-Lakewood-Lakehurst association (LLL)

This small, nearly level area occurs in the eastern corner of the county, at elevations ranging from 70 to 100 feet.

The soils have developed from sands, and their surface layers have been leached gray to some extent. These soils hold little water available for plants, and commercial fertilizer washes out easily.

The Lakeland, Lakewood, and Lakehurst soils are dominant. Water enters and drains through the Lakeland and Lakewood soils at an excessive rate. The same is true of the Lakehurst soil, except that the water table rises to within 20 to 30 inches of the surface during winter and is within 4 to 6 feet during drier seasons.

All the soils are so infertile and droughty that they have not been cleared extensively for crops. Much of the cleared acreage is now idle. Sweetpotatoes, peaches, and pumpkins are grown to a minor extent. Most areas are still in forests of pitch pine.

Inland wet soils: Muck-Alluvial land-Fallsington-Pocomoke association (MAFP)

The inland wet soils occur in nearly level, narrow, wet areas along streams. Elevations range from 10 to 160 feet.

Muck makes up about 50 percent of this general soil area; Alluvial land and Fallsington, Pocomoke, and minor soils make up most of the rest. Muck and the Fallsington and Pocomoke soils are most abundant along streams that drain to the east and southeast. They also occur to a minor extent in the narrower areas that drain to the Delaware River, and in these places Alluvial land is most extensive.

Included in this general area are the Pasquotank, Bayboro, Leon, and St. Johns soils, all of which are wet to very wet.

An estimated 25 percent of the area has been cleared. The water table must be lowered in all the soils before crops can be grown. After a soil has been properly drained, corn, soybeans, summer vegetables, and pasture plants can be grown.

Forests of Atlantic white-cedar and maple grow on much of the Muck. Oak, sweetgum, maple, and other species grow on the other soils.

Descriptions of the Soils

This section describes the soil series and individual soils—mapping units—of Gloucester County. Characteristics of the soils and properties that affect use and management are given, and suitable crops are suggested.

The soil series and mapping units are arranged alphabetically. A detailed description, including a complete description of the soil profile, is given for each series. After this, there is a description of the mapping units in the series. Technical terms used in the soil descriptions are defined in the Soil Survey Manual (*9*)[1] and in the Glossary in the back part of the report. Descriptions of soil color are based on the Munsell color charts.

A list of the soils and the map symbols and capability classification of each are given in the "Guide to Mapping Units and Capability Units" at the end of the report. The approximate acreage and proportionate extent of each mapping unit are given in table 1, and the location and distribution of each are shown on the soil map in the back of the report.

Alluvial Land

Alluvial land (Ad).—This miscellaneous land type is composed of various materials. It occurs along the streams on flats that are subject to overflow. In some places it is flooded several times a year; in others, only once in several years.

Alluvial land has formed on material deposited by streams that flow west to the Delaware River. The streams begin in the gravelly divides and flow through several belts of different kinds of soils and geologic materials. They cross the general soil areas of nearly level to steep, fine sandy soils (WNB); gently to strongly sloping soils from greensand (FCC); and gently sloping, brown clay soils (KLE). Material from each of these areas has been removed and deposited on flood plains to form Alluvial land. In most places the texture of the surface layer is loam, but in some it is sandy loam.

Most areas of Alluvial land have large amounts of organic matter near the surface. Also, ground water is relatively close to the surface in most places. The soils vary from place to place but do not consist of definite horizons.

The native vegetation varies according to the texture of the soil material and the degree of wetness. Red maple

[1] Italic numbers in parentheses refer to Literature Cited, p. 83.

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

Map symbol	Soil	Area	Extent
		Acres	*Percent*
Ad	Alluvial land	5, 200	2. 5
AmB	Aura loamy sand, 0 to 5 percent slopes	3, 500	1. 7
ArB	Aura sandy loam, 0 to 5 percent slopes	25, 600	12. 2
AsB	Aura-Sassafras loamy sands, 0 to 5 percent slopes	500	. 2
AsC	Aura-Sassafras loamy sands, 5 to 10 percent slopes	600	. 3
AuB	Aura-Sassafras sandy loams, 0 to 5 percent slopes	1, 000	. 5
AuC	Aura-Sassafras sandy loams, 5 to 10 percent slopes	1, 400	. 7
AuC3	Aura-Sassafras sandy loams, 5 to 10 percent slopes, severely eroded	400	. 2
Ba	Bayboro loam	200	. 1
Ck	Colemantown-Matlock loams	400	. 2
CmB	Collington loamy sand, 0 to 5 percent slopes	650	. 3
CmC	Collington loamy sand, 5 to 10 percent slopes	150	. 1
CnA	Collington sandy loam, 0 to 2 percent slopes	150	. 1
CnB	Collington sandy loam, 2 to 5 percent slopes	650	. 3
CnC	Collington sandy loam, 5 to 10 percent slopes	200	. 1
CoB	Colts Neck soils, 0 to 5 percent slopes	600	. 3
CoC	Colts Neck soils, 5 to 10 percent slopes	400	. 2
DoB	Downer loamy sand, 0 to 5 percent slopes	15, 000	7. 1
DsA	Downer sandy loam, 0 to 2 percent slopes	10, 700	5. 1
DsB	Downer sandy loam, 2 to 5 percent slopes	2, 800	1. 3
Ek	Elkton loam	1, 400	. 7
Fa	Fallsington loam	2, 500	1. 2
Fd	Fallsington sandy loam	6, 600	3. 1
FhB	Freehold loamy sand, 0 to 5 percent slopes	16, 400	7. 8
FhC	Freehold loamy sand, 5 to 10 percent slopes	3, 700	1. 8
FnB	Freehold sand, thick surface variant, 0 to 10 percent slopes	1, 100	. 5
FoA	Freehold sandy loam, 0 to 2 percent slopes	3, 000	1. 4
FoB	Freehold sandy loam, 2 to 5 percent slopes	8, 100	3. 9
FoC	Freehold sandy loam, 5 to 10 percent slopes	1, 700	. 8
FoC3	Freehold sandy loam, 5 to 10 percent slopes, severely eroded	50	[1]
FoD3	Freehold sandy loam, 10 to 15 percent slopes, severely eroded	450	. 2
FsD	Freehold soils, 10 to 15 percent slopes	1, 800	. 9
FtE	Freehold, Colts Neck, and Collington soils, 15 to 25 percent slopes	1, 700	. 8
FtF	Freehold, Colts Neck, and Collington soils, 25 to 40 percent slopes	1, 000	. 5
Fw	Fresh water marsh	300	. 1
KpB	Keyport sandy loam, 0 to 5 percent slopes	1, 800	. 9
KpC3	Keyport sandy loam, 5 to 10 percent slopes, severely eroded	300	. 1
KrB	Kresson sandy loam, 0 to 5 percent slopes	300	. 1
LaA	Lakehurst sand, 0 to 5 percent slopes	2, 400	1. 1
LdB	Lakeland sand, 0 to 10 percent slopes	7, 000	3. 3
LeB	Lakewood sand, 0 to 5 percent slopes	500	. 2
LkA	Lenoir and Keyport loams, 0 to 5 percent slopes	250	. 1
Lo	Leon sand	4, 500	2. 1
Mc	Made land, coarse materials	1, 300	. 6
Mf	Made land, fine materials	300	. 1
MrB	Marlton sandy loam, 0 to 5 percent slopes	2, 200	1. 0
MrC	Marlton sandy loam, 5 to 10 percent slopes	350	. 2
MrC3	Marlton sandy loam, 5 to 10 percent slopes, severely eroded	500	. 2
MrD	Marlton sandy loam, 10 to 15 percent slopes	100	. 1
MrD3	Marlton sandy loam, 10 to 15 percent slopes, severely eroded	300	. 1
MrE	Marlton sandy loam, 15 to 25 percent slopes	350	. 2
MrF	Marlton sandy loam, 25 to 40 percent slopes	350	. 2
Mu	Muck	13, 100	6. 2
NbB	Nixonton and Barclay soils, 0 to 5 percent slopes	1, 400	. 7
Pa	Pasquotank fine sandy loam	1, 000	. 5
Pg	Pits	700	. 3
Po	Pocomoke loam	1, 300	. 6
Ps	Pocomoke sandy loam	300	. 1
Sa	St. Johns sand	1, 300	. 6
SfB	Sassafras loamy sand, 0 to 5 percent slopes	2, 600	1. 2
SfC	Sassafras loamy sand, 5 to 10 percent slopes	1, 700	. 8
SrA	Sassafras sandy loam, 0 to 2 percent slopes	3, 600	1. 7
SrB	Sassafras sandy loam, 2 to 5 percent slopes	6, 600	3. 1
SrC	Sassafras sandy loam, 5 to 10 percent slopes	1, 000	. 5
SrD3	Sassafras sandy loam, 10 to 15 percent slopes, severely eroded	60	[1]
SsD	Sassafras soils, 10 to 15 percent slopes	1, 100	. 5
SsE	Sassafras soils, 15 to 40 percent slopes	600	. 3
Tm	Tidal marsh	7, 400	3. 5
WaD3	Westphalia fine sandy loam, 10 to 15 percent slopes, severely eroded	200	. 1
WhB	Westphalia soils, 0 to 5 percent slopes	5, 900	2. 8
WhC	Westphalia soils, 5 to 10 percent slopes	1, 600	. 8
WhD	Westphalia soils, 10 to 15 percent slopes	300	. 1
WhE	Westphalia soils, 15 to 40 percent slopes	500	. 2
WnA	Woodstown and Dragston loams, 0 to 2 percent slopes	200	. 1
WoB	Woodstown and Dragston loamy sands, 0 to 5 percent slopes	900	. 4
WsB	Woodstown and Dragston sandy loams, 0 to 5 percent slopes	10, 800	5. 1
WtB	Woodstown and Klej loamy sands, 0 to 5 percent slopes	3, 700	1. 8
	Total	210, 560	99. 8

[1] Less than 0.1 percent.

and Atlantic white-cedar are common in some places; sweetgum, yellow-poplar, ash, red oak, boxelder, black walnut, and redcedar grow on others. All of the soil material is extremely acid.

Nearly all the areas are in forest, but some small areas have been cleared for pasture. This land type is in capability unit VIIw-1.

Aura Series

Aura soils have a grayish-brown coarse to medium sandy loam or loamy sand surface layer. The upper subsoil is yellowish brown and is generally sandy loam or loamy sand. The deeper subsoil, beginning generally at depths of 18 to 36 inches, is noticeably reddish and more clayey. It is extremely hard when dry, commonly is firm to very firm when moist, and consists of stratified and crossbedded, coarse, harsh sand and fine gravel coated with clay. In places the clay coatings fill much of the space between the coarser particles. Much of the sand and gravel has been softened by weathering. Pebbles in the upper part of the soil are cleaner and commonly coarser than those in the lower part. The larger pebbles, more than 1 inch in diameter, are most numerous in the upper part of the profile. In the lower part, most of the pebbles are less than half an inch in diameter.

The Aura soils are well drained. They occupy the highest areas of the county. Near Glassboro and Williamstown they are nearly level; in the Richwood area they are more sloping. Further west, Aura soils occupy the tops of knolls.

Native woodland consists of red, white, and black oaks and some pitch pines.

Aura soils occur in association with Sassafras, Downer, and Woodstown soils. The Aura soils are redder and firmer with increasing depth than are the Sassafras and Downer soils. They are free from the mottling that is common in the subsoil of the seasonally wet Woodstown soils.

Representative profile (Aura sandy loam, 0 to 5 percent slopes, in a peach orchard one-eighth mile south of Richwood):

A_p (Plow layer). 0 to 8 inches, very dark grayish-brown (2.5Y 3/2) coarse sandy loam; weak, fine, granular structure; in places platy in the lower part; very friable; roots abundant; 10 to 15 percent of mass is rounded, clean, quartzose pebbles; worm channels common; pH 6.4; smooth lower boundary.

A_2 8 to 14 inches, yellowish-brown (10YR 5/4) coarse sandy loam; weak, fine, granular to medium, platy structure; friable to firm; roots common; worm and root channels common and filled with material from plow layer; few clean pebbles; pH 6.4; gradual, smooth lower boundary; 6 to 10 inches thick.

B_1 14 to 24 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; friable; about 10 percent of mass is rounded quartzose pebbles, coated with clay; a few pebbles have been softened by weathering; clay flows abundant; pH 6.2; clear, smooth lower boundary; 8 to 10 inches thick.

B_{21} 24 to 36 inches, brown (7.5YR 4/4) coarse sandy clay loam; moderate, medium, subangular blocky structure; firm, very hard when dry; small roots common; coarse fragments make up about 5 percent of mass; all fragments coated with and imbedded in clay; clay flows abundant; pebbles, both round and angular, commonly softened by weathering; ironstone fragments, one-eighth inch thick, in horizontal position at a depth of about 36 inches; sandy pockets common; pH 5.4.

B_{22} 36 to 60 inches, strong-brown (7.5YR 5/8) coarse sandy clay loam decreasing in clay with depth; massive to medium, platy structure or stratified; firm in place, friable when removed; common, sharp, gritty fine gravel imbedded in clay; weathered yellow fragments abundant; pH 4.6.

Micropodzol horizons occur in the upper 4 inches of forested soils. Areas under pitch pine have a slightly grayer surface horizon than those under hardwoods. Under native vegetation, Aura soils rarely contain earthworms.

The deeper soil generally is hard when dry. In small sandy areas, however, the soil remains loose. The depth to the firm horizon averages about 2 feet, but it ranges from about 18 to 36 inches. The subsoil normally is sandy clay loam, and, below a depth of 2 feet, it contains about 5 percent silt. Generally, below a depth of 5 feet, the soil gradually becomes less firm and more friable. Rounded quartzose pebbles are most abundant in the upper 2 feet, and usually they make up about 5 to 10 percent of the soil. In places, however, they make up as much as 30 percent.

As mapped, most areas of Aura soils contain some Sassafras and Downer soils.

Aura soils are moderately or moderately slowly permeable in the subsurface soil. Runoff is rapid, and erosion is a problem, even on gentle slopes. Irrigation water should be applied slowly. Few roots penetrate the firm deeper horizons, which hold little water that is available to plants. In places these soils contain enough pebbles to hinder disking, as well as the planting of small seeds.

The soils are low in content of organic matter and low in natural fertility, but plants grown on them respond to fertilization. They are suited to fruit, flowers, general farm crops, and most vegetables (fig. 3). Special care is needed to maintain organic matter and a good soil structure so that the soil can absorb more water.

Aura loamy sand, 0 to 5 percent slopes (AmB).—This soil has a profile similar to the one described for the series, except that the surface layer is more sandy and a few inches thicker. In uneroded areas the surface layer of this soil is 16 inches thick.

Because the surface layer is sandy, the soil warms early, but it is droughty and is subject to wind erosion

***Figure 3.*—Irrigated peonies being harvested on Aura sandy loam.**

if left bare. This soil is suited to early vegetables and sweetpotatoes. Capability unit IIIs-1.

Aura sandy loam, 0 to 5 percent slopes (ArB).—This is the soil described as having a profile representative of the Aura series. In the eastern part of the county, small areas that have a loam surface layer were mapped with this soil.

Included also are small areas where erosion has removed most of the original surface layer. In these areas the soil contains little organic matter; it is stickier than normal and is, therefore, harder to plow and cultivate.

This soil is suitable for fruit, vegetables, general farm crops, and commercial flowers. It does not warm soon enough for the earliest vegetables and is not well suited to sweetpotatoes. The surface soil becomes hard when dry and, therefore, is not easily cultivated in summer. Unless the content of organic matter is maintained, the soil will crust easily and cause poor germination of seed. Runoff is rapid. Under traffic, the soil packs readily. Capability unit IIs-2.

Aura-Sassafras loamy sands, 0 to 5 percent slopes (AsB).—This complex of soils consists of areas of Aura loamy sand and of Sassafras loamy sand (described under the Sassafras series). The soils are so interspersed that it was impractical to separate them at the scale of mapping used.

The surface layer of both soils is generally grayish brown and very sandy. It is loamy sand in texture and is relatively thick. It commonly extends to a depth of 16 inches and, in places, to a depth of more than 20 inches. The subsoil is finer in texture than the surface layer. Generally the subsoil is sandy loam or sandy clay loam, but in some small areas it has a sandier texture. At depths of about 30 to 40 inches, the Sassafras soil grades to loose loamy sand or sand. At the same depths, the Aura soil grades to coarse sand and fine gravel. This Aura soil material is coated with clay and generally firm to very firm. In places there are clay lenses in the substratum.

The Aura soil is dominant on the more level areas, and the Sassafras soil is dominant on the more sloping areas. On farmed land, erosion ranges from slight to moderate.

These soils are suited to fruit, asparagus, early vegetables, and forests. Capability unit IIIs-1.

Aura-Sassafras loamy sands, 5 to 10 percent slopes (AsC).—Except for steeper slopes, this mapping unit is similar to Aura-Sassafras loamy sands, 0 to 5 percent slopes. Generally, the Aura soil occupies most of the milder slopes, and the Sassafras soil occupies most of the steeper slopes.

In most cultivated fields, erosion generally has been moderate. In small areas most of the original surface layer has been removed by erosion. Because of the clayey subsoil material in the plow layer, these spots are harder to work than areas with a normal surface layer.

These soils are suited to fruit and to asparagus and other vegetables. Wind and water erosion must be controlled on these soils. Capability unit IIIe-2.

Aura-Sassafras sandy loams, 0 to 5 percent slopes (AuB).—These soils occur in such an intricate pattern that it was not practical to separate them at the scale of mapping used. The Sassafras soil is described under the Sassafras series.

The major differences between the Aura and Sassafras soils occur below a depth of about 20 to 36 inches. At this depth, the Aura soil consists of coarse sand and gravel, which is coated with clay and is generally firm to very firm. In contrast, the Sassafras soil, below 20 to 36 inches, is more friable and sandy than at less depth. The Aura soil predominates on the more gently sloping areas, and the Sassafras soil, on the more sloping.

In some farmed areas, slight to moderate erosion has reduced the thickness of the surface layer from about 14 inches to about 8 to 12 inches. Erosion is a constant hazard, and some small areas have lost most of the original surface layer.

These soils are suited to most vegetables, fruits, and general farm crops. Capability unit IIs-2.

Aura-Sassafras sandy loams, 5 to 10 percent slopes (AuC).—For practical purposes, these intricately mixed soils have been mapped as a unit. The Sassafras soil is more extensive than the Aura. The differences in the two soils have been previously described under Aura-Sassafras sandy loams, 0 to 5 percent slopes.

In farmed areas, erosion is slight to moderate. The thickness of the surface layer has been reduced to about 8 to 12 inches. Small areas have lost most of the original surface layer, and, as a result, the plow layer is more clayey than normal. Runoff is rapid on the sloping soils of this complex; consequently, erosion is severe unless carefully controlled.

Because of runoff and the risk of erosion, contour planting is needed for peach orchards and for asparagus. The soils are suited to fruit, vegetables, and general farm crops. Capability unit IIIe-1.

Aura-Sassafras sandy loams, 5 to 10 percent slopes, severely eroded (AuC3).—These soils resemble the other Aura-Sassafras sandy loams. They have steeper slopes, however, and they have been eroded much more. The Sassafras soil is the more extensive.

Erosion has removed most of the original surface layer and exposed the more clayey subsoil. The subsoil is very low in organic matter and is harder to cultivate than the original surface layer. Gullies, 1 to 2 feet deep, occur in places. Runoff is rapid, and the risk of further erosion is severe. Crop yields are low. Capability unit IVe-1.

Barclay Series

Barclay soils have a dark grayish-brown surface soil over a mottled yellowish-brown fine sandy loam subsoil and a gray fine sandy loam substratum. The texture is uniform throughout. There is a little more clay in the subsoil than in the surface layer. The Barclay soils have formed on marine deposits of yellowish-brown, loose fine sand. This fine sand contains some mica and, in places, at least a small amount of glauconite. Prolonged wetness of the subsoil has caused the gray colors and the mottling. In farmed areas, drainage has been improved.

These somewhat poorly drained soils occupy nearly level areas. They receive runoff water and possibly undergound drainage water from adjoining higher areas. The Barclay soils are only in the area of fine sandy soils (shown by symbol WNB on the general soil map).

The native forest is composed mostly of pin oak, willow oak, sweetgum, yellow-poplar, beech, and holly.

These soils occur in association with Westphalia, Nixonton, and Pasquotank soils. Barclay soils are not so wet and gray as Pasquotank soils. They are wetter and more mottled than Westphalia and Nixonton soils.

Representative profile (Barclay loamy fine sand, 0 to 2 percent slopes, in a field one-half mile southwest of Turnersville):

A_p 0 to 10 inches, dark grayish-brown (2.5Y 4/2) loamy fine sand; weak, fine, granular structure; very friable; roots abundant; about 1 to 3 percent of mass is rounded quartzose pebbles; earthworms common; pH 6.0; abrupt, smooth lower boundary; 9 to 11 inches thick.

A_2 10 to 18 inches, pale-brown (10YR 6/3) loamy fine sand; a few distinct mottles; root and worm channels filled with soil from horizon above; very weak, medium, granular structure; very friable; roots common; mica common; sand uniformly fine; in the uppermost 0 to 3 inches of this layer there is a discontinuous remnant of a dark-brown horizon, like a B_{ir} horizon; pH 6.0; clear, smooth boundary; 6 to 9 inches thick.

B_g 18 to 28 inches, light olive-brown (2.5Y 5/4) fine sandy loam with many, fine, prominent mottles (10YR 5/8 and 6/2), especially around the roots; weak, medium, subangular blocky structure; friable or slightly sticky; roots common; mica common; pH 4.8; gradual, wavy boundary; 9 to 12 inches thick.

C_{1g} 28 to 38 inches, light olive-brown (2.5Y 5/4) loamy fine sand; common, fine, prominent mottles of yellowish brown (10YR 5/8); single grained; loose; few roots; 0 to 10 percent of mass is rounded quartzose pebbles; mica common; few spheroidal concretions; sand uniformly fine; pH 4.8; irregular, wavy boundary; 10 to 20 inches thick.

C_{2g} 38 to 42 inches, light brownish-gray (2.5Y 6/2) fine sand; single grained; loose; contains pockets of brightly colored pebbles and cobbles; pH 5.4; 0 to 6 inches thick.

C_{3g} 42 to 60 inches +, light olive-gray (5Y 6/2) fine sand; many, fine to medium, faint mottles of yellowish brown (10YR 5/8); single grained; loose; few brightly colored (10YR 5/8) spheroidal concretions; soil pH 4.4, water pH 4.6 (at 72 inches).

The subsoil of the Barclay soils ranges from yellowish brown with gray mottling to gray with yellowish-brown mottling. The mottling is mostly prominent but ranges from faint to prominent. In some places part of the A_2 horizon has thin, platy structure; in others clay lenses, 6 to 12 inches thick, occur below a depth of 30 inches. Various amounts of rounded quartzose pebbles, ½ to 2 inches in diameter, are scattered over the surface and, in spots, throughout the soil. The most sandy areas tend to have a discontinuous organic layer that, in places, constitutes a weak hardpan.

The Barclay soils have low natural fertility. Crop production and tillage are hindered by excess ground water. The soils are moderately slowly permeable. Because the fine sands slough, special care is needed in the construction of drainage systems.

If adequately drained, the Barclay soils are suited to vegetables and general crops. They do not warm soon enough in spring for the earliest vegetables.

In Gloucester County the Barclay soils were mapped only with the Nixonton soils as Nixonton and Barclay soils, 0 to 5 percent slopes.

Bayboro Series

Bayboro soils have a black surface layer underlain by a gray clay or silty clay that is mottled. In their natural condition, these soils are covered by water much of the winter and during wet periods. In cultivated fields, drainage has been improved.

The soils have formed from clay marine deposits that contain little or no glauconite. The clay deposits range in thickness from 2 to 60 feet.

These very poorly drained soils occur in low positions. They are not extensive in this county.

The native forest includes pin oak, sweetgum, red maple, willow oak, beech, and swamp white oak.

The Bayboro soils occur primarily in association with Elkton, Fallsington, and Dragston soils. They contain more clay than the Fallsington and Dragston soils and have a darker surface layer than the Elkton soils.

Representative profile (Bayboro loam, under a stand of sweetgum 1½ miles east of Harrisonville):

A_p 0 to 10 inches, very dark gray (10YR 3/1) loam; moderate, medium, granular structure; friable when moist, plastic and nonsticky when wet; abundant roots; clear, smooth boundary.

A_2–B_1 10 to 16 inches, black (10YR 2/1) silty clay with few, fine, prominent mottles in the lower part; moderate, medium, subangular blocky structure; firm when moist, plastic and sticky when wet; abundant roots; clear boundary.

B_{2g} 16 to 24 inches, very dark gray (10YR 3/1) clay with many, fine, prominent mottles of yellowish brown (10YR 5/6); moderate to strong, medium, blocky structure; very firm when moist, very plastic and very sticky when wet; abundant roots; gradual boundary.

B_{3g}–C_g 24 to 48 inches, yellowish-brown (10YR 5/8) clay with common, fine, prominent mottles; moderate, medium, blocky structure; very firm when moist, very plastic and very sticky when wet; common roots; few, thin sandy streaks; about 3 percent of mass is rounded quartzose pebbles.

The color of the surface layer of the Bayboro soils ranges from black to very dark gray; that of the subsoil ranges from gray to yellowish brown and has much gray mottling. In places the subsoil is gray to depths of 2 to 3 feet, where it becomes yellowish brown. In some places interbedded layers of clay and sand occur within 2 feet of the surface.

The Bayboro soils are very poorly drained. They dry out so slowly that they cannot be worked until late in the season. Because they occur in low positions, they are subject to flooding in extremely wet periods. Permeability is too slow for the effective use of underdrains. Subsoiling, blasting, and the application of gypsum are of little or no benefit on these clayey soils.

The Bayboro soils are moderately fertile. They contain large amounts of clay and organic matter. As a result, large amounts of lime are needed to correct acidity. These soils are subject to severe frost action. If adequately drained, the soils are suited to general farm crops and summer vegetables. If undrained, they are most suitable for pasture, woodland, or wildlife habitats. Good stands of sweetgum occur in places.

Bayboro loam (Ba).—This is the only Bayboro soil in the county. Nearly all of the larger areas contain some spots of Elkton soil. Capability unit IIIw–2.

Colemantown Series

Colemantown soils have a gray to dark-gray surface layer and olive clay subsoil that is mottled. In their natural condition, these soils are covered with water during most of the winter and during other wet periods.

The soils have formed in clay marine deposits that contain enough glauconite to give an olive coloring to the soil and parent material. They occur from Harrisonville station to beyond Mullica Hill and are in the narrow, gently sloping to steep, irregular belt of olive clay soils (shown by symbol MK on the general soil map). These poorly drained soils occupy nearly level areas that receive runoff water and possibly underground seepage from the surrounding higher areas.

The native forest includes sweetgum, pin oak, willow oak, beech, red maple, and swamp white oak.

The Colemantown soils occur in association with Matlock, Kresson, and Marlton soils. They are wetter than the Marlton and Kresson soils and are not so dark on the surface as the Matlock soils.

Representative profile (Colemantown loam, 0 to 2 percent slopes, in pasture one-half mile west of Jefferson at the headwaters of Rattling Run):

A_p 0 to 5 inches, very dark grayish-brown (2.5Y 3/2) loam or clay loam; common, faint, olive-brown mottles (2.5Y 4/4); moderate, medium, granular structure; slightly sticky.

A_{2g} 5 to 12 inches, gray or grayish-brown (2.5Y 5/2) sandy loam; many, faint, olive-brown mottles (2.5Y 4/3); moderate, subangular blocky structure; friable.

B_{2g} 12 to 26 inches, clay that is greener than dark olive gray (5Y 3/2) and has many, medium to coarse, prominent, yellowish-brown mottles (10YR 5/8); angular blocky structure; very dense, very sticky; no pores observable; 5 percent of mass is quartzose pebbles.

C_1 26 to 36 inches, clay or clay loam that is greener than dark olive (5Y 3/3); no mottling; massive; sticky; roots common; few small iron concretions.

C_2 36 to 54 inches, dark-olive (5Y 3/3) clay or clay loam that has a sandy "feel"; no mottling; massive; firm in place, friable when removed.

The texture of the subsoil is normally clay, but, in places, it is sandy clay or sandy clay loam. Mottling is generally prominent, but it may be absent in parts of the profile. The subsoil and substratum are grayer in places where sand is interbedded with the clay. In places the soils contain ironstone.

In some places the upper part of the profile contains less glauconite than typical. Here, the soil commonly is sandy and is composed of materials deposited over the main glauconitic formation.

Colemantown soils are poorly drained. Permeability, in most places, is too slow for effective use of underdrains. Ditches, however, can be used to remove surface water. All farmed areas of these soils have been drained.

These soils dry out so slowly that plowing and other cultivation is frequently delayed. They are moderately fertile, but the number of suitable crops and the yields are restricted by too much water. The soils are subject to severe frost action.

Colemantown-Matlock loams (Ck).—Because these two soils are not extensive in the county and are always intermingled, they have been mapped as a single unit. The Matlock soil is described under the Matlock series.

In places the texture of the surface layer is clay loam instead of loam.

In this county the soils occur at the headwaters of streams. Since they are subject to flooding, they are used extensively for pasture or woodland. Capability unit IIIw-2.

Collington Series

Collington soils have a grayish-brown surface layer over a brown to olive-brown sandy loam to sandy clay loam subsoil and a sandy loam substratum.

These well-drained soils have developed from sandy marine deposits that contain enough glauconite to make the subsoil olive brown. They occur in the areas of gently to strongly sloping soils from greensand (shown by symbol FCC on the general soil map).

The native forest consists primarily of mixed oaks and yellow-poplar.

Collington soils occur mostly in association with Freehold, Marlton, and Westphalia soils. They contain less glauconite and clay than the Marlton soils but more than the Freehold and Westphalia soils.

Representative profile (Collington sandy loam, 2 to 5 percent slopes, in an idle field in Woodbury Heights, on Highland Avenue one-fourth mile east of the road to Fairview, one-fourth mile south of a cemetery, and on the south side of Woodbury Creek):

A_p 0 to 6 inches, very dark grayish-brown (2.5Y 3/2) sandy loam; weak, medium, granular structure; very friable, nonsticky, slightly plastic; roots abundant; abrupt, smooth boundary.

B_{21} 6 to 17 inches, light olive-brown (2.5Y 5/4) clay loam; moderate to strong, medium to coarse, subangular blocky structure; friable; nonsticky, slightly plastic; clay films on peds; glauconite obvious; roots abundant; smooth, gradual boundary.

B_{22} 17 to 32 inches, brown to olive-brown (10YR 4/4 to 2.5Y 4/4) sandy clay loam; moderate, medium to coarse, subangular blocky structure; friable, nonsticky, plastic; clay films on peds; glauconite obvious; roots common; 5 percent of mass is quartzose pebbles; gradual boundary.

C_1 32 to 45 inches, dark olive-gray to black (5Y 3/2 to 2/2) sandy loam; massive; stratified; very friable, nonsticky, slightly plastic; glauconite abundant; few roots; parent material stratified.

C_2 45 to 70 inches, dark-brown (7.5YR 4/4) sandy loam; structureless; stratified; small ironstone concretions and mica more abundant with increasing depth; variations in color increase with depth.

The soil just described is moderately eroded, and its A horizon is thinner than normal. The average thickness of the normal A horizon is about 14 inches. In the normal soils, there is an A_2 horizon below the A_p horizon.

The content of clay and glauconite in the Collington soils varies from place to place. Normally, glauconite is most abundant where the content of clay is highest. In soils that have a high content of clay, the combined surface layer and subsoil tend to be especially thick. Where the subsoil is exposed in banks, it crusts easily and forms fine aggregates.

As a rule, the substratum is light olive-brown sandy loam, but, in places, it is dark olive brown or nearly black. In some places, Collington soils contain various amounts of rounded quartzose pebbles, ½ to 2 inches in diameter;

the pebbles are scattered over the surface and within the soil.

In some small areas, thick deposits of loamy sand overlie the olive-brown subsoil.

Collington soils are well drained. They are easy to work and moderately permeable. Roots penetrate deeply. Where the surface layer is not too sandy and thick, the soils are moderately fertile, respond well to fertilization, and retain moisture well.

Collington soils are well suited to vegetables, fruits, and general farm crops.

Collington loamy sand, 0 to 5 percent slopes (CmB).—Except for the texture of the surface layer, the profile of this soil is similar to the profile described for the series. The thickness of the original surface layer of this soil averages about 18 inches and ranges from 16 to 30 inches. The soil is more droughty and less fertile than the Collington sandy loams. It is subject to severe wind erosion. It is suited to fruits, sweetpotatoes, and perennial vegetables. Capability unit IIs–1.

Collington loamy sand, 5 to 10 percent slopes (CmC).—This soil includes cultivated areas that are moderately eroded. It is subject to rapid runoff and severe erosion. It is suited to perennial vegetables, fruits, and sweetpotatoes. Capability unit IIIe–2.

Collington sandy loam, 0 to 2 percent slopes (CnA).—This soil has a profile similar to the one described as representative of the series. It is nearly level, and the surface layer is 10 to 16 inches thick.

In small areas the soil is slightly wet and has some pale coloring or mottling in the subsoil. Areas to be used for high-value vegetables or fruits will need drainage. The movement of sprayers over wet areas destroys soil structure and makes the soil nearly impermeable.

This soil is suited to most crops and produces good yields. Capability unit I–1.

Collington sandy loam, 2 to 5 percent slopes (CnB).—A profile of this soil is described as representative of the series. In cultivated fields there are areas that have been moderately eroded. Nearly all crops grown locally are suited to the soil. Capability unit IIe–1.

Collington sandy loam, 5 to 10 percent slopes (CnC).—Runoff is rapid and erosion can be serious on this sloping soil unless control measures are used. In most cultivated fields there are scattered gullies and moderately eroded areas. As a result, the thickness of the surface layer varies considerably. In typical areas it averages about 14 inches. In eroded areas the thickness is less than that of a common plow layer and the surface soil contains a mixture of the browner, more clayey subsoil.

If erosion is controlled, this soil is well suited to vegetables, fruits, and general farm crops. Capability unit IIIe–1.

Colts Neck Series

Colts Neck soils have a reddish-brown sandy loam or loamy sand plow layer over red sandy loam to sandy clay subsoil. The subsoil is underlain by a red or reddish-brown sandy loam substratum.

These soils have formed from sandy marine deposits that generally contain small amounts of glauconite. This mineral, however, is commonly obscured by the coatings of iron on the peds. The marine deposits are as much as 20 feet thick. These soils are highly oxidized and, in places, their subsoil contains discontinuous fragments of ironstone, 4 to 8 inches thick.

These well-drained soils occur chiefly near Swedesboro. They are mostly in nearly level, high areas but are also on slopes of up to 10 percent.

The native forest consists of mixed oaks and yellow-poplar.

The Colts Neck soils occur primarily in association with Freehold soils, which are not so red. Colts Neck soils are thicker than the other sandy soils in the county. The subsoil commonly extends to a depth of 40 inches or more, and the parent material contains more clay than that of most sandy soils.

Representative profile (Colts Neck loamy sand, 0 to 2 percent slopes, in an asparagus field 2⅛ miles southwest of Swedesboro High School):

A_p 0 to 8 inches, dark reddish-brown (5YR 3/4) loamy sand or coarse sandy loam; weak, fine, granular structure; 5 to 10 percent of soil mass is quartzose pebbles.

A_2 8 to 12 inches, yellowish-red (5YR 5/6) sandy loam; massive but crushes to weak, fine clods; very friable.

B_{21} 12 to 24 inches, red (2.5YR 4/6) sandy clay to sandy clay loam; medium to coarse, subangular blocky structure; friable when moist; many fine pores; red, angular ironstone fragments, ¼ to 1 inch in diameter, isolated in this horizon; peds are coated with clay.

B_{22} 24 to 40 inches, red (2.5YR 4/6) sandy clay loam; medium, subangular blocky structure; friable when moist, slightly plastic when wet; red, angular ironstone fragments, ¼ to 1 inch in diameter; clay bridges on peds.

C 40 to 60 inches, dark-red (2.5YR 3/6) sandy loam; structureless; very friable; red, angular ironstone fragments, ¼ to 1 inch in diameter.

There is considerable variation in the thickness of the surface layer. In its natural condition, the surface layer ranges from 10 to 16 inches in thickness. In places a yellowish-brown A_2 horizon occurs between the plow layer and the subsoil.

On some of the narrow ridgetops, the plow layer contains ironstone, which comprises up to 25 percent of the soil mass. These areas are not extensive, but the ironstone hinders plowing, planting, and cultivating. Generally, the ironstone occurs as rock fragments, 24 to 26 inches below the surface, but locally, it occurs in ledges.

In places there are large, very hard quartzite rocks, locally called "bull heads," in the soil. The largest of these are several feet in diameter. Various amounts of rounded quartzose pebbles, ¼ to 2 inches in diameter, occur on the surface and mixed through the soil.

Colts Neck soils are well drained and moderately fertile. In most places they are easy to work. Because the subsoil is unusually thick, the soils retain much moisture. They are moderately permeable. Traffic pans form easily in these soils. The content of organic matter is generally low.

The Colts Neck soils are well suited to fruits and vegetables.

Colts Neck soils, 0 to 5 percent slopes (CoB).—This mapping unit has sandy loam and loamy sand surface-soil textures in almost equal proportions.

Wind erosion is a problem on these soils, especially if sweetpotatoes and asparagus are grown. Because the soils are sandy and the surface layer dries easily, there is much drifting of sand late in winter and early in spring on areas where these crops are grown. As a result, the surface layer varies in thickness.

On the stronger slopes—2 to 5 percent—water erosion is also a problem. In most fields with these slopes, the surface layer is now only 6 to 10 inches thick. Capability unit IIs-1.

Colts Neck soils, 5 to 10 percent slopes (CoC).—These soils are generally redder than normal for the series because erosion has removed some of the original brown surface horizon. The surface layer ranges from about 6 to 8 inches in thickness.

Shallow gullies are common in places where water concentrates. In some small areas, most of the surface layer has been removed. The subsoil is mixed with the surface soil when these eroded spots are plowed. The plow layer is, therefore, especially red and is more clayey than normal for the series.

These sloping soils erode easily. If erosion is controlled, they are suitable for fruits, vegetables, and general farm crops. Capability unit IIIe-1.

Downer Series

Downer soils have a grayish-brown plow layer over yellowish-brown, light sandy loam subsoil. The subsoil is underlain by sand or gravelly sand.

The soils have formed on sandy marine or stream sediments. They are most common on the terrace of the Delaware River and in parts of the eastern half of the county. These two areas are shown by symbols DWSK and ASD, respectively, on the general soil map. The Downer soils are nearly level to gently sloping and are well drained.

The native vegetation is a mixed forest of oak and pine.

Downer soils occur primarily in association with Klej, Aura, Sassafras, Woodstown, and Lakeland soils. They lack the firm to very firm, clay-coated sand and gravel that characteristically occur in the Aura soils below depths of 20 to 36 inches. They contain less clay in the subsoil than the Sassafras soils. The Downer soils contain more clay in the subsoil than the Lakeland and Klej soils. A more brightly colored subsoil that lacks mottling distinguishes the Downer from the Woodstown soils.

Representative profile (Downer loamy sand, 0 to 5 percent slopes, in an asparagus field one-half mile north of Hardingville):

A_p 0 to 10 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable to loose; abrupt lower boundary.

A_2 10 to 18 inches, yellowish-brown (10YR 5/4) loamy sand; massive to weak, fine, granular structure; very friable; no coarse fragments; abrupt lower boundary.

B 18 to 30 inches, dark yellowish-brown (10YR 4/4) sandy loam; very weak, fine, subangular blocky structure; friable; slightly sticky, nonplastic; no coarse fragments.

C 30 to 40 inches, dark-brown (7.5YR 4/4) loamy sand; very weak, fine, granular structure; friable, nonsticky; few quartzose pebbles.

D 40 to 50 inches, dark-brown (7.5YR 4/4) sand and gravel; single grained; loose; 30 percent of soil mass consists of coarse fragments.

In forested areas, Downer soils develop micropodzol A_2 and B_2 horizons in the uppermost 4 inches. Areas under pitch pine forest have a grayer surface soil than those under hardwood.

The texture of the subsoil ranges from loamy sand to light sandy loam but is most commonly light sandy loam.

Typically, the subsoil is little or no redder than the surface soil. The subsoil is principally yellowish brown and dark yellowish brown, but it has a faint reddish tinge. In Gloucester County, the Downer series includes soils with a thick surface layer of loamy sand and sand. These soils tend to have a more reddish tone in the subsoil than those with a sandy loam surface layer. In places the subsoil has more clay or is redder than is typical for the series.

The average thickness of the subsoil is about 14 inches, but the range is from 10 to 25 inches. In some areas gravel is scattered through the soil or is in beds generally below a depth of 24 inches.

The Downer soils are low in organic matter, clay, and natural fertility. They respond to fertilization, but, because they are sandy, fertilizer that is added will easily leach from the soils. The soils are well drained and are easily worked. They are moderately droughty, and so they are best suited to deep-rooted perennial vegetables and fruits, sweetpotatoes, and irrigated vegetables. Because of the sandy surface layer, the soils are subject to wind erosion if not protected.

Downer loamy sand, 0 to 5 percent slopes (DoB).—A profile of this soil is described as representative of the series. In some places, however, the B horizon consists of sandy loam bands, 1 inch to 2 inches thick, interspersed in 4 to 6 inches of loamy sand. Spots of Lakeland soil with very sandy subsoil are included in some areas.

Normally, the ground water is well below a depth of 30 inches. In some areas, however, it is higher during winter. Such areas are small in cropland but are large in woodland, where the survey was more generalized. In some small areas, wind or water erosion has reduced the thickness of the surface layer from about 20 inches to 14 inches or less. In other areas, especially along hedgerows, sand has drifted over the normal soil and is 1 foot or more in depth.

This soil is suited to asparagus and other deep-rooted perennials, fruits, early vegetables, and sweetpotatoes. It is easy to work and warms early in spring, but it is droughty and is easily blown. Capability unit IIs-1.

Downer sandy loam, 0 to 2 percent slopes (DsA).—The surface horizon of this soil averages between 10 and 14 inches in thickness. It is thicker in some places because of deposits from higher adjoining areas. Ground water generally occurs at depths of 5 to 10 feet. In some places firm layers, 1 to 2 inches thick, are in the C and D horizons. In places the subsoil is more clayey than normal.

This soil is suitable for many kinds of crops. Capability unit I-1.

Downer sandy loam, 2 to 5 percent slopes (DsB).—Except for stronger slopes, this soil is like Downer sandy loam, 0 to 2 percent slopes. It is suited to many kinds of crops. Capability unit IIe-1.

Dragston Series

Dragston soils have a dark grayish-brown surface layer, mottled in the lower part, that overlies a mottled sandy loam to sandy clay loam subsoil. The substratum is loamy sand and contains various amounts of gravel and, in places, lenses of clay. Its color in most places is yellowish brown with very gray mottling. During winter the ground water normally is within 1 foot of the surface, but during summer it drops to a depth of about 3 feet. Drainage has been improved in most cultivated areas.

These somewhat poorly drained soils are scattered throughout most of the county. They have formed mainly on nearly level sandy deposits but also occur in circular depressions.

The native forest commonly includes black oak, red oak, scarlet oak, and white oak and, in places, yellow-poplar, sweetgum, pitch pine, and beech.

Dragston soils are next to Woodstown, Sassafras, Aura, Downer, Fallsington, and Pocomoke soils. They have mottled lower horizons that distinguish them from the Aura, Sassafras, and Downer soils. The yellowish-brown subsoil distinguishes the Dragston soils from the Pocomoke and Fallsington soils, which have gray subsoils. In Dragston soils the mottling is in the lower part of the A horizon and in the subsoil, whereas in Woodstown soils it is confined to the subsoil.

Representative profile (Dragston sandy loam, 0 to 5 percent slopes, in a gladiola field 1½ miles southeast of Clayton):

A_p 0 to 10 inches, very dark gray (10YR 3/1) sandy loam; weak, fine, granular structure; very friable; 2 to 5 percent of mass is white, rounded quartz pebbles, up to 1 inch in diameter; pH 6.2; abrupt, smooth lower boundary.

A_{2g} 10 to 15 inches, yellowish-brown (10YR 5/6) sandy loam; weak, fine, granular structure; very friable or slightly sticky; few, faint, medium mottles; pH 6.2; clear, smooth lower boundary.

B_{1g} 15 to 20 inches, yellowish-brown (10YR 5/6) sandy loam that contains more clay than the soil in horizon above; moderate, medium, subangular blocky structure; friable or slightly sticky; common, medium, faint mottles; clear, smooth lower boundary.

B_{2g} 20 to 30 inches, yellowish-brown (10YR 5/8) sandy loam with common, medium, distinct to prominent mottles of yellowish brown and light brownish gray (10YR 5/4 and 10YR 6/2); moderate, medium, subangular blocky structure; friable.

C 30 to 38 inches, yellowish-brown (10YR 5/8) loamy sand; single grained; loose; pH 6.0.

D 38 to 50 inches, yellowish-brown (10YR 5/8) sandy clay or sandy clay loam; massive; friable to firm or slightly plastic; many, medium, prominent mottles of yellowish red, pale brown, and red (5YR 4/6, 10YR 6/3, and 2.5YR 4/6); pH 4.4.

In forested areas, Dragston soils have micropodzol A_1, A_2, and B_h horizons totaling 3 inches in thickness. Areas under pine forests have a grayer surface layer than those under hardwoods.

In most places the subsoil extends to a depth of 30 inches; in some, however, it is either deeper or shallower. Some areas have beds of gravel below a depth of 24 inches, and others have clay lenses below a depth of 30 inches.

In some profiles, mottling is not distinct, but the subsoil is paler than normal, even if it lacks mottling. In the western part of the county, these soils contain small amounts of glauconite, but not enough to give them an olive color.

The Dragston soils have only a moderate amount of organic matter and are low in clay; therefore, they are low in natural fertility. Tillage is restricted by wetness, unless the soils are artificially drained.

Permeability is moderate to a depth of 30 inches. Below 30 inches it ranges from slow to moderately rapid. Underdrains can operate effectively except in places where underlying layers of clay are closer to the surface than normal.

If adequately drained, Dragston soils are suited to vegetables, fruit, and general farm crops.

Dragston soils were not mapped separately but were combined with the Woodstown soils as Woodstown and Dragston loams, sandy loams, and loamy sands. These mapping units are described under the Woodstown Series.

Elkton Series

The Elkton soils have a gray to very dark gray plow layer over a gray clay subsoil that is mottled. The substratum consists of clay that is interbedded with sand in places. In their natural condition, these soils drain slowly. Water remains on the surface until late in winter, even if rainfall has been normal, and also during very wet periods. In cropped areas, drainage has been improved.

Elkton soils have formed from marine deposits of brown clay that contain little or no glauconite. These poorly drained soils receive runoff water from adjoining higher areas. The larger areas of the soils are in the western part of the county; in the eastern part, the soils are confined to small circular depressions.

The native forest includes willow oak, pin oak, sweetgum, beech, and swamp white oak.

The Elkton soils occur primarily in association with Bayboro, Lenoir, Keyport, Woodstown, and Dragston soils. They contain much more clay than the Woodstown and Dragston soils. They have a grayer subsoil than the Keyport and Lenoir soils and a surface layer that is not so dark as that of the Bayboro soils.

Representative profile (Elkton loam, in a cornfield 1¼ miles east of Harrisonville):

A_p 0 to 8 inches, dark-gray (10YR 4/1) loam or silt loam; weak, fine, granular structure; friable when moist, slightly sticky when wet; roots abundant; abrupt, smooth lower boundary.

B_g 8 to 28 inches, gray (10YR 5/1) clay; about 60 percent of mass has many, fine to medium mottles of yellowish brown (10YR 5/8); moderate to strong, medium, blocky structure; firm when moist, very plastic when wet; roots common; continuous, thin clay films; gradual, smooth lower boundary.

C_g 28 to 50 inches, gray (10YR 5/1) silty clay; many, medium, prominent mottles of yellowish brown (10YR 5/8); stratified; firm when moist, plastic when wet; few roots.

Normally, Elkton soils have formed on thick deposits of clay, but in places the clay is interbedded with sand. The layers of sand are generally saturated.

Elkton soils are poorly drained and poorly aerated. Since they dry out slowly, they are difficult to work. They are so slowly permeable that underdrains are usually impractical. These soils are subject to frost action. They are moderately fertile. Large amounts of lime are necessary to make the soils less acid.

If adequately drained, these soils are suited to general farm crops and summer vegetables. Because they are clayey, the soils dry slowly and are difficult to work; therefore, they are best suited to pasture or woodland (fig. 4).

Figure 4.—**Improved pasture on Elkton loam. This wet clayey soil dries slowly and is hard to drain and to work.**

Elkton loam (Ek).—This is the only Elkton soil mapped in the county. In small areas the surface layer consists of clay loam and sandy loam. The areas with a sandy loam surface layer have formed in deposits washed from nearby slopes. The soil is not so dark as the normal Elkton loam. This mapping unit also contains areas of Bayboro soils and Lenoir soils that are too small to be mapped separately. Capability unit IIIw-2.

Fallsington Series

Fallsington soils have a dark-gray or very dark grayish-brown surface layer over a grayish-brown or yellowish-brown subsoil that is mottled. The texture ranges from loam to sandy loam in the surface layer, from sandy loam to sandy clay loam in the subsoil, and from sandy loam to loamy sand in the substratum.

These soils are scattered throughout the county. They have formed in circular depressions and on flats adjacent to streams and are poorly drained; most of the time, they are wet almost to the surface. Open ditches or tile is used to drain cultivated areas.

The native woodland consists of pin oak, willow oak, sweetgum, red maple, and a heavy understory of shrubs and briers. In places pitch pine is the dominant tree.

Fallsington soils are most commonly associated with the Pocomoke, Dragston, and Woodstown soils. They occupy slightly higher areas than the Pocomoke soils and lower areas than the Dragston and Woodstown soils. The surface layer of the Fallsington soils is not so dark as that of the Pocomoke soils but is darker and grayer than those of the Dragston and Woodstown soils.

Representative profile (Fallsington sandy loam, 0 to 5 percent slopes, in a hayfield 1½ miles south of the high school at Glassboro):

A_p 0 to 8 inches, very dark gray (10YR 3/1) sandy loam; weak, fine, granular structure; very friable; 0 to 3 percent of mass consists of white, rounded quartzose pebbles; abrupt, smooth lower boundary.

A_2 8 to 10 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; abrupt, smooth lower boundary.

A_{22} 10 to 16 inches, grayish-brown (2.5Y 5/2) loamy sand; single grained; very friable or nonsticky; pH 6.6; clear, smooth lower boundary.

B_{1g} 16 to 22 inches, grayish-brown (2.5Y 5/2) sandy loam; a few, medium, faint, light olive-brown (2.5Y 5/4) mottles; weak, medium, subangular blocky structure; friable or slightly sticky; gradual lower boundary.

B_{2g} 22 to 28 inches, grayish-brown (2.5Y 5/2), clayey sandy loam; common to many, medium, distinct to prominent, yellowish-brown and light brownish-gray (10YR 5/8 and 2.5Y 6/2) mottles; moderate, medium, subangular blocky structure; friable, but sticky when wet; roots common; pH 5.4.

C 28 to 35 inches, yellowish-brown (10YR 5/4) sand; single grained; loose; pH 5.2; saturated.

D_{1g} 35 to 40 inches, brown (10YR 5/3) sandy clay; with many, coarse, prominent, yellowish-red (5YR 4/6) mottles; massive; very plastic; pH 4.4; very moist.

D_2 40 to 60 inches, strong-brown (7.5YR 5/8) sandy clay; massive; firm or very sticky; pH 4.4; 5 to 10 percent of mass consists of rounded quartzose pebbles; moist.

The description of this profile was made during summer. At that time the C horizon was saturated, the D_{1g} horizon appeared to be very moist, and the D_2 horizon was moist. The site was partly drained by an open outlet ditch.

The thickness of the surface layer varies from place to place according to the amount of soil material deposited from nearby areas. The deposits are lighter in color and contain less organic matter than the normal surface layer of Fallsington soils.

The subsoil ranges from pale gray to brown. The mottling is usually faint where the subsoil is quite sandy and prominent where it contains more clay. In places where the soils are sandiest, a weak organic hardpan has formed in the upper part of the subsoil. In small areas the subsoil has lenses or pockets of clay, commonly below a depth of 30 inches.

In some areas in the western part of the county, the subsoil and substratum contain glauconite, but rarely enough to give the soil an olive color. In places ironstone is present in the soils; it occurs especially in association with glauconite.

Mapped with the Fallsington soils in Gloucester County were small areas of Pocomoke, Dragston, and Woodstown soils.

The Fallsington soils warm slowly. Many areas are in frost pockets. These soils are moderately fertile, but they need drainage. In most areas permeability is moderate to a depth of 30 inches; therefore, underdrains can effectively lower the level of ground water. Permeability below a depth of 30 inches ranges from moderately rapid to slow.

With adequate drainage, the soils are suited to summer vegetables, blueberries, and general farm crops. They are not well suited to asparagus, fruit, and alfalfa. These crops can be grown, however, if deep drainage is provided. Pasture crops and soybeans may be suitable on areas with impeded drainage. Because of the high water table, these soils are generally suitable as sites for ground-water ponds.

Fallsington loam (Fa).—This soil has a profile similar to the one described as representative of the series. The surface layer, however, consists of loam instead of sandy loam, and the subsoil is likely to be sandy clay loam. Fallsington loam generally contains more organic matter and is more fertile than Fallsington sandy loam. However, it requires more intensive drainage, and it warms a little more slowly in spring. Suitable crops are listed under the series description. Capability unit IIIw–1.

Fallsington sandy loam (Fd).—This soil has the profile described as representative of the Fallsington series. In some small areas, the surface layer is loamy sand. In general, this soil is suited to the crops mentioned in the series description. Capability unit IIIw–1.

Freehold Series

Freehold soils have a grayish-brown surface layer over a yellowish-brown sandy loam to sandy clay loam subsoil. The subsoil is underlain by a loose, yellowish-brown sandy substratum.

The soils have formed from sandy marine deposits containing small amounts of glauconite. They are mostly gently sloping, but small areas along streams are steeply sloping. The soils are well drained.

The native woodland consists of mixed oaks and yellow-poplar.

Freehold soils occur in association with Collington, Colts Neck, Marlton, Westphalia, Woodstown, and Dragston soils. They are not mottled like the Woodstown and Dragston soils. They are not so red as the Colts Neck soils. Freehold soils contain less glauconite than the Collington soils and are, therefore, less olive brown. They are much sandier and much less glauconitic than the Marlton soils and are not composed of uniformly fine sand, as are the Westphalia soils.

Representative profile (Freehold loamy sand, 0 to 5 percent slopes, in woodland 1 mile west of Clements Bridge):

A_0 1½ inches to 0 inch, matted, fibrous, very dark brown mor; contains needles of Virginia pine and leaves of white, chestnut, and black oaks.

A_1 0 to 4 inches, brown to yellowish-brown (10YR 5/3) medium or coarse sand; single grained; loose.

A_2 4 to 14 inches, yellowish-brown (10YR 5/4) loamy sand or sand; single grained; 5 percent of mass is rounded quartzose pebbles, 1 to 2 inches in diameter, that occur about 2 inches above the B horizon; boundary abrupt.

B_2 14 to 40 inches, yellowish-red (5YR 4/6) sandy clay or sandy clay loam; massive or very weak, subangular blocky structure; friable when moist, slightly sticky or somewhat plastic when wet, firm to very firm when dry; coarse fragments are more abundant and make up 15 to 20 percent of soil mass, but pebbles do not touch each other; only a few weak vertical cracks; no apparent clay flows; boundary gradual.

BC 40 to 96 inches, yellowish-red (5YR 4/6) sandy loam in discontinuous bands, ½ to 1 inch thick, alternating with bands of strong-brown (7.5YR 5/8) medium to coarse sand, 3 to 4 inches thick; the bands continue to a depth of 8 feet; single grained.

The combined thickness of the A_1 and A_2 horizons in the profile described is less than normal for Freehold loamy sand. The A_2 horizon varies greatly in thickness within short distances.

Normally, there is enough glauconite in the subsoil to be recognized in the field by an experienced observer. In places glauconite is apparent only in the substratum. In some places the older glauconitic deposits have been covered by more recent materials containing much gravel, slabs of ironstone, and little or no glauconite. In some small areas, the soils contain enough glauconite to be similar to the Collington soils; in other areas the soils contain little or no glauconite. Small amounts of mica occur in the soils in places. In many areas the substratum contains material high in iron, either in the form of concretions or as thin, wavy bands that range from loose to firmly cemented.

The color of the subsoil ranges from yellowish brown to yellowish red. The thickness of the subsoil ranges from 12 to 30 inches but averages approximately 20 inches.

Freehold soils are well drained and are easily worked. They are mainly low to moderate in natural fertility. Their subsoil is moderately permeable.

Freehold loamy sand, 0 to 5 percent slopes (FhB).—A profile of this soil is described as representative of the series. The thickness of the surface layer ranges from 10 to 30 inches but averages about 20 inches. In some areas the surface layer consists of sand. In places the subsoil contains little clay or only thin bands of clay. In some low-lying positions, ground water rises into the subsoil late in winter. As a result, the lower part of the subsoil is mottled.

This soil is suited to asparagus, sweetpotatoes, fruit, and early vegetables. Because of droughtiness, the soil is not suited to peppers, tomatoes, or eggplants unless it is irrigated. It is too droughty for corn, hay, and soybeans. Because it is sandy, the soil is susceptible to severe wind erosion and fertilizer leaches out readily. Capability unit IIs–1.

Freehold loamy sand, 5 to 10 percent slopes (FhC).—Except for stronger slopes, this soil is similar to Freehold loamy sand, 0 to 5 percent slopes. As a result, it is more susceptible to water erosion and requires more careful management.

This soil is suited to the same crops as Freehold loamy sand, 0 to 5 percent slopes. Capability unit IIIe–2.

Freehold sand, thick surface variant, 0 to 10 percent slopes (FnB).—This soil has a thicker surface layer than the other Freehold soils. The thickness of the surface layer of sand is normally 30 inches, but it ranges from 10 to 40 inches. Beneath the sand is a sandy loam subsoil similar to that in the other Freehold soils.

This soil is very droughty, is very low in natural fertility, and is subject to severe wind erosion. Fertilizer leaches readily through the soil. This soil is best suited to woodland or to wildlife habitats. Capability unit IVs–1.

Freehold sandy loam, 0 to 2 percent slopes (FoA).—This soil has a profile similar to the one described for the series. The surface layer, however, contains enough silt and clay to be of sandy loam texture. It averages 14 inches in thickness. In small areas the surface layer is fine sandy loam. In some low-lying positions, especially where the soil is underlain by layers of clay, ground water rises into the subsoil. In these places the soil is likely to be wet for short periods during each year and the subsoil may be mottled. Drainage improvement may be needed if fruit or high-value vegetables are grown.

The soil is easily worked and responds well to fertilization. It retains moisture moderately well.

This soil, on the whole, is suited to many kinds of crops. Most areas, however, do not warm soon enough for early vegetables. This soil is not sandy enough for sweetpotatoes. Capability unit I–1.

Freehold sandy loam, 2 to 5 percent slopes (FoB).—Except for stronger slopes, this soil is similar to Freehold sandy loam, 0 to 2 percent slopes. As a result, it is more susceptible to erosion.

The soil is suited to the same crops as the less sloping Freehold sandy loam, but greater care is needed to prevent erosion and loss of moisture through runoff. In places the soil has developed over layers of clay. Where close to the surface, these layers slow the downward movement of water. Consequently, the soil is excessively wet at times. Capability unit IIe–1.

Freehold sandy loam, 5 to 10 percent slopes (FoC).—This soil is similar to the less sloping Freehold sandy loams, but it has a greater susceptibility to erosion. The original surface layer averages about 8 inches in thickness. In some fields there are a few gullies, and in places the plow turns up some of the browner and more clayey subsoil.

This soil is suited to general farm crops, vegetables, and fruit, if erosion is controlled. Capability unit IIIe–1.

Freehold sandy loam, 5 to 10 percent slopes, severely eroded (FoC3).—Erosion has removed most of the original surface layer of this soil and exposed the more clayey subsoil. Because of the finer texture and lack of organic matter, the present surface layer has poor tilth. It absorbs water more slowly, has greater runoff, and is harder when dry than that of the uneroded Freehold soil on comparable slopes. This soil needs intensive management. Erosion is especially difficult to control.

If carefully managed, this soil can be used to grow fruit, vegetables, small grains, hay, and pasture plants. Yields are not high. Capability unit IVe–1.

Freehold sandy loam, 10 to 15 percent slopes, severely eroded (FoD3).—This soil has lost much of the original surface soil through erosion. The remaining surface soil was mixed with the more clayey subsoil by tillage. In places gullies have cut deeply or are so numerous that farming is impractical. The soil is very low in organic matter, and crop yields are poor.

In some of the less eroded areas, the soil has a loamy sand surface layer. Small areas of Collington and Colts Neck soils and also of a clay-textured soil are included with this soil. The areas of clay-textured soil have especially rapid runoff and are particularly difficult to work because they are either too wet or too dry most of the time.

Because of the severe hazard of erosion, this soil is best suited to pasture, hay, forest, or wildlife habitats. Capability unit VIe–1.

Freehold soils, 10 to 15 percent slopes (FsD).—The texture of the surface layer of these soils is predominantly loamy sand, but in places it is sandy loam. Some places in cultivated fields have been moderately eroded. Consequently, the thickness of the surface layer ranges from 6 to 14 inches. In spots where most of the original surface layer has been eroded, plows have cut into the more clayey subsoil.

This mapping unit includes areas of Collington and Colts Neck soils that are not extensive enough to be mapped separately. Also included are small areas of soils that are silty clay in texture to a depth of 3 or more feet. The clayey soil is difficult to plow because it is either too wet or too dry most of the time.

Because of the hazard of erosion, these strongly sloping soils are generally suited only to small grains and fruit. Capability unit IVe–1.

Freehold, Colts Neck, and Collington soils, 15 to 25 percent slopes (FtE).—This undifferentiated unit is composed mainly of Freehold loamy sand. It also includes Freehold sandy loam, Colts Neck sandy loam and loamy sand, and Collington sandy loam and loamy sand. These soils were mapped as an undifferentiated unit because they occur in an irregular pattern and occupy steep slopes, and because there are many variations within each soil.

Normally, the surface layer is not so thick as those described in the representative profiles of the Freehold, Colts Neck, and Collington series. In small cultivated areas, erosion has been severe enough to expose the more clayey subsoil and to cut gullies.

Some small areas of very clayey soil have been included in this mapping unit. Seeps are common in places where sand overlies clay.

The soils of this undifferentiated unit have more rapid runoff than soils on lower slopes, and, therefore, they are more droughty. Because of rapid runoff and the hazard of erosion, these steep soils are best suited to pasture, hay, woodland, and wildlife habitats. Capability unit VIe–1.

Freehold, Colts Neck, and Collington soils, 25 to 40 percent slopes (FtF).—These soils are on steep banks, mostly along streams, where the soil material is dominantly sandy to very sandy. In places the loose, friable sandy surface layer is underlain, at depths of about 10 to 15 inches, by somewhat more clayey subsoil. This subsoil is similar to the normal subsoil of the Freehold, Colts Neck, and Collington series. Elsewhere, the materials underlying the surface layer are the geologic strata from which these soils normally develop. The true subsoil, where it occurs, is likely to be thinner than that of the normal soil, and it may be less clayey.

A clayey soil, weakly developed in thick beds of clay, is included in this mapping unit.

As a rule, glauconite occurs in the soils of this undifferentiated unit in small amounts; but in a few areas, it constitutes from 15 to 40 percent of the soil material.

Much of the rainfall runs off of these steep soils. The sandy areas are droughty, although small, scattered spots may be moist during some seasons because of underground seepage.

Because of the steep slopes, these soils are subject to severe erosion. They are productive of forest, however, and are suitable for wildlife habitats. Capability unit VIIe–1.

Fresh Water Marsh

Fresh water marsh (Fw).—This miscellaneous land type is covered almost continually by water. It occurs primarily along the larger streams, just above the tidal marshes. The tide level controls the degree of drainage possible. Some areas are flooded by extremely high tides, and most areas are frequently flooded by the streams.

Organic material is abundant in the surface soil, and in places it extends to a depth of several feet. In some spots organic matter makes up most of the soil material and may constitute peat or muck. The layer underlying the highly organic horizon ranges from sand to clay but is predominantly sand mixed with gravel.

The native vegetation consists of marsh grasses and shrubs. The areas are too wet for any use except wildlife habitats. Capability unit VIIIw-1.

Keyport Series

Keyport soils have a dark-brown to dark grayish-brown plow layer over yellowish-brown, mottled, plastic clay subsoil. These moderately well drained soils have formed in clay deposits and are nearly level to steeply sloping. During some seasons nearly level soils have excess water on the surface as well as in the soil. Small areas occur throughout the county, but the soils are principally in the general area of brown clay soils (shown by symbol KLE on the general soil map).

The natural forest includes red, white, and black oaks, beech, sweetgum, and yellow-poplar.

These soils are principally associated with Lenoir and Elkton soils, which have developed from the same deposits of clay. The Keyport soils are generally more sloping than the Lenoir and Elkton soils, and, therefore, they are better drained and browner.

Representative profile (Keyport loam, 1 percent slope, in a tomato field 1⅛ miles south of Repaupo):

A_p 0 to 8 inches, brown or dark-brown (10YR 3/3) loam; moderate, fine, granular structure; friable; abrupt, smooth lower boundary; 4 to 10 inches thick.

B_{2g1} 8 to 24 inches, yellowish-brown (10YR 5/6 to 5/8) silty clay with few, faint mottles; strong, fine, angular blocky structure; firm or plastic; roots abundant; peds coated with clay.

B_{2g2} 24 to 60 inches, yellowish-brown (10YR 5/8) silty clay with many, fine, distinct mottles of gray (10YR 5/1) that are more abundant at greater depths; strong, medium, angular blocky structure; very firm or plastic.

The texture of the subsoil ranges from silty clay to clay. The subsoil normally continues to a depth of 30 inches. In places interbedded sand occurs at a depth of 24 inches.

The mottling in the subsoil indicates that in wet seasons the Keyport soils have been poorly aerated. It is believed that the poor aeration is caused by the inability of water to drain through the clayey subsoil. In nearly level areas, excess water saturates the soil material above the clay. Permeability is too slow for practical use of underdrains. Ditches are more effective in getting rid of surface water.

In small areas the soil has better drainage than normal, and it is not mottled.

The Keyport soils hold a large supply of available moisture. Because of restricted aeration, however, roots may not be able to reach the water held in the clayey horizons. Wetness limits tillage and the number of suitable crops. In sloping areas, erosion is severe because water soaks into the soils slowly.

The soils are moderately fertile. Fertilizers do not leach out readily. Much lime, however, is needed to correct the acidity of the soil.

These soils are suited to general farm crops under favorable management that includes the removal of standing water and the prevention of erosion.

Keyport sandy loam, 0 to 5 percent slopes (KpB).—The texture of the surface layer of this soil is dominantly sandy loam. But some areas with silt loam and silty clay loam textures have been included because it was not practical to map them separately. Also included with this soil are small areas of the more strongly mottled, wetter Lenoir soil.

The thickness of the surface layer of Keyport sandy loam, 0 to 5 percent slopes, ranges from 8 to 16 inches. Areas on slopes of 3 to 5 percent are subject to erosion if left exposed. Erosion has removed part of the surface layer in cultivated fields. Capability unit IIw-3.

Keyport sandy loam, 5 to 10 percent slopes, severely eroded (KpC3).—This soil has lost most of its original surface layer, and the very clayey subsoil has been exposed. The exposed subsoil is low in organic matter and much harder to cultivate than the original surface layer. Also, it crusts more readily, and seeds do not germinate so uniformly in it.

Under proper management, including control of erosion, this soil is suited to general farm crops. Capability unit IVe-2.

Klej Series

Klej soils have a grayish-brown plow layer over yellowish-brown sand. The sand is faintly mottled because of fluctuating ground water. In years of normal rainfall, the water table is highest late in winter, but it may be high during any prolonged wet spell. The normal high water level is around 30 inches from the surface; it drops to about 60 inches in summer. On most farms on which high-value crops are grown, drainage has been improved either by open ditches or by underdrains.

The nearly level Klej soils have formed from coarse-textured sediments. They are most extensive in the area of sandy flats along the Delaware River (shown by symbol DWSK on the general soil map) but occur also in scattered areas in the eastern part of the county. The soils are moderately well drained to somewhat poorly drained.

The native forest commonly contains black, white, and chestnut oaks and, in places, pitch pine.

Klej soils occur principally in association with Lakeland, Downer, Woodstown, and Dragston soils. They can be distinguished from the Lakeland and Downer soils by their mottled or distinctly paler third horizon. The second horizon of the Klej soils is somewhat sandier than that of the Woodstown and Dragston soils.

Representative profile (Klej loamy sand, 0 to 5 percent slopes, in a cultivated field one-fourth mile northeast of the Salem County line along U.S. Highway No. 130):

A_p 0 to 12 inches, dark-brown (10YR 3/3) loamy sand; single grained; loose; no coarse fragments; abrupt lower boundary.

C_1 12 to 30 inches, yellowish-brown (10YR 5/8) medium sand; single grained; loose; no coarse fragments.

C_2 30 to 40 inches, strong-brown (7.5YR 5/8) medium sand with few, faint mottles; single grained; loose.

In areas of hardwood forests, Klej soils develop a micropodzol horizon in about the upper 2 inches. In areas under abundant pitch pine, the uppermost 4 inches is grayer than the micropodzol horizon of hardwood forests and the A_p horizon of the profile just described. These differences are destroyed when the land is plowed.

Klej soils generally contain little gravel. In places, however, gravel either is scattered through the soil or is in thin beds several feet below the surface. In local areas the substratum contains clay lenses, usually not more than 1 foot thick.

Mottling is generally faint; it is normally between depths of 12 and 30 inches. In places the subsurface horizon is distinctly paler, though not mottled. Ground water periodically saturates the substratum and possibly the lower part of the subsoil, even though permeability is very rapid. Layers of clay, deep in the soil, restrict the downward movement of ground water.

Klej soils are low in organic matter, low in clay, and low in natural fertility. Underdrains work well in the soils. The loose surface soil is subject to wind erosion if it is not protected. The soils are easy to work.

Klej soils were not mapped separately. They are interspersed with Woodstown soils and were mapped as Woodstown and Klej loamy sands, 0 to 5 percent slopes, described under the Woodstown series.

Kresson Series

Kresson soils have a dark grayish-brown plow layer over an olive clay subsoil that is prominently mottled. Under natural conditions at least part of the subsoil is saturated late in winter and during unusually wet periods.

The soils have developed from glauconitic clay marine deposits, commonly covered with thin sandy sediments. There is enough glauconite in the parent materials to impart olive colors to the soils. Where the material is unoxidized, it is almost black. These somewhat poorly drained soils occur only in a narrow strip of olive clay soils (shown by the symbol MK on the general soil map). They are in depressions that receive runoff and possibly seepage from adjoining higher slopes.

The native forest consists of mixed oaks but, in places, includes yellow-poplar and sweetgum.

The Kresson soils occur in association with Marlton and Colemantown soils, which were derived from the same kind of parent material. Mottling, if present in Marlton soils, is confined to the lower subsoil, whereas in Colemantown soils it occurs up to the surface and makes the soil grayer.

Representative profile (Kresson sandy loam, 0 to 2 percent slopes, in a formerly cultivated field one-fourth mile north of Mullica Hill):

A_p 0 to 6 inches, very dark grayish-brown (2.5Y 3/2) sandy loam; weak, fine, granular structure; very friable; roots common; very strongly acid; abrupt, smooth lower boundary; 6 to 8 inches thick.

A_{2g} 6 to 10 inches, olive-brown (2.5Y 3/4) sandy loam with common, fine, faint, olive-brown (2.5Y 4/4) mottles; weak, fine, granular structure; very friable; roots common; very strongly acid; clear, smooth lower boundary; 4 to 10 inches thick.

B_{2g1} 10 to 16 inches, olive-brown (2.5Y 4/4) to olive (5Y 4/4) fine sandy clay loam or fine sandy clay with common, medium, distinct brown (7.5YR 4/4) mottles; strong, medium, angular and subangular blocky structure; firm or slightly sticky and strongly plastic; roots common; many fine pores; thin, complete clay films on peds; very strongly acid; gradual, smooth lower boundary; 4 to 8 inches thick.

B_{2g2} 16 to 24 inches, olive (5Y 4/3) to dark-green (or greener) clay with common, medium, distinct, dark-brown (7.5YR 4/4) and yellowish-red (5YR 4/6) mottles; moderate, medium, angular and subangular blocky structure; firm or sticky and strongly plastic; few roots; many fine pores; thin clay films surround most peds; very strongly acid; gradual lower boundary; 6 to 12 inches thick.

C_g 24 inches +, about the same as horizon above, but massive.

In places the substratum of these soils is interbedded with sand that is saturated in winter and other especially wet periods. In some places the water in these sandy layers is under pressure.

Natural fertility is moderate. Fertilizers do not easily leach out of these soils. Successful crop production is uncertain, however, unless drainage is improved. Permeability is so slow that the use of underdrains alone is ineffective in most places. Where the soils have saturated layers of sand, however, underdrains might be beneficial. The available moisture-holding capacity is high.

Kresson sandy loam, 0 to 5 percent slopes (KrB).—This is the only Kresson soil in the county. The friable surface layer is predominantly sandy loam, but in places it is loam or clay loam. The thickness of the surface layer varies according to the amount of material deposited on it. This material has eroded from higher adjoining slopes.

The soil is subject to frost action, particularly in areas where the surface layer has more clay. It dries out very slowly.

In its natural condition, this soil is suited to pasture, soybeans, and corn. If adequately drained, it is also suited to most annual vegetables. Capability unit IIIw-2.

Lakehurst Series

Lakehurst soils have a gray surface layer, 6 or more inches thick, over several inches of dark-brown or dark reddish-brown sand coated with organic matter. Under this material is yellowish-brown sand. In most places the substratum, or possibly the lower part of the subsoil, is mottled. Normally, the water table is within 3 feet of the surface in winter, but it drops to a depth of about 5 feet in summer.

The soils have developed from thick deposits of medium and coarse sand. In places various amounts of quartzose pebbles are mixed with the sand. These moderately well drained to somewhat poorly drained soils occupy very slight slopes in the eastern part of the county. These slopes are along the larger streams, such as Hospitality Branch and Great Egg Harbor River, and the tributaries of Maurice River near Porchtown.

The native forest is composed mostly of pitch pine mixed with black, white, post, and scrub oaks. The soils are extremely acid.

Lakehurst soils are not extensive in this county. They occur primarily in association with Lakewood, Leon, and St. Johns soils. Lakehurst soils are not so dry as the Lakewood soils nor so wet as Leon and St. Johns soils.

Representative profile (Lakehurst sand, 0 to 5 percent slopes, in an idle field one-half mile west of Berryland):

A_p 0 to 4 inches, dark-gray (2.5Y 4/1) sand; single grained; loose; abrupt, wavy lower boundary; 0 to 5 inches thick.

A_2 4 to 16 inches, light-gray (10YR 6/1) sand; single grained; loose; clear, wavy lower boundary; 12 to 20 inches thick.

B_2 16 to 22 inches, dark-brown (7.5YR 4/4) loamy sand; single grained to weak, fine, granular structure; loose to slightly firm; roots are concentrated in this horizon; firm concretions, one-fourth inch in diameter, are common; brown sand occurs around roots and extends 6 to 8 inches into the underlying horizon; gradual, wavy lower boundary; 2 to 6 inches thick.

B_3 22 to 30 inches, yellowish-brown (10YR 5/6) sand; single grained; loose; few concretions; gradual, smooth lower boundary; 6 to 20 inches thick.

C_{1g} 30 to 54 inches, light yellowish-brown (10YR 6/4) sand with common, medium, faint mottles; single grained; loose; few concretions.

C_{2g} 54 to 60 inches, yellowish-brown (10YR 5/6) sand with common, medium, faint mottles; single grained; few concretions.

In areas east of Berryland on the south side of Great Egg Harbor River, the bleached surface horizon is unusually thick; in places it exceeds 20 inches in thickness.

The dark organic horizon is generally thin, and it is discontinuous, but in places it is very dark and as much as 6 inches thick. Small, firm concretions occur in the B horizon.

Lakehurst soils are very low in organic matter, clay, and natural fertility. Fertilizer leaches out easily, and the soils are extremely acid. If exposed, the soils are easily blown. Permeability is very rapid. Despite the somewhat high water table, these very sandy soils are droughty in dry periods.

Because the soils are droughty and low in fertility, most crops cannot be profitably grown. Most areas are in forest, and cleared areas are generally idle.

Lakehurst sand, 0 to 5 percent slopes (LaA).—A profile of this soil was described as representative of the series. This is the only Lakehurst soil in the county. Some areas mapped with this soil near Cedar Lake have a profile similar to the representative profile to depths of 20 to 24 inches; however, the underlying material is clay instead of loose sand. Capability unit VIIs–1.

Lakeland Series

Lakeland soils are deep, loose, yellowish-brown sands that have a grayish-brown surface horizon several inches thick. They have developed from thick deposits of mainly medium and coarse sand. In places there are various amounts of rounded quartzose pebbles. These excessively drained soils occur mainly on gently sloping areas in the eastern part of the county.

The native forest consists mostly of pitch pine mixed with shortleaf pine and black, white, chestnut, post, and scrub oaks.

Lakeland soils occur in association with Downer, Klej, Woodstown, and Lakewood soils. They do not have as thick or as gray a surface layer as the Lakewood series, and they are sandier than the Downer and Woodstown soils. They are better drained than the Klej and Woodstown soils.

Representative profile (Lakeland sand, 2 percent slope, in an undisturbed area 1 mile northwest of Hardingville):

A_0 ½ to 0 inch, nearly black (10YR 2/1) mor; weak, fine, granular structure; many fibrous rootlets; isolated, clean, quartzose grains are conspicuous.

A_1 0 to 4 inches, dark-gray (10YR 4/1) sand; single grained; loose; very strongly acid; sand is clean; many rounded, silt-sized particles of organic matter mixed with the sand; abrupt, smooth lower boundary; 2 to 6 inches thick.

C_1 4 to 12 inches, yellowish-brown (10YR 5/4) sand; single grained; loose; very strongly acid; sand is slightly coated; numerous silt-sized particles of organic matter mixed with the sand; clear, smooth lower boundary; 6 to 18 inches thick.

C_2 12 to 24 inches, yellowish-brown (10YR 5/6) sand; single grained; loose; very strongly acid; most of the sand is coated, but some is clean; clear, smooth lower boundary; 10 to 15 inches thick.

C_3 24 to 42 inches, light yellowish-brown (10YR 6/4) sand; single grained; loose; very strongly acid; many sand grains are coated; gradual, smooth lower boundary; 10 to 15 inches thick.

C_4 42 to 108 inches, light yellowish-brown (10YR 6/4) sand; single grained; loose; very strongly acid; few or no sand grains are coated.

In some forested areas, Lakeland soils develop micropodzol horizons in the upper 4 inches. These horizons are destroyed when the fields are plowed. In cultivated fields the soils have a grayish-brown (10YR 5/2) to dark grayish-brown (2.5Y 4/2) A_p horizon.

Normally, the texture throughout the profile ranges from sand to loamy sand.

The Lakeland soils are very low in organic matter, clay, and natural fertility. Fertilizer leaches out readily. Permeability is very rapid, and the soils are very droughty. They are highly susceptible to wind erosion if left exposed. Because of these limitations, the production of most crops is unprofitable. Cultivated areas are used mostly for sweetpotatoes and peaches. Most of the acreage of Lakeland soils is in forest.

Lakeland sand, 0 to 10 percent slopes (LdB).—A profile of this soil is described as representative of the series. This is the only Lakeland soil in the county.

The surface layer of this soil is predominantly sand, but in small areas it is loamy sand. Normally, the amount of clay in the subsoil is not much greater than that in the surface layer and substratum; however, this mapping unit includes soils (among them the Downer soils) that have slightly more clay in the subsoil. In some areas the soil has layers of clay in the substratum. Ground water normally is below a depth of 5 feet but is higher in small, wet areas.

Because most of this soil is forested, it was not feasible to map the included soils separately. Capability unit IVs–1.

Lakewood Series

Lakewood soils have a gray surface layer, 6 or more inches thick, over a discontinuous, brown subsoil. This is underlain by deep, yellowish-brown loose sand. These soils have developed from thick beds of sand. In places they contain various amounts of rounded quartzose pebbles. These excessively drained soils occupy gentle slopes in the eastern part of the county. They are not extensive.

The native forest consists of pitch pine, some shortleaf pine, and a scattering of black, white, and scrub oaks. The oaks are generally of poor quality, and many are diseased.

The Lakewood soils occur in association with Lakeland, Lakehurst, and Leon soils, all of which are very sandy. The surface layer of the Lakewood soils is more leached than that of Lakeland soils, and the soil material throughout the profile is not so wet as that of Lakehurst and Leon soils.

Representative profile (Lakewood sand, 2 percent slope, in an idle field five-eighths mile west of Berryland):

A_p 0 to 6 inches, dark-gray (2.5Y 4/1) sand; single grained; loose; extremely acid; few white, rounded quartzose pebbles; abrupt, smooth lower boundary; 4 to 8 inches thick.

A_2 6 to 8 inches, grayish-brown (2.5Y 5/2) sand; single grained; loose; extremely acid; clear, wavy lower boundary; 0 to 4 inches thick.

B_2 8 to 12 inches, brown (10YR 5/3) sand; single grained; loose; 0 to 4 inches thick.

B_3 12 to 30 inches, yellowish-brown to brownish-yellow (10YR 5/6 to 10YR 6/6) sand; single grained; loose; large roots are concentrated in this horizon; firm concretions, up to 1 inch in diameter, are common; extremely acid; gradual, wavy lower boundary; 15 to 20 inches thick.

C 30 to 72 inches, light yellowish-brown (10YR 6/4) sand; single grained; loose; extremely acid.

In many forested areas, the soils have an A_{00} horizon of pine needles that averages 2 inches in thickness. In many other places, however, this horizon is lacking. An A_1 horizon, which is 1 inch thick, occurs in some profiles in forested areas, but in most places this horizon is also lacking.

In Gloucester County the bleached surface layer of Lakewood soils averages about 8 inches in thickness. It is thinner than that of the normal Lakewood soils in adjacent counties. The color of the surface layer ranges from dark gray to light gray. In places the brown B_2 horizon is absent. Much of the acreage of Lakewood soils in this county occurs on stream terraces. As a result, the water table is closer to the surface (within 5 to 10 feet) than is normal for the series.

Lakewood soils are very low in organic matter, clay, and natural fertility and are very droughty. They are extremely acid. Fertilizer leaches out of the soils readily. Permeability is very rapid. Because of these limitations, crop production ordinarily is not profitable. The soils are primarily in forest, which is their best use.

Lakewood sand, 0 to 5 percent slopes (LeB).—A profile of this soil is described as representative of the series. This is the only Lakewood soil in the county. Capability unit VIIs–1.

Lenoir Series

Lenoir soils have a dark grayish-brown surface layer over yellowish-brown, mottled silty clay to clay subsoil. The subsoil is underlain by a clay substratum. Under natural conditions, surface water stands on these soils late in winter and during other wet seasons. The drainage on farmed areas of these soils has been improved.

The Lenoir soils have developed from clay deposits that contain little or no glauconite. These somewhat poorly drained soils occupy low-lying positions and receive runoff from the adjoining slopes. They occur throughout the county in small areas.

The most common native trees are pin oak, willow oak, beech, sweetgum, white oak, and yellow-poplar.

Lenoir soils occur mostly in association with Keyport, Elkton, and Bayboro soils. They are wetter than the Keyport soils and, therefore, have mottling closer to the surface. They are not so wet as the Elkton and the Bayboro soils and, therefore, have a browner surface soil and less gray coloring in the subsoil.

Representative profile (Lenoir loam, 1 percent slope, in a tomato field one-fourth mile north of Oak Grove School):

A_p 0 to 8 inches, dark grayish-brown (10YR 4/2) loam with few, distinct, yellowish-brown (10YR 5/8) mottles; medium, fine, granular structure; friable when moist; abrupt, smooth lower boundary; 6 to 12 inches thick.

B_{1g} 8 to 24 inches, yellowish-brown (10YR 5/8) silty clay with many, medium, prominent, gray (10YR 6/1) mottles; moderate, medium, blocky structure; very plastic.

B_{2g} 24 to 36 inches, light-gray (10YR 7/1) silty clay with many, prominent mottles of yellowish brown (10YR 5/8); moderate, medium, blocky structure; very plastic.

Where the surface layer is sandy loam, it probably consists of sediments that once overlaid the clay formation from which the Lenoir soils normally develop. The color of the lower subsoil ranges from yellowish brown to gray. In most areas the texture of the surface soil is loam, but it ranges from sandy loam to silty clay loam.

These soils have a moderate content of organic matter and are moderately fertile. The yields and the number of crops that are suitable, however, are limited by the moderately slow permeability and resulting poor soil aeration after prolonged wetness. The soils are so slowly permeable that underdrains ordinarily do not work well enough to be practical.

Lenoir and Keyport loams, 0 to 5 percent slopes (LkA).—This mapping unit contains about equal acreages of Keyport loam (described under the Keyport series) and Lenoir loam. Included with these soils are small areas of Elkton soil.

The lower slopes are occupied mostly by Lenoir loam. Drainage must be improved if crops are to be grown. The upper slopes consist mostly of Keyport loam. Control of erosion is needed on these slopes.

This mapping unit is best suited to general farm crops, pasture, or woodland. The soils are hard to work because they dry out slowly. They are subject to severe frost action. Capability unit IIIw–2.

Leon Series

Leon soils have a dark-gray surface layer over a dark-brown subsoil, or B horizon, that is stained by organic matter. The subsoil is normally from 15 to 25 inches below the surface. Generally, grayish-brown sand occurs below the layer stained by organic matter. In winter the water table is usually about 1 foot below the surface; in summer it drops a foot or more. In many places the brown B horizon has been cemented into a hardpan by the accumulation of organic matter. The hardpan, however, is not continuous. This horizon normally hardens whenever the water table is low enough for the soil material to dry.

The poorly drained Leon soils occur in the eastern part of the county. They are not extensive. They have formed on nearly level stream terraces.

The native forest is composed of pitch pine, a scattering of blackgum and red maple, and a dense undergrowth of shrubs.

Leon soils occur mainly in association with St. Johns, Lakehurst, and Lakewood soils. They are wetter than

Lakewood and Lakehurst soils but not so wet as St. Johns soils.

Representative profile (Leon sand, in a blueberry field one-eighth mile northeast of Berryland):

A_p 0 to 6 inches, dark-gray (10YR 4/1) to very dark gray (10YR 3/1) sand; very weak, fine, granular structure or single grained; very friable; about 1 percent of soil mass is white, rounded quartzose pebbles; moderately high in organic matter; abrupt, smooth lower boundary; 4 to 8 inches thick.

A_2 6 to 16 inches, light-gray (10YR 6/1) sand; single grained; loose; clear, smooth lower boundary; 2 to 24 inches thick.

B 16 to 20 inches, very dark grayish-brown (10YR 3/2) to very dark brown (10YR 2/2) loamy sand or sand; massive; firm to friable when moist, hard when dry; tree roots penetrate this horizon; gradual, smooth to wavy lower boundary; 3 to 8 inches thick.

C 20 to 40 inches, gray (2.5Y 6/1) sand; single grained; loose; 0 to 10 percent of soil mass is quartzose pebbles; horizon is saturated.

At the site of the profile just described, the level of the ground water was controlled for blueberry culture.

Most of the Leon soils have little or no mottling. In places where clay is mixed with the sand, however, mottling is common. In some places the C horizon is yellowish brown. Clayey layers, either gray or brightly colored, commonly occur below a depth of 30 inches. Some areas with a loamy sand surface layer were mapped with areas of Leon sand.

The organic hardpan, in places, is somewhat reddish and is believed to have iron mixed with the organic matter.

A moderate amount of organic matter occurs in the surface layer of the Leon soils, but it is easily lost through cultivation. Permeability in the B horizon is moderately rapid. The water table is high because of the slowly permeable, clayey layers that are 3 to 10 or more feet below the surface. The soils are very low in natural fertility and are extremely acid. When artificially drained, they hold very little water.

These soils are too wet and too infertile for the growing of most crops. With careful drainage and control of the level of ground water, they are suitable for blueberries. They are, however, considered less suitable than the St. Johns soils.

Leon sand (Lo).—This is the only Leon soil in the county. The Leon and St. Johns soils are too interspersed to be mapped separately in all parts of the county. Consequently, nearly all areas of Leon sand contain some St. Johns sand. In some areas the texture of the surface layer is loamy sand. Capability unit Vw-1.

Made Land

Made land, coarse materials (Mc).—This miscellaneous land type is composed mainly of coarse material pumped from the channel of the Delaware River into the adjacent diked areas. Large stones, gravel, and coarse sand settled mostly near the place of discharge. The finer material settled in the lower areas at some distance from the discharge pipe. But since several pumpings were made and the discharge pipe was moved from place to place, the texture and depth of the layers vary from one area to another. The fill material ranges in depth from 10 to 20 feet.

After the pumping operations were completed and the water drained off the surface, a tall grass (*Phragmites* sp.) covered the area. It held the soil material in place and added organic matter.

Made land, coarse materials, is low in natural fertility and ranges from strongly acid to medium acid. It is sandy and holds little water. In some places layers of silt and clay are near the surface; these layers slow drainage and retain some moisture. Because of their location, areas of this land type will probably be used as industrial sites.

This mapping unit includes abandoned sand, gravel, and borrow pits that have been leveled. It is not classified as to capability.

Made land, fine materials (Mf).—This miscellaneous land type is composed mostly of fine material pumped from the channel of the Delaware River into diked areas. The fine material has settled some distance from the discharge pipe. But because pumping was done at intervals and the discharge pipe was moved from place to place, the texture of the soil material in the different layers varies. The fill material may be as much as 20 feet deep.

The surface layer of the soil material is grayish brown, and the second layer is gray with prominent mottles. The soil drains somewhat slowly, except where drainage has been improved. The level of the ground water depends upon the texture of the soil material and the amount of artificial drainage installed since pumping was stopped.

As soon as pumping was completed and the soil material dried somewhat, a grass (*Phragmites* sp.) began to cover the surface. This grass grows tall and adds large amounts of organic matter to the soil material.

The soil material ranges from strongly acid to medium acid. It is moderately fertile but extremely low in phosphorus.[2] Large amounts of water are held by the silty soil material. Drainage of this land type may be complicated by the variability of texture in some places and by the uniformity of texture in others. This mapping unit is not classified as to capability.

Marlton Series

Marlton soils have a dark grayish-brown sandy surface layer over olive, plastic subsoil. Beneath the subsoil is olive clay that, in places, contains beds of sand. The subsoil and substratum consist of highly glauconitic and clayey material. The olive colors come from the green mineral called glauconite; the content of glauconite in the parent material ranges from 30 to more than 90 percent (*5*).

The soil occurs in the narrow belt of olive clay soils (shown by symbol MK on the general soil map). They have formed mostly on areas with gentle slopes but also on areas with steep slopes adjacent to streams. They are well drained to moderately well drained.

The native woodland consists of mixed oaks.

Marlton soils occur primarily beside Kresson, Colemantown, Matlock, Westphalia, and Freehold soils. They are not so wet as the Kresson, Colemantown, and Matlock soils, which have developed on similar geologic material.

[2] Based on unpublished data from the Gloucester County Soil Testing Laboratory.

Marlton soils contain more clay than Freehold and Westphalia soils.

Representative profile (Marlton sandy loam, 0 to 5 percent slopes, in a cornfield 1 mile northwest of Fairview):

A_p 0 to 8 inches, dark grayish-brown (2.5Y 4/2) sandy loam; weak, fine, granular structure; friable; abrupt, lower boundary.

A_2 8 to 12 inches, yellowish-brown (10YR 5/6) sandy loam; weak, fine, granular structure; very friable; abrupt lower boundary.

B 12 to 36 inches, olive (5Y 4/4) clay mixed with a small amount of fine or very fine sand; free of mottling; moderate, medium and coarse, blocky structure; very dense, plastic; clay coats on the peds; clear lower boundary.

C 36 to 60 inches, alternate layers of olive (5Y 5/4), glauconitic sand and olive (5Y 4/4), dense, plastic clay; below a depth of 48 inches, the clay has common, medium, distinct mottles of yellowish brown (10YR 5/6) on as much as 5 to 10 percent of an exposed surface; the clay layers are 4 to 6 inches thick; the sand layers are 6 to 8 inches thick and have no structure.

Under natural vegetation, Marlton soils commonly have a micropodzol horizon at the surface that does not exceed 1 inch in thickness.

In most places, Marlton soils are olive and lack mottling, but in some the upper part of the subsoil is dark reddish brown. The lower part of the subsoil is mottled in some areas. In some places the substratum is made up of thick layers of sandy clay; in others it consists of layers of clay alternating with thin beds of sand.

The thickness of the surface layer of Marlton soils is less than that of most soils with sandy loam surface layers in the county. It averages about 10 inches. Only the sandy loam type has been mapped in Gloucester County, but there are small areas with loam, loamy sand, and clay loam surface layers. In some areas rounded quartzose pebbles are scattered on or through the soils.

Marlton soils are moderately fertile. They are high in potassium (6 to 8 percent K_2O) (*5*), but this element is not in a form that is easily available to plants. Large amounts of lime are needed to correct the acidity of these clayey soils. Because the clayey subsoil is moderately slowly permeable to water and air, the soils may contain excessive water in winter and during other prolonged wet periods. They hold a large amount of available moisture. Marlton soils are mostly well drained but are occasionally too wet for tillage on nearly level areas.

Marlton sandy loam, 0 to 5 percent slopes (MrB).—Most of this soil has enough slope to be subject to runoff and erosion. The surface layer generally consists of 8 inches or more of sandy loam. In some eroded spots in cultivated areas, however, the more clayey subsoil has been plowed up and mixed with the surface layer.

In low positions small areas of somewhat poorly drained Kresson soil are included with this soil.

This Marlton soil is suited to general farm crops and most vegetables. It is not well suited to sweetpotatoes and asparagus because the clayey subsoil is generally too near the surface. Alfalfa does well except in spots where surface water is trapped. Apple trees are difficult to establish, because of excess water. Capability unit IIe–2.

Marlton sandy loam, 5 to 10 percent slopes (MrC).—Some cultivated areas of this soil have been eroded. In these areas the clayey subsoil is nearer the surface and runoff and the hazard of further erosion have increased. In some places the olive clay subsoil is within plow depth. Here, tillage will mix the subsoil with the remaining part of the sandy loam surface layer, if the moisture content is favorable. If the ground is dry and hard in such places, however, the plow will slide on top of the subsoil without turning full furrows.

The movement of water downgrade in the surface soil just above the clayey subsoil may cause seep spots on the lower parts of slopes.

This soil is best suited to general farm crops. Apple trees can be grown. Capability unit IIIe–3.

Marlton sandy loam, 5 to 10 percent slopes, severely eroded (MrC3).—In this severely eroded soil, the clay subsoil is generally mixed with the surface layer by tillage. Patches of dark-colored subsoil can be seen in plowed fields. If the soil is to be plowed properly, it must have a favorable content of moisture. The clayey subsoil material is sticky when wet and hard as a brick when dry. Scattered gullies are present.

Tillage is restricted on this soil, seed germination is poor, and yields of crops are low and irregular. The hazards of runoff and erosion are severe. Frost action is also severe.

Small grains and hay are the most suitable crops. Capability unit IVe–2.

Marlton sandy loam, 10 to 15 percent slopes (MrD).—Runoff is rapid on this soil, as the subsoil takes in water slowly. If the soil is left exposed, there is intensive erosion. Some fields contain spots that have been eroded down to the sticky, clayey, olive subsoil, and some contain shallow gullies.

Because of the special management required for cultivation, this soil is best suited to hay, pasture, woodland, and wildlife habitats. Capability unit IVe–2.

Marlton sandy loam, 10 to 15 percent slopes, severely eroded (MrD3).—This soil has lost so much of the original surface layer that, in most areas, the plow layer extends into the clay subsoil. The olive clay soil now at the surface is hard to plow and cultivate because it is either too wet or too dry most of the time. Yields of crops are low. Because of the strong slopes, slow permeability, and rapid runoff, the hazard of erosion is severe.

This soil needs more organic matter. It is best suited to hay, pasture, woodland, or cover for wildlife. Capability unit VIe–2.

Marlton sandy loam, 15 to 25 percent slopes (MrE).—The texture of the surface layer of this soil ranges from sandy loam to clay loam.

In abandoned fields, the soil is generally eroded. Shallow gullies that extend into the olive clay subsoil are hard to obliterate. Runoff is rapid, and, where the soil is exposed, erosion is severe.

This soil is best suited to woodland, pasture, or wildlife habitats. Most areas are in forest. Capability unit VIe–2.

Marlton sandy loam, 25 to 40 percent slopes (MrF).—Most of this soil is on steep slopes along streams. The soil horizons generally are indistinct, and the surface layer is thin over the clay subsoil or the interbedded clayey and sandy geologic stratum. Some especially steep slopes have been cut back by the streams. On these slopes an olive-green geologic stratum is exposed or is covered by only a few inches of what might be regarded as surface soil. Runoff is very rapid, and exposed areas of this soil erode severely. Capability unit VIIe-2.

Matlock Series

Matlock soils have a nearly black surface layer over an olive clay subsoil that is mottled. They have developed from clay marine deposits that contain enough glauconite to impart olive colors to the soil and parent material. In any location, however, the upper horizons may have developed from less glauconitic silty, loamy, or sandy deposits of more recent origin. These deposits lie above the more glauconitic and clayey parent material of the deeper part of the profile. In places the clay is interbedded with sand.

The soils occur in the narrow belt of olive clay soils (shown by symbol MK on the general soil map). They receive runoff water from higher adjacent areas. Under natural conditions, water stands on these soils during much of the winter and during other wet periods. Drainage has been improved in cultivated fields.

The native forest includes willow, white, and pin oaks, beech, and sweetgum.

Matlock soils occur in association with Colemantown, Pasquotank, Barclay, and Nixonton soils. They have a darker surface layer than Colemantown soils. Unlike the Nixonton, Barclay, and Pasquotank soils, they have an olive clay subsoil.

Representative profile (Matlock loam, 1 percent slope, in pasture one-half mile west of Jefferson):

A_p 0 to 12 inches, black (10YR 2/1) loam or silt loam; moderate, medium, granular structure; friable; about 5 percent of soil mass is rounded, white quartzose pebbles; abrupt, smooth lower boundary.

B_g 12 to 24 inches, gray (10YR 5/1) fine sandy clay with common, fine, prominent mottles of strong brown (7.5YR 5/8); moderate, medium, blocky structure; firm or plastic.

C 24 to 42 inches, olive (5Y 4/4) clay with many, fine, prominent mottles of yellowish brown (10YR 5/8); massive; firm or very plastic.

The A_p and B_g horizons of this profile overlie the main glauconitic formation.

The surface layer ranges from 4 to 16 inches in thickness and from black to very dark gray in color. In places this layer has been built up by deposits washed from nearby slopes. The normal texture of the subsoil is clay, although in places it is sandy clay.

The interbedded layers of sand are saturated during wet periods and are mainly gray. Iron, in solution, is common in these soils, and in places, especially where sand is interbedded in the clay, ironstone has formed. Permeability, in most places, is so slow that underdrains used alone are not effective. Surface ditches are better for getting rid of surface water.

These soils dry out so slowly that tillage is severely restricted. They are moderately fertile, but very poor drainage hinders crop production. The soils are subject to severe frost action.

In this county, Matlock soils are inextensive and are intermingled with Colemantown soils. For this reason, the two soils are mapped as Colemantown-Matlock loams. The mapping unit is described under the Colemantown series.

Muck

Muck (Mu).—This mapping unit consists of partly decomposed organic matter that ranges from 1 to 3 feet or more in thickness. The upper 10 to 20 inches of the profile is black and granular. In places the lower part consists of brown, less decomposed organic matter that is known as peat. Muck occurs primarily over gray sand and gravel but is underlain by clay in places. It is extremely acid.

The areas of Muck are extensive along the larger streams that flow to the east and south. Several large areas also occur near the Delaware River, just above the tidal flats.

It is believed that the native vegetation consisted of dense stands of Atlantic white-cedar. All of the forests have been cut a number of times, and some have had severe fires. Red maple has replaced the cedar in some places.

Muck in this county occurs in narrow strips and is not very deep. In addition, it is extremely acid and subsides greatly upon drying. Because of these unfavorable features, it has not been developed for farming. Some small areas, however, have been cleared for pasture. Capability unit VIIw-1.

Nixonton Series

Nixonton soils have a grayish-brown to dark grayish-brown surface layer over a yellowish-brown to olive-brown, mottled fine sandy loam subsoil and substratum.

The soils have formed on marine deposits of uniformly fine sand that contains small amounts of mica and, in places, some glauconite. The excessive wetness in some seasons causes the mottling and olive colors in the soil. These moderately well drained soils have formed in the area of fine sandy soils (shown by symbol WNB on the general soil map).

The native forest includes mixed oaks, yellow-poplar, and holly.

Nixonton soils occur in association with Westphalia, Barclay, Pasquotank, and Elkton soils. Nixonton soils are mottled in the subsoil, but Westphalia soils are not. They are not so wet and are not mottled so near the surface as the Barclay and the Pasquotank soils, and their surface layer is not so dark as that of the Pasquotank soils. Nixonton soils have a fine sandy loam subsoil, as compared with the clay subsoil of the Elkton soils.

Representative profile (Nixonton loamy fine sand, 2 percent slope, in a cultivated field five-eighths mile southwest of Turnersville):

A_p 0 to 7 inches, dark grayish-brown (2.5Y 4/2) loamy fine sand; weak, fine, granular structure; very friable; roots abundant; 0 to 3 percent of soil mass is rounded quartzose pebbles; pH 6.6; abrupt, smooth lower boundary; 6 to 9 inches thick.

A_2 7 to 14 inches, yellowish-brown and light yellowish-brown (10YR 5/4 and 6/4) loamy fine sand; very weak, fine, granular structure; very friable; roots common; 0 to 2 percent of soil mass is rounded quartzose pebbles; soil material is uniformly fine; pH 6.0; clear, smooth lower boundary; 6 to 8 inches thick.

B_2 14 to 26 inches, yellowish-brown (10YR 5/6) fine sandy loam; material in upper few inches is mixed with soil from horizon above; very weak, medium, subangular blocky structure; very friable; roots common; 0 to 3 percent of soil mass is rounded quartzose pebbles; soil material is uniformly fine; pH 6.2; gradual, wavy lower boundary; 10 to 18 inches thick.

B_{3g} 26 to 44 inches, light olive-brown (2.5Y 5/4) fine sandy loam with few to common, fine, faint mottles; very weak, medium, subangular blocky to very weak, thin, platy structure; slightly firm in place, very friable when removed; few roots; 2 to 5 percent of soil mass is rounded quartzose pebbles; mica common; soil material is uniformly fine; clear, wavy lower boundary; 15 to 20 inches thick.

C 44 to 60 inches, brownish-yellow (10YR 6/6) loamy fine sand with few to common, fine, distinct mottles; single grained; very friable; mica common; soil material is uniformly fine; pH 4.8.

The pH readings of the profile just described were made by the colorimetric method. At the time the profile was described, the water table was below a depth of 60 inches.

The color of the subsoil ranges from pale olive to yellowish brown. Mottles vary in abundance, size, and contrast, but generally they are distinct between depths of 20 and 30 inches. Gray colors, if present, occur below a depth of 30 inches. In some areas there are layers of clay below a depth of 30 inches. In places, rounded quartzose pebbles, ½ to 2 inches in diameter, are scattered on or through the soils.

Nixonton soils are easily worked, moderately well drained, and low in natural fertility. Fertilizer leaches easily. Ground water rises into the subsoil in winter but drops in summer. Available moisture-holding capacity is moderate, and permeability is moderately slow. Underdrains generally work well enough in these soils, but special care is needed to prevent sloughing of the water-filled fine sand.

Where properly drained, Nixonton soils are well suited to asparagus, sweetpotatoes, fruit, summer vegetables, nursery plants, and general farm crops. Wind erosion is a problem unless the soils are protected.

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

Nixonton and Barclay soils, 0 to 5 percent slopes (NbB).—Nixonton and Barclay soils, occurring in association, are mapped in this undifferentiated unit. The soils have loamy fine sand and fine sandy loam surface layers.

Barclay soils are described under the Barclay series. These soils need more drainage improvement than Nixonton soils. Capability unit IIw–1.

Pasquotank Series

Pasquotank soils have a gray to dark-gray plow layer over a gray fine sandy loam subsoil. Beneath this is the substratum of yellowish-brown fine sand. The parent material is a marine deposit of uniform fine sand. The fine sand contains small amounts of mica and, in places, some glauconite.

These poorly drained soils have formed in nearly level depressions in the area of fine sandy soils (shown by symbol WNB on the general soil map). Under natural conditions, ground water occurs within 1 foot of the surface in winter and drops to a depth of about 3 feet in summer. In cultivated fields, drainage has been improved.

The native forest includes yellow-poplar, red, white, swamp white, pin, and willow oaks, beech, and sweetgum.

Pasquotank soils occur in association with Barclay, Nixonton, Bayboro, and Elkton soils. They have much less clay than the Elkton and the Bayboro soils. The subsoil, and generally the surface soil, is grayer in Pasquotank soils than in Barclay and Nixonton soils.

Representative profile (Pasquotank fine sandy loam, 1 percent slope, in a pasture 1½ miles southwest of Barnsboro):

A_p 0 to 8 inches, dark-gray (10YR 4/1) fine sandy loam that, in places, has fine, strong-brown (7.5YR 5/8) mottles; weak, fine, granular structure; very friable; 2 to 5 percent of the soil mass is white, rounded quartzose pebbles; abrupt, smooth lower boundary.

A_{2g} 8 to 14 inches, gray (10YR 6/1) fine sandy loam with common, fine, prominent mottles; weak, fine, granular structure, but, in places, platy in lower part; friable; few pebbles; mica common.

B_{2g} 14 to 30 inches, gray (10YR 6/1) fine sandy loam with many, medium, prominent mottles; subangular blocky structure; firm; few pebbles; mica common.

C 30 to 36 inches, yellowish-brown (10YR 5/8) gravelly fine sand; single grained; nonsticky; about 10 to 20 percent of soil mass is quartzose pebbles.

In Gloucester County, the B and C horizons of Pasquotank soils are normally gray, mottled with yellowish brown. In places there are clay lenses below a depth of 30 inches.

These soils are poorly drained. They have moderately slow permeability. Special care must be taken to keep ditches from caving in and to keep saturated fine sand from flowing into tile underdrains. Excess water in the soil greatly restricts tillage, crop suitability, and yields. Drainage improvement is needed. The soils have a moderate content of organic matter.

Pasquotank fine sandy loam (Pa).—This is the only Pasquotank soil in the county. Included with this soil as mapped are small areas of Barclay and Nixonton soils. Small areas of a soil with a blacker surface layer than that characteristic of the Pasquotank series are also included. Because of these inclusions, areas of this soil have a wide range in the coloring and mottling of the subsoil. Where the subsoil is the sandiest, a weak organic hardpan tends to form.

If adequately drained, this soil is suitable for general crops and summer vegetables. Capability unit IIIw–1.

Pits

Pits (Pg).—This mapping unit is made up of gravel, sand, and borrow pits, which are 2 feet or more in depth. Sand, gravel, and fill material taken from the pits are used for road building and industrial and other purposes. Most of the pits are in use, but some have been abandoned.

The areas are mostly in Aura soils but also occur in some of the sandy soils. Pits that have been abandoned for some time become covered with pine if seed trees are nearby.

Because the soil material varies, this mapping unit is not classified as to capability.

Pocomoke Series

Pocomoke soils have a surface layer that is black or nearly black, because of the high content of organic matter, and a subsoil that is gray to grayish brown and mottled. The texture of the subsoil ranges from sandy loam to sandy clay loam. The substratum is more sandy.

Pocomoke soils have developed from sandy sediments. These very poorly drained soils have formed in circular depressions and in flat areas that have been wet to the surface much of the time. All cultivated fields are artificially drained.

The native vegetation is a dense forest of pin oak, willow oak, sweetgum, and red maple, and a thick undergrowth of shrubs and briers.

In many places these soils are adjacent to areas of Muck, but they generally occupy the slightly higher areas. Pocomoke soils are commonly associated with Fallsington, Dragston, and Woodstown soils. The parent material of the Pocomoke soils is similiar to that of the higher lying, poorly drained Fallsington, the somewhat poorly drained Dragston, and the moderately well drained Woodstown soils.

Representative profile (Pocomoke sandy loam, in an apple orchard 2 miles north of Swedesboro):

A_p 0 to 8 inches, black (10YR 2/1) sandy loam; medium to fine, granular structure; friable; about 5 percent of soil mass is rounded, white quartzose pebbles; abrupt, smooth lower boundary; 6 to 16 inches thick.

A_{2g} 8 to 20 inches, gray (10YR 5/1) sandy loam; massive; friable; clear, smooth lower boundary; 10 to 16 inches thick.

B_g 20 to 28 inches, grayish-brown (10YR 5/2) sandy clay loam; many, medium, prominent mottles of yellowish brown (10YR 5/8); massive; friable; sticky and plastic when wet; abrupt, smooth lower boundary.

C_g 28 to 42 inches, yellowish-brown (10YR 5/8) sandy loam or loamy sand; many, medium, prominent mottles of grayish brown (10YR 5/2); single grained; very friable; nonsticky and nonplastic; 5 to 10 percent of soil mass is rounded quartzose pebbles.

Natural drainage had been improved in the orchard in which the representative profile was observed.

The surface layer ranges in thickness from 6 to 16 inches. In most areas it is black, but in some it is very dark gray. In places the subsoil contains thin layers of clay, but these areas are not extensive.

In some areas in the western part of the county, the subsoil and substratum contain some glauconite, but not enough to impart olive colors. Also, in the western part of the county, some of the Pocomoke soils contain enough ironstone to hinder tillage.

The substratum ranges from gray to yellowish red; it is mottled in some places.

In many places Pocomoke soils contain small areas of Fallsington soils.

Permeability of the Pocomoke soils ranges from moderate to moderately slow. In low areas the water table is high. At higher elevations, water is held up by the deep clay stratum. The Pocomoke soils are moderately fertile, but very poor drainage restricts tillage and crop production. Heavy applications of lime are needed to correct the acidity.

These soils need adequate drainage before they can be tilled. If adequately drained, they are suited to general farm crops, blueberries, and quick-maturing vegetables. Because of very poor drainage, they are not well suited to asparagus, alfalfa, or fruit. The sites are generally good for ground-water ponds.

Pocomoke loam (Po).—The profile of this soil is like the profile described for the series, except that the surface layer is loam. In places the surface layer, which is very high in organic matter, resists wetting. Water has covered the surface in some areas for a period of several weeks, yet the soil below has remained dry.

In places where layers of clay are close to the surface, underdrains may not be satisfactory. Capability unit IIIw-1.

Pocomoke sandy loam (Ps).—A profile of this soil is described as representative of the series. In some areas the soil is somewhat sandier than the one described in the representative profile. This sandier soil occurs in small, isolated spots within areas of the normal soil, and it is more permeable. In some places it has a weak organic hardpan in the upper part of the subsoil. Capability unit IIIw-1.

St. Johns Series

St. Johns soils are composed of very wet sands. They have a black surface layer that is underlain by a dark-brown, organic-stained horizon, usually at depths between 10 and 20 inches. In most places the brown layer is cemented into a hardpan, but in some places it is soft or absent. Below the hardpan, the sand is generally gray or grayish brown. In winter the normal water table is within a foot of the surface; in summer it drops a foot or more.

These very poorly drained soils occur in the eastern part of the county. They are on nearly level areas, adjacent to the larger streams, and in circular depressions.

The native forest consists mostly of pitch pine mixed with a few Atlantic white-cedars. Red maple, blackgum, and gray birch grow adjacent to streams or in open areas.

St. Johns soils are not extensive in the county. They are associated with Leon, Lakehurst, and Fallsington soils and are darker and wetter than these soils. St. Johns and Leon soils are similar, but the surface layer of the St. Johns soils is darker and the organic layer is closer to the surface.

Representative profile (St. Johns sand, in a blueberry field five-eighths mile northeast of Berryland):

A_p 0 to 9 inches, black (10YR 2/1) or very dark gray (10YR 3/1) loamy sand or sand; weak, fine, granular structure; very friable; 0 to 3 percent of soil mass is rounded, white quartzose pebbles; abrupt, smooth lower boundary; 6 to 14 inches thick.

A_2 9 to 12 inches, gray (10YR 5/1) sand; single grained; loose; clear, smooth lower boundary; 0 to 5 inches thick.

B_2 12 to 16 inches, very dark brown (10YR 2/2) to dark brown (7.5YR 3/2) loamy sand; massive; firm to very firm when moist, hard when dry; tree roots concentrate in this horizon; clear, smooth lower boundary; 3 to 8 inches thick.

B_3 16 to 20 inches, dark-brown (10YR 3/3) loamy sand; massive; firm to friable when moist, hard to soft when dry; clear, smooth lower boundary; 0 to 4 inches thick.

C_1 20 to 32 inches, grayish-brown (2.5YR 5/2) sand; single grained; loose; 8 to 30 inches thick.

C_2 32 to 40 inches, gray (5Y 6/1) sand; single grained; loose.

At the site of the profile just described, the water table was controlled for the growing of blueberries. The soil was saturated up through the B_2 horizon, within about 12 inches of the surface.

Generally, the St. Johns soils are not mottled. In places a gray horizon, which varies in thickness, occurs between the black surface layer and the brown layer. Where the hardpan is more reddish, it is believed to have iron mixed with the organic matter. The thickness of the B horizon averages 8 inches but ranges from 2 to 16 inches. In places the lower part of the B horizon is yellowish brown.

The St. Johns soils are high in organic matter but low in clay, and they are considered low in natural fertility. If these soils are artificially drained and cultivated, the organic matter is easily lost from the surface layer. Permeability is moderately rapid. Since the sandy layers retain little water, it is necessary to control the level of the water table if blueberries are to be grown.

In some adjacent counties, these soils are used extensively for growing blueberries and cranberries. They have been only partly developed for this purpose in Gloucester County, however, because of their limited acreage.

St. Johns sand (Sa).—This is the only St. Johns soil in the county. Some areas that have a loamy sand surface layer and some areas that are finer textured than normal throughout are included. The profile of the finer textured material contains some clay and is more mottled than that of the normal St. Johns soil. In some places the soil is clayey below the main part of the brown subsoil. In places the profile has definite layers of clay below a depth of 30 inches.

Some small areas have a mucky surface layer, 6 to 10 inches thick. Water is held high in the soil by layers of clay, even though in places these layers are at depths of 10 or more feet.

St. Johns and Leon soils are so closely associated that it was not always practical to map them separately. Therefore, this mapping unit includes small areas of Leon soil. Capability unit Vw-1.

Sassafras Series

Sassafras soils have a grayish-brown surface layer over yellowish-brown or strong-brown, heavy sandy loam to sandy clay loam. Beneath this is a loose sand or gravelly sand substratum. Excess water drains through the soils readily.

These well-drained soils have formed from sandy sediments that contain little or no glauconite. They occur primarily east and west of the greensand belts, but some areas lie within these belts. The principal areas are on sandy flats along the Delaware River (shown by symbol DWSK on the general soil map) and within the gravelly soils on the higher divides (shown by symbol ASD on the general soil map). The slopes range from nearly level to steep.

The native vegetation is a forest of mixed oaks that contains scattered pines.

Sassafras soils occur in association with Aura, Downer, Woodstown, and Dragston soils. They have a loose substratum, in contrast to the firm substratum of the Aura soils. They are thicker and contain more clay in the subsoil than the Downer soils. They do not have mottling or pale subsoil like the Woodstown and Dragston soils.

Representative profile (Sassafras sandy loam, 0 to 2 percent slopes, in a vegetable field one-half mile southwest of Thorofare and east of U.S. Highway No. 130):

A_p 0 to 10 inches, dark grayish-brown (10YR 4/2) sandy loam; mainly weak, fine, granular structure but thin, platy at depths of 9 to 10 inches; very friable or nonsticky; no coarse fragments; abrupt, smooth lower boundary.

A_2 10 to 18 inches, yellowish-brown (10YR 5/4), heavier sandy loam; weak, medium, granular structure; friable or nonsticky; no coarse fragments; clear, smooth lower boundary.

B_{21} 18 to 30 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; friable or slightly sticky; roots abundant; few pebbles; clay films on peds; gradual, smooth lower boundary.

B_{22} 30 to 36 inches, dark-brown (7.5YR 4/4), lighter sandy clay loam; weak, medium, subangular blocky structure; friable or nonsticky; few pebbles; clear, smooth lower boundary.

C_1 36 to 60 inches, dark yellowish-brown (10YR 4/4) loamy sand; structureless; very friable or loose; lowest 2 inches are weakly cemented.

C_2 60 to 72 inches, several dark-brown (7.5YR 4/4) bands of sandy loam, 2 to 4 inches thick, between thicker, more sandy layers.

Forested areas have micropodzol horizons up to 3 inches thick. These horizons are in the upper part of the profile.

The average thickness of the surface layer is 16 inches, but the range is from 10 to 30 inches. In places rounded quartzose pebbles, ½ to 2 inches in diameter, are scattered over the surface and mixed through the soil horizons. They occupy up to 20 percent of the soil mass in some places. Normally, the pebbles are most abundant at the surface, but, in places, especially where the soil has formed on stream terraces, beds of gravel occur below a depth of 24 inches.

The thickness of the subsoil is about 16 inches, but the range is from 10 to 30 inches. The amount of available moisture held by the soils ranges from low to moderate, depending on the thickness and texture of the different horizons. In places layers of clay occur below a depth of 30 inches.

Sassafras soils are easy to work. They are low in organic matter, relatively low in clay, and low in natural fertility. They respond well to fertilization.

The soils are well suited to nearly all the crops grown in the county.

Sassafras loamy sand, 0 to 5 percent slopes (SfB).—This soil is similar to the soil described as representative of the series, except that the surface layer is sandier and thicker. The thickness of the surface layer averages 18 inches and ranges from 10 to 30 inches. The subsoil is generally thinner than normal for Sassafras sandy loams; it averages about 14 inches in thickness. The substratum, in most places, is loamy sand that contains various amounts of gravel.

At the higher elevations, this soil occurs in association with Aura soils, and, in nearly all places, it includes small areas of these soils. In some places where this soil occurs in low positions, ground water rises into the subsoil. As a result, the soil in these places is mottled and has a profile similar to that of the Woodstown soils. In most areas, underdrains can be used satisfactorily.

This soil is suited to early vegetables and fruit. Because it is very sandy, the soil is subject to intensive wind erosion. Capability unit IIs–1.

Sassafras loamy sand, 5 to 10 percent slopes (SfC).—This soil is similar to Sassafras loamy sand, 0 to 5 percent slopes, except that the thickness of the surface layer averages about 14 inches. Erosion by wind and water is a hazard; in cultivated fields some of the original surface layer has been removed and a few gullies have been cut. If well managed, this soil is suited to fruit, vegetables, and general farm crops. Capability unit IIIe–2.

Sassafras sandy loam, 0 to 2 percent slopes (SrA).—A profile of this soil is described as representative of the series. The average thickness of the surface layer is 14 inches and that of the subsoil is 20 inches. In most places ground water is more than 5 feet below the surface, but in some it is higher. The hazard of erosion is slight. The soil is well suited to most crops grown in the area. Capability unit I–1.

Sassafras sandy loam, 2 to 5 percent slopes (SrB).—This soil has a profile similar to the one described as representative of the series, but it has stronger slopes. Erosion is a hazard, and, in some spots on cultivated fields, the surface layer has been eroded to a depth of 10 inches. The soil is well suited to most crops grown in the county. Capability unit IIe–1.

Sassafras sandy loam, 5 to 10 percent slopes (SrC).—In some cultivated areas, erosion has removed part of the original surface layer and has exposed the subsoil in spots. Occasional gullies hinder fieldwork. Nevertheless, the soil is suited to most crops grown in the area. Capability unit IIIe–1.

Sassafras sandy loam, 10 to 15 percent slopes, severely eroded (SrD3).—This soil has been cultivated, and, as a result, erosion has removed most of the original surface layer and cut many gullies. Over most of the area, plows now cut into the clayey subsoil, which is low in organic matter and harder to work than the original surface layer. Before the subsoil was mixed with the plow layer, some of the soil had a loamy sand surface layer. Some of the original surface layer may still occur between erosion scars.

Yields of crops are irregular. Because of the hazard of erosion, the soil is best kept under continual cover. Use for hay, pasture, forest, or wildlife habitats is suitable. Capability unit VIe–1.

Sassafras soils, 10 to 15 percent slopes (SsD).—The surface layer of these soils consists of about 90 percent loamy sand and 10 percent sandy loam.

Cultivated areas contain some gullies and some spots where erosion has removed the original surface layer. The exposed, more clayey subsoil is harder to work than the original surface layer. Yields of crops are low in these eroded areas.

These soils are suited to fruit, small grains, hay, and pasture. Capability unit IVe–1.

Sassafras soils, 15 to 40 percent slopes (SsE).—The soils of this mapping unit have steep to very steep slopes and belong mostly to the Sassafras or related series. On the strongest slopes, there may be little or no soil development but only geologic layers that are mostly sand but in places are clay. These layers are either wholly exposed or are under a thin cover of friable material. Generally, however, the soils in this unit have some profile development. In some places the soils are weakly developed; they are very sandy and have little subsoil. In other places, especially where the soils are less sloping, they are more strongly developed and have profiles that are normal for the Sassafras series.

The erosion hazard is severe, and the soils are, therefore, best suited to use for hay, pasture, forest, and wildlife habitats. Capability unit VIIe–1.

Tidal Marsh

Tidal marsh (Tm).—This miscellaneous land type lies so near sea level that tides cover it daily. It occurs chiefly along the Delaware River, but extends inland along tributaries, such as Oldmans, Raccoon, Mantua, and Woodbury Creeks. Gloucester County lies some distance upstream along the Delaware River. Because of the mixing of brackish water from the river with fresh water from the tributaries, the tidewater is only slightly brackish to fresh.

Tidal marsh is composed of much organic matter and mineral particles, mostly silt but some clay. Generally, this mixed material extends to depths of 3 to 10 feet. In places, however, it is less than 24 inches thick over the underlying silt, sand, or muck. The content of organic matter in the surface material ranges from high to very high, and in spots the material is peat.

The native vegetation was salt-tolerant marsh grasses and weeds. By the 1930's, however, much of the area had been diked or ditched, or both, and was being cultivated. Now, virtually all the cultivated land has been abandoned. Some hay is cut, but most areas are idle and covered by willows, buttonball bush, hibiscus, viburnums, and poison-ivy. The cultivated areas were abandoned because of the cost of repairing dikes and tide gates, the extreme acidity of the soil material, and the subsidence of the land. Capability unit VIIIw–1.

Westphalia Series

Westphalia soils have a surface layer of dark grayish-brown very fine sand and a subsoil of yellowish-brown fine sandy loam. The substratum is yellowish-brown fine sand.

The parent material is a marine deposit of fine sand that is unusually uniform in size and that feels soft. It contains small amounts of mica and, in places, some glauconite. The Westphalia soils are well drained. Their slopes are mostly gentle, but some are very steep. The soils occur in a belt that extends across the county from Harrisonville, through Jefferson, Barnsboro, and Hurffville, to Blackwood Terrace. This belt is the area of fine sandy soils (shown by symbol WNB on the general soil map).

The native forest is composed of mixed oaks, beech, yellow-poplar, and holly.

Westphalia soils have formed primarily in association with Nixonton, Barclay, Pasquotank, Marlton, Freehold, and Aura soils. They are free from the mottling that is characteristic of the Nixonton, Barclay, and

Pasquotank soils. They do not have an olive clay subsoil like the Marlton soils. Westphalia soils have developed from finer sands and generally have less clay in the subsoil than the Freehold soils. They have a soft, loose substratum, as compared to the firm substratum of the Aura soils.

Representative profile (Westphalia loamy fine sand, 0 to 5 percent slopes, in woodland along road to Jefferson, 1½ miles west of Barnsboro):

A_{00} 1¼ to 1 inch, loose litter, mostly of oak leaves.
A_0 1 to 0 inch, granular mor containing very dark brown fragments of leaves; lower part has many fine sand grains
A_1 0 to 2 inches, dark grayish-brown (10YR 4/2) very fine sand that appears gray in places; a faint trace of a dark-brown podzol B_2 horizon, one-half inch thick, occurs in the lower part of this horizon.
A_2 2 to 12 inches, yellowish-brown (10YR 5/6) very fine sand or loamy fine sand; single grained; very friable; abrupt lower boundary; 10 to 20 inches thick.
B 12 to 28 inches, strong-brown (7.5YR 5/8) very fine sandy loam or fine sandy loam; moderate, medium, subangular blocky structure; firm in place, friable, nonsticky, or nonplastic when removed; 8 to 20 inches thick.
C 28 inches to 20 feet +, very fine sand streaked with strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/6); the paler streaks are almost gray; very friable; breaks into very weak clods; mica flakes are common; the sand deposit continues to depths of 20 to 30 feet, with only slight variations in color and a few thin strata of quartzose gravel.

The upper few inches of the profile are more leached in forests where pitch pine is abundant than in forests composed of other trees.

The thickness of the horizons varies. The A horizon averages about 18 inches in thickness but ranges from 12 to 40 inches. The thickness of the subsoil averages about 16 inches but ranges from 0 to 24 inches.

In places many rounded quartzose pebbles are either scattered over the surface or mixed in the soil. These pebbles are a remnant of deposits that overlie the very fine sand. In some places they make up 30 percent of a horizon, but on the average, they make up less than 5 percent.

Because they are friable, Westphalia soils are easy to work throughout the year. They are low in natural fertility but respond to fertilization. They are well drained and moderately slowly permeable.

The soils, especially the sandier ones, are subject to wind erosion. If cultivated, the sloping soils are subject to water erosion. Gullying is especially severe on the strong slopes because the material in the substratum has little bonding strength. The soils tend to flow when saturated. In places water carries the fine material downward through old root channels and animal burrows, and in this way depressions similar to sinkholes are formed. Several of these depressions, which are more than 10 feet wide and 5 feet deep, were observed in a field after a very rainy season.

The Westphalia soils are suited to early vegetables, summer vegetables, fruit, nursery plants, and general farm crops.

Westphalia fine sandy loam, 10 to 15 percent slopes, severely eroded (WaD3).—Except for the effects of erosion, the profile of this soil is similar to the profile described for the series. Erosion has removed most of the original surface layer and cut many gullies, some of which are deep. The content of organic matter is low, especially where the plow layer contains brown subsoil.

Because of the hazard of erosion, this soil is best suited to pasture, woodland, or wildlife habitats, all of which provide permanent cover. Capability unit VIe-1.

Westphalia soils, 0 to 5 percent slopes (WhB).—In many areas Westphalia soils with loamy fine sand and fine sandy loam surface soils occur without clear distinction. In such areas they have been mapped as a unit. The fine sandy loam soil is more fertile and less droughty. The loamy fine sand soil retains little moisture, but it warms sooner in spring.

In low-lying areas, ground water rises in the soils during winter and during other prolonged wet periods. Here, the soils have a pale or mottled subsoil like that of the Nixonton and Barclay soils. Drainage should be improved in these areas if they are to be used for nursery plants or other high-value crops.

These soils are well suited to nursery plants, vegetables, fruit, and general farm crops, including alfalfa hay and pasture. Capability unit IIs-1.

Westphalia soils, 5 to 10 percent slopes (WhC).—This mapping unit is similar to Westphalia soils, 0 to 5 percent slopes, except for its stronger slopes.

Some cultivated areas are moderately eroded. In spots, erosion has removed most of the original surface layer or has cut gullies. Gullying is difficult to stop on these soils. Wind erosion is still a hazard.

These soils are suited to vegetables, fruit, and general farm crops, including hay and pasture. Capability unit IIIe-2.

Westphalia soils, 10 to 15 percent slopes (WhD).—These soils are similar to the less sloping Westphalia soils.

Some cultivated areas have been eroded considerably. In spots most of the original surface layer has been removed. There are some gullies.

These soils are suited to fruit, small grains, hay, pasture, and woodland. Capability unit IVe-1.

Westphalia soils, 15 to 40 percent slopes (WhE).—These steep to very steep soils occur along streams. They consist chiefly of the fine sandy material. The soils vary in characteristics. In most areas they are like other Westphalia soils. In some areas they have a subsoil that is about as sandy as other parts of the profile. The subsoil is likely to be more nearly normal in the less sloping areas than in the steeper areas.

In places, especially on the steeper slopes, a geologic stratum of fine sand is exposed or is covered with only a few inches of loose material. At the lower parts of some very steep slopes, a stratum of clay, which is commonly very dark olive or nearly black and contains glauconite, is exposed or is near the surface.

The soils in this unit are generally well drained, except where seeps occur above the clay stratum. Some small patches have been severely eroded.

Because of the hazard of erosion, these soils need a permanent cover of grass, trees, or shrubs. Capability unit VIIe-1.

Woodstown Series

Woodstown soils have a dark-brown plow layer over a yellowish-brown, mottled, sandy subsoil. Beneath the subsoil there is mostly loose sand and gravel, but, in places, there are layers of clay below a depth of 30 inches. Under natural conditions, the water table in these soils rises to about 2 feet from the surface during winter and drops to a depth of about 4 feet in summer. Drainage has been improved in fields where vegetables are grown.

Woodstown soils are extensive and occur throughout most of the county. They have formed on nearly level areas and in the circular depressions that are so common in the county. They receive runoff from adjoining slopes (fig. 5).

Figure 5.—**Improved drainage is needed on this field of Woodstown sandy loam if high-value crops are to be grown.**

The native forest includes red, black, and white oaks. In places there are yellow-poplar, beech, and pitch pine.

Woodstown soils are associated with Fallsington, Dragston, Sassafras, Aura, Downer, and Freehold soils. Woodstown soils can be distinguished from the well-drained Aura, Downer, Freehold, and Sassafras soils by their mottled or pale subsoil. Their surface layer is browner than that of the Fallsington soils. In the Woodstown soils, mottling is confined to the subsoil, but, in the Dragston soils, it is common in the lower part of the surface horizon.

Representative profile (Woodstown sandy loam, 0 to 5 percent slopes, in an asparagus field three-fourths mile west of Cross Keys):

A_p 0 to 9 inches, very dark grayish-brown (2.5Y 3/2) sandy loam; weak, fine, granular structure; very friable; 0 to 3 percent of soil mass is rounded quartzose pebbles; abrupt, smooth lower boundary.

A_2 9 to 16 inches, light olive-brown (2.5Y 5/4) sandy loam; weak, fine, granular structure; friable; 0 to 2 percent of soil mass is rounded quartzose pebbles.

B_{2g} 16 to 22 inches, light olive-brown (2.5Y 5/4) sandy loam that contains more clay than horizon above; few, fine, faint mottles; weak, medium, subangular blocky structure; friable or slightly plastic; 0 to 2 percent of soil mass is rounded quartzose pebbles.

C 22 to 30 inches, yellowish-brown (10YR 5/6) gravelly loamy sand; single grained; loose; 20 to 30 percent of soil mass is rounded quartzose pebbles.

D 30 to 45 inches, grayish-brown (2.5Y 5/2) sandy loam; structureless; 5 to 10 percent of soil mass is rounded quartzose pebbles, up to 1 inch in diameter.

The texture of the subsoil ranges from sandy loam to sandy clay loam. In most places the subsoil extends to a depth of 30 inches, but this depth varies in places. Layers of clay occur below a depth of 30 inches in some areas. Where these soils occur on terraces along the larger streams, beds of gravel are common at a depth of about 24 inches. These beds range in thickness from several inches to several feet.

As a rule, mottling in the subsoil is pale and indistinct; such mottling indicates short, infrequent periods of saturation. The mottling ranges from pale brown to strong brown, against a dominant color of yellowish brown. In places the subsoil is light olive brown.

In the western part of the county, the soils contain some glauconite, but not enough to impart olive colors.

Permeability is moderate to a depth of 30 inches. Below 30 inches it ranges from slow to moderately rapid. Underdrains work successfully in these soils, except where layers of clay are closer to the surface than normal. The soils are low in natural fertility. Normally, tillage is restricted slightly by wetness; the soils dry more slowly than well-drained soils.

In Gloucester County the Woodstown soils are mapped only in undifferentiated units with the Dragston soils and in an undifferentiated unit with the Klej soil.

Woodstown and Dragston loams, 0 to 2 percent slopes (WnA).—This mapping unit consists of undifferentiated areas of Woodstown and Dragston soils. These areas occur in the western part of the county. The dominant texture of the surface layer is loam. The Dragston soil, which is described under the Dragston series, occurs in the lower parts of depressions. The Woodstown soil occurs on the slightly raised borders of hollows and on other sites that are not so wet.

The soils overlie clay in places. Where the clay is below a depth of 30 inches, underdrains are generally effective.

These soils are suitable for many kinds of crops, and they produce good yields if adequately drained. They contain a little more organic matter in the surface horizon than well-drained soils. The soils warm slowly in spring, however, and are difficult to work during wet periods. Capability unit IIw–2.

Woodstown and Dragston loamy sands, 0 to 5 percent slopes (WoB).—This mapping unit consists of undifferentiated areas of Woodstown and Dragston soils. The Dragston soil, which is described under the Dragston series, occurs in the more depressed areas, and the Woodstown soil is on the slightly raised borders of hollows and in other sites that are not so wet.

The soils have sandier surface layers than are shown in the representative profiles described for the Woodstown and the Dragston series. Their subsoils are sandy. In places the subsoils consist of bands of finer material, 1 to 2 inches thick, between layers of loamy sand, 4 to 6 inches thick. In some places a weak organic horizon, which is hardened in spots, occurs below the surface layer.

In areas where the surface layer is looser and more sandy, the soils warm earlier in spring than Woodstown and Dragston soils that have loam or sandy loam surface layers. In general, the soils have excessive ground water, but, if drainage is improved, most areas can be used for growing vegetables. Capability unit IIw-1.

Woodstown and Dragston sandy loams, 0 to 5 percent slopes (WsB).—The soils in this undifferentiated unit are described by the representative profiles of the Woodstown and Dragston series. The Dragston soil occurs in more depressed areas, whereas the Woodstown soil is on the slightly raised borders of hollows and in other sites that are not so wet.

In small areas the surface layer is loam or loamy sand. The areas with a loam surface layer occur mostly in the bottoms of depressions. In some places material eroded from adjoining slopes has been deposited on the soils of this unit. Here, the surface layer is unusually thick. In some places layers of clay, which commonly occur below a depth of 30 inches, are closer to the surface. Generally, the sand component of these soils is medium, but in some places a notable amount is fine.

These soils contain a little more organic matter than well-drained soils, and, if adequately drained, they are more productive of crops. Traffic pans form readily, probably because the soils dry out slowly and are worked when still wet. Under good soil management, tile underdrains will be effective unless clay layers are closer to the surface than normal. If high-value crops are to be grown, adequate drainage must be provided. Capability unit IIw-2.

Woodstown and Klej loamy sands, 0 to 5 percent slopes (WtB).—This mapping unit consists of undifferentiated areas of Woodstown loamy sand and Klej loamy sand. Woodstown loamy sand is more common.

Included with this mapping unit are small areas of Dragston soil.

In all of the areas of this undifferentiated unit, ground water rises into the subsoil late in winter and during other prolonged wet periods. Because of their very sandy surface layer, the soils generally warm early enough for the growing of early vegetables. They are permeable enough for underdrains to be effective. Unless protected, the soils are subject to wind erosion. Capability unit IIw-1.

Soils and Land Use

This section is designed to help the land operator understand the behavior and potentiality of his soils. The first part consists of a discussion of general soil factors that affect land use. This is followed by an explanation of the system of capability grouping used by the Soil Conservation Service and a discussion of management by capability units. Next, estimated yields of crops are given for the soils of the county. The use of the soils for forestry, wildlife habitats, engineering work, and suburban development is also discussed.

Some Soil Factors Affecting Land Use

Major factors that affect land use in Gloucester County are the fertility of the soils, drainage, and the presence of traffic pans, or plowsoles as they are sometimes called. A discussion of each of these factors follows.

Fertility

In some areas of the county, vegetables have been grown for about 100 years. As a result, the soils have been heavily limed and fertilized for the past 50 to 80 years.

In general, recent annual applications of fertilizer have been 1,000 to 2,000 pounds of 5-10-10 [3] per acre for vegetables, 500 to 1,000 pounds for fruit, and 400 to 800 pounds for field crops, except established stands of alfalfa and clover. Sweetpotatoes have received 1,000 to 2,000 pounds of 3-9-12. As the result of heavy fertilization, the general availability of magnesium, phosphorus, and potassium has been increased in the cultivated soils.

In their natural state, nearly all the soils in the county are very strongly acid; their pH ranges from 4.0 to 5.0. By repeated liming, the pH of the surface soil in most cultivated fields has been raised to about 6.0. The pH of the subsoil of the sandier soils has also been raised. The soils that have very clayey subsoil are still moderately to strongly acid.

The decrease in acidity and the increase in the availability of important minerals have made the cultivated soils of Gloucester County more productive than they originally were. For the maintenance of productivity, however, all the soils need continuous liming and fertilization. Also, organic matter must be replenished. Lime and fertilizer should be applied in amounts determined by soil tests and crop needs.

Drainage

About 30 percent of the acreage in this county consists of soils that are generally wet or are seasonally wet. As a result, they may not be well enough aerated for the best growth of plants. In soils under forest, wetness not only limits the kinds of trees that will grow but also governs the density and rate of growth.

A high water table causes wetness in the Woodstown, Fallsington, Pocomoke, Klej, Lakehurst, Leon, and St. Johns soils (fig. 6). Blueberries grow abundantly on the very wet St. Johns soil, but, if they are to be grown commercially, the water table should be lowered and controlled. In the Fallsington soils, the water table rises almost to the surface during the wettest seasons. These soils are too wet for some crops—in some places even after artificial drainage has been applied.

Not all drainage problems in the county are caused by a high water table and flat relief. In part, the Keyport and Kresson soils occur in sloping areas and are above the water table, but they have a very clayey subsoil and substratum. They are wet because the subsoil is more slowly permeable than the surface soil. The Elkton, Bayboro, and Colemantown soils, which also have slowly permeable subsoil, occur in slightly sloping areas and on flats.

Much of the cultivated land in the county has been tiled or ditched, or both, for the removal of excess water (fig. 7). The effectiveness of artificial drainage is closely related to the texture of the soil; sands are relatively permeable, and clays are very slowly permeable.

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[3] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

Figure 6.—**High water table of an inadequately drained soil in a peach orchard.**

A high water table, slow permeability, and lack of slope affect not only the use of soils for crops and woodland, but also the suitability for construction of house basements and other structures and for landscaping, recreational facilities, and other uses.

Traffic pans

Traffic pans, or plowsoles, are likely to develop in the soils of Gloucester County. These are firm, dense layers 2 to 4 inches thick, that occur between 4 and 10 inches below the surface. They limit permeability and, in places, restrict the growth of roots. They promote runoff and erosion and thereby reduce the intake of water into the soils. Soils in which traffic pans occur include those with surface layers of light sandy loam or loamy sand. For highest productivity of crops, care must be taken against packing of the soil and the breakdown of soil aggregates.

Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable they 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.

Figure 7.—**Deep ditch in an apple orchard provides outlet for excess water.**

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through 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 land forms so rough, shallow, wet, 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 up to 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 of soils for many statements about their management. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIe-2.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive land-forming 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–1.—Deep, nearly level, well-drained sandy loams.

Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe.—Soils that have a moderate risk of erosion if they are not protected.
  - Capability unit IIe–1.—Gently sloping, deep, well-drained sandy loams.
  - Capability unit IIe–2.—Slowly permeable, well drained to moderately well drained, nearly level to gently sloping soils.
- Subclass IIs.—Soils that have moderate limitations of droughtiness or shallowness.
  - Capability unit IIs–1.—Nearly level to gently sloping, somewhat droughty soils that are subject to wind erosion.
  - Capability unit IIs–2.—Nearly level to gently sloping, well-drained soils; shallow to a firm horizon.
- Subclass IIw.—Soils that have moderate limitations because of excess water.
  - Capability unit IIw–1.—Deep, nearly level to gently sloping, moderately well drained to somewhat poorly drained soils that have a loamy sand surface layer.
  - Capability unit IIw–2.—Deep, nearly level to gently sloping, moderately well drained to somewhat poorly drained soils that have a loam or sandy loam surface layer.
  - Capability unit IIw–3.—Deep, nearly level to gently sloping, dominantly moderately well drained soils that have a slowly permeable subsoil.

Class III.—Soils that have severe limitations that reduce the choice of plants or require special conservation practices, or both.
- Subclass IIIe.—Soils that have a severe risk of erosion if they are cultivated and not protected.
  - Capability unit IIIe–1.—Deep, well-drained, moderately sloping sandy loams.
  - Capability unit IIIe–2.—Moderately sloping soils that have dominantly a thick loamy sand surface layer and a sandy loam subsoil.
  - Capability unit IIIe–3.—Moderately sloping, slowly permeable soils that have a clay subsoil.
- Subclass IIIs.—Soils that have severe limitations of moisture capacity or of tilth.
  - Capability unit IIIs–1.—Nearly level to gently sloping, well-drained soils that have a loamy sand surface layer.
- Subclass IIIw.—Soils that have severe limitations because of excess water.
  - Capability unit IIIw–1.—Nearly level, poorly drained and very poorly drained, permeable or moderately slowly permeable loamy soils.
  - Capability unit IIIw–2.—Nearly level to gently sloping, mainly somewhat poorly drained to poorly drained, 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 that have a very severe risk of erosion if they are cultivated and not protected.
  - Capability unit IVe–1.—Deep, well-drained, permeable soils that are moderately steep or are moderately sloping and severely eroded.
  - Capability unit IVe–2.—Slowly permeable soils that are moderately steep or are moderately sloping and severely eroded.
- Subclass IVs.—Soils that have very severe limitations of low moisture capacity or other soil features.
  - Capability unit IVs–1.—Nearly level to moderately sloping, very sandy, droughty, infertile soils.

Class V.—Soils that have little or no erosion hazard but have other limitations, 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 cultivation because of excess water and infertility.
  - Capability unit Vw–1.—Nearly level, poorly drained to very poorly drained, infertile sands.

Class VI.—Soils that have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, 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–1.—Permeable soils that are steep or are moderately steep and severely eroded.
  - Capability unit VIe–2.—Slowly permeable soils that are steep or are moderately steep and severely eroded.

Class VII.—Soils that have very severe limitations that make them unsuited to cultivation without major reclamation, and that restrict their use largely to grazing, woodland, or wildlife.
- Subclass VIIe.—Soils very severely limited, chiefly by risk of erosion if protective cover is not maintained.
  - Capability unit VIIe–1.—Moderately steep and steep, generally permeable soils.
  - Capability unit VIIe–2.—Steep, slowly permeable soils.
- Subclass VIIs.—Soils very severely limited by moisture capacity or other soil features.
  - Capability unit VIIs–1.—Deep, nearly level to gently sloping, loose, sandy, infertile soils.
- Subclass VIIw.—Soils very severely limited by excess water.
  - Capability unit VIIw–1.—Wet soils subject to frequent overflow and very wet organic soils.

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.

Subclass VIII.—Extremely wet or marshy land.

Capability unit VIIIw-1.—Tidal marshes and fresh water marshes.

Management by capability units

In this section the soils of the county are arranged in capability units. (Two miscellaneous land types, Pits and Made land, were not classified as to capability.) The soils of a capability unit have about the same limitations, are suited to about the same crops, and require similar management. A description of each unit follows.

CAPABILITY UNIT I-1

Capability unit I-1 consists of nearly level, deep, well-drained sandy loams. These soils are easy to work. They are permeable to water and air and have moderate capacity to hold moisture that plants can use. They are naturally acid and have a moderate to low supply of nutrients.

The soils are:

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

These soils are well suited to all fruits, nursery crops, general farm crops, and all but the earliest vegetables grown in the area. They can be tilled regularly without great risk of erosion. A fertilized cover crop grown after each row crop will add organic matter and improve soil structure. Some farmers grow a summer cover crop 1 year out of 5 to rest the land. If succeeding crops need much nitrogen, the cover crop can be a grass-legume mixture. A sod crop grown every few years will help to maintain good soil structure.

Lime and fertilizer should be applied regularly because these soils are naturally acid and moderate or low in fertility. The amounts needed should be determined by soil tests.

CAPABILITY UNIT IIe-1

This capability unit consists of deep, well-drained gently sloping sandy loams. The soils have good structure. They are permeable to water and air and have a moderate capacity to hold moisture that plants can use. They are naturally acid and are moderate to low in natural fertility.

The soils are:

Collington sandy loam, 2 to 5 percent slopes.
Downer sandy loam, 2 to 5 percent slopes.
Freehold sandy loam, 2 to 5 percent slopes.
Sassafras sandy loam, 2 to 5 percent slopes.

These soils are suitable for almost all vegetables, fruits, general farm crops, nursery crops, and pasture. Soil-borne diseases are reported to have damaged sweetpotatoes more severely on these soils than on the deeper sands.

Control erosion on these sloping soils. Plow and plant on the contour on the short slopes; in addition use diversion terraces on the long slopes. Use contour strips on fields where general crops are grown. If asparagus or sweetpotatoes are grown, especially on the sandier areas, use privet windbreaks to protect against wind erosion. Maintain the content of organic matter by using crop rotations, by growing cover crops, and by applying manure or other organic material. These practices will help to maintain good soil structure.

Apply lime and fertilizer in amounts determined by soil tests. For most vegetables, plow down one-third of the fertilizer and add the rest as side dressings throughout the season.

CAPABILITY UNIT IIe-2

Capability unit IIe-2 consists of nearly level to gently sloping, well drained to moderately well drained soils. The surface layer is sandy, and the subsoil is clayey. Water drains through these soils slowly. The soils retain moisture moderately well, and they have moderate natural fertility. They are subject to frost heaving.

In this county the only soil in this unit is:

Marlton sandy loam, 0 to 5 percent slopes.

This soil is best suited to general farm crops, hay and pasture, and tomatoes, peppers, eggplants, and other vegetables. It is also used for apple trees and alfalfa, where drainage is adequate.

The soil is hard to work because it is either too wet or too dry much of the time. Spot drainage may be necessary in depressed areas.

Because water drains through the soil slowly, runoff is rapid and erosion is severe on sloping areas. Plow and plant approximately on the contour, but go off the contour enough to provide adequate drainage. On the longer slopes, remove water through diversion terraces. Plant crops in contour strips on dairy and general farms. The easiest way to maintain soil structure is to use crop rotations that include sod crops. Follow all row crops with a cover crop.

This soil is rarely irrigated. If it is used for irrigated crops, be careful not to apply water too rapidly.

Apply lime and fertilizer in amounts determined by soil tests and according to crop needs. The soil requires large amounts of lime. Most of the fertilizer used can be plowed down with little chance of leaching.

CAPABILITY UNIT IIs-1

Capability unit IIs-1 consists of deep, nearly level to gently sloping, well-drained, somewhat droughty soils. In general, they have a thick, very sandy surface layer and a sandy loam subsoil. The soils have a moderately low capacity to hold moisture that plants can use. They are low in organic matter and low in natural fertility. If not protected, they are subject to severe wind erosion (fig. 8).

The soils are:

Collington loamy sand, 0 to 5 percent slopes.
Colts Neck soils, 0 to 5 percent slopes.
Downer loamy sand, 0 to 5 percent slopes.
Freehold loamy sand, 0 to 5 percent slopes.
Sassafras loamy sand, 0 to 5 percent slopes.
Westphalia soils, 0 to 5 percent slopes.

These soils are best suited to asparagus, small fruit, peaches, apples, and other deep-rooted, long-lived crops. Sweetpotatoes do well. If the soils are used for peppers,

Figure 8.—This field was left bare during winter and has been severely damaged by wind erosion.

eggplants, sweet corn, or other high-value crops, irrigation likely will be needed.

Use contour planting on the more sloping areas to control erosion, especially where asparagus or peach trees are grown. Cover crops planted early and fertilized heavily provide the most protection against winter winds. Privet windbreaks will also protect these loose sandy soils against wind erosion.

Fertilizer and lime should be used in amounts determined by soil tests. Fertilizer applied as side dressings to summer vegetables will keep losses through leaching to a minimum.

CAPABILITY UNIT IIs-2

Capability unit IIs-2 consists of nearly level to gently sloping, well-drained soils. The Aura soils are shallow over a hard sand-and-clay substratum that is moderately slowly permeable to water; the Sassafras soils have a loose sandy substratum. The soils of this unit are easy to work in spring when they are moist but hard to work in summer when they are dry. They are low in natural fertility and moderate to low in available moisture.

The soils are:

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

These soils are best suited to fruit and general crops that do not require too much cultivation in summer.

Plant crops on the contour to reduce erosion and runoff. On the longer slopes, plant asparagus, peach trees (fig. 9), and other long-lived crops on the contour. Seed cover crops early and fertilize heavily. Stripcropping can be used on the long slopes and the more sloping fields of dairy and general farms.

The surface of the soils cakes and crusts easily, and, unless the soils are well managed, traffic pans will form. Traffic pans can be loosened by subsoiling on the contour late in summer when the soils are driest.

Maintain the content of organic matter by using rotations that include sod crops, by growing cover crops, and by adding manure or other organic material to the soils. If long-lived row crops are planted, use diversion terraces to prevent the concentration of excess water.

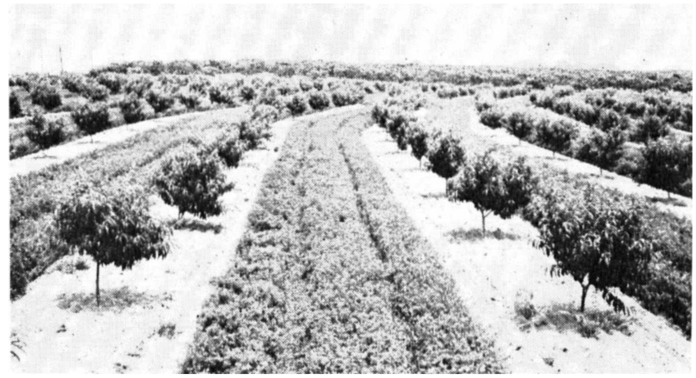

Figure 9.—Peach trees planted on the contour to reduce the risk of runoff and erosion.

Apply lime and fertilizer in amounts determined by soil tests. Where vegtables are grown, one-third of the fertilizer can be plowed down and the rest used as a side dressing.

CAPABILITY UNIT IIw-1

Capability unit IIw-1 consists of deep, moderately well drained to somewhat poorly drained soils that have a loamy sand surface layer. The soils are nearly level to gently sloping. They are easily worked and warm early in spring. Ground water rises within 2 feet of the surface during extremely wet seasons. The soils are low in natural fertility and are naturally acid.

The soils are:

Nixonton and Barclay soils, 0 to 5 percent slopes.
Woodstown and Dragston loamy sands, 0 to 5 percent slopes.
Woodstown and Klej loamy sands, 0 to 5 percent slopes.

These soils are suited to summer vegetables and general farm crops, if they are drained by tile or ditches. If the soils are adequately drained, fruit and asparagus can also be grown.

Maintain the content of organic matter by growing cover crops. Use privet windbreaks to protect soils that are worked early in the season. Apply lime and fertilizer in amounts determined by soil tests. Add the fertilizer as side dressings during the growing season to reduce losses through leaching.

CAPABILITY UNIT IIw-2

Capability unit IIw-2 consists of deep, nearly level to gently sloping sandy loams and loams. These soils are moderately well drained to somewhat poorly drained. In wet seasons, ground water rises to within 20 to 30 inches of the surface and the surface layer is also wet. Consequently, the soils are easily compacted by heavy equipment (fig. 10). The subsoil is moderately permeable and moderately low in natural fertility.

The soils are:

Woodstown and Dragston loams, 0 to 2 percent slopes.
Woodstown and Dragston sandy loams, 0 to 5 percent slopes.

If adequately drained, these soils are suited to most of the vegetables grown in the area and to general farm crops. Underdrains work satisfactorily in most areas. If wet, the soils slough easily when ditches are being dug.

Figure 10.—**Moist soil that has been compacted by the wheels of a sprayer.**

Figure 11.—**Asparagus planted on the contour in Colts Neck soils, 5 to 10 percent slopes. The soil on contoured fields holds more water, organic matter, lime, and fertilizer than the soil on fields plowed up and down the slope.**

CAPABILITY UNIT IIw-3

Capability unit IIw-3 consists of deep, nearly level to gently sloping, dominantly moderately well drained soils that have moderately slowly permeable subsoil. The surface layer is sandy loam, and the subsoil consists of clay. These soils are subject to frost action.

In this county the only soil in this unit is:

Keyport sandy loam, 0 to 5 percent slopes.

If adequately drained, this soil is suited to general farm crops. The soil is hard to work, as water passes slowly through it.

Plow and plant approximately on the contour, but go off the contour enough to provide adequate drainage. Use drainage diversions on this soil. On the more nearly level areas, construct shallow V-type ditches to reduce excess surface water.

Apply lime and fertilizer in amounts determined by soil tests. The soil requires large amounts of lime. Fertilizer can be plowed down without risk of leaching.

CAPABILITY UNIT IIIe-1

Capability unit IIIe-1 consists of deep, well-drained, moderately sloping sandy loams. The soils are permeable to water and air but have only a moderate capacity to hold moisture that plants can use. They are moderate to low in natural fertility.

The soils are:

Aura-Sassafras sandy loams, 5 to 10 percent slopes.
Collington sandy loam, 5 to 10 percent slopes.
Colts Neck soils, 5 to 10 percent slopes.
Freehold sandy loam, 5 to 10 percent slopes.
Sassafras sandy loam, 5 to 10 percent slopes.

If erosion is controlled, these soils are well suited to all but the earliest vegetables, to all fruits, and to the general crops grown in the county.

Plant peach trees, asparagus, and other long-lived crops on the contour to control erosion (fig. 11). On the long slopes, use diversion terraces to prevent runoff water from concentrating. Use contour strips to control erosion on fields planted to general farm crops. Cover crops planted early and fertilized heavily will provide the best protection against erosion and the most organic matter.

Apply lime and fertilizer regularly in amounts determined by soil tests and crop needs. Plow down one-third of the fertilizer used for summer vegetables, and add the rest as side dressing throughout the season.

CAPABILITY UNIT IIIe-2

Capability unit IIIe-2 consists of moderately sloping soils that have dominantly a thick loamy sand surface layer and a sandy loam subsoil. The surface soil is very easy to work and can be cultivated soon after heavy rainfall. Since the surface soil is sandy, it soaks up rainfall readily but cannot hold much moisture. It is low in organic matter and natural fertility and blows easily.

The soils are:

Aura-Sassafras loamy sands, 5 to 10 percent slopes.
Collington loamy sand, 5 to 10 percent slopes.
Freehold loamy sand, 5 to 10 percent slopes.
Sassafras loamy sand, 5 to 10 percent slopes.
Westphalia soils, 5 to 10 percent slopes.

These soils are best suited to long-lived crops that have deep roots. Asparagus, peaches, and apples are most commonly produced. Sweetpotatoes do well in areas not contaminated by soil-borne diseases. Pumpkins, cantaloups, and squash are frequently grown without irrigation. In most places, however, irrigation is used for peppers, eggplant, sweet corn, snap beans, and other vegetables. The Westphalia soils are used more extensively for general farm crops than the other soils of this capability unit.

Runoff is very rapid where crops are grown in rows that run up and down the hill. Plow and plant on the contour to conserve water and reduce erosion (fig. 12). Plant cover crops early and fertilize them heavily to provide good protection against winter winds and to add to the supply of organic matter. Use privet hedges to prevent sand blowing on asparagus fields and other places where the soil must be worked early in the year. On the

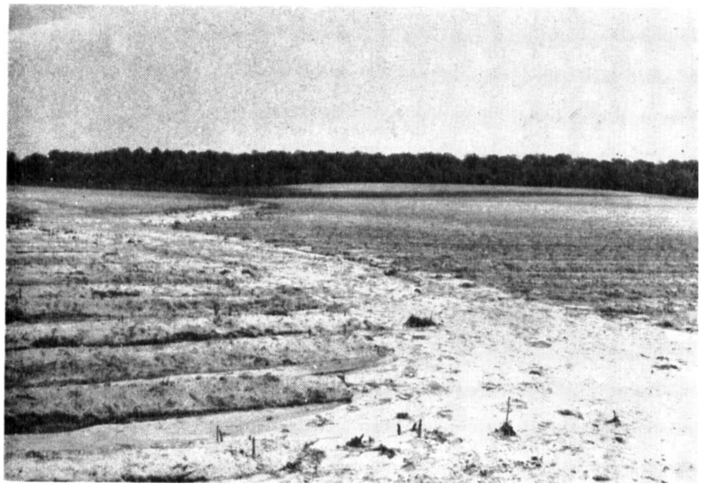

Figure 12.—**This asparagus field, which was not cultivated on the contour, has been damaged extensively by gullying and shifting of sand.**

longer slopes, use diversion terraces to prevent runoff water from concentrating.

Apply lime and fertilizer in amounts determined by soil tests. Because the soils leach easily, apply fertilizer in several applications as a side dressing.

CAPABILITY UNIT IIIe-3

Capability unit IIIe-3 consists of moderately sloping soils that have a clay subsoil. The soils are well drained to moderately well drained, but water passes slowly through the subsoil. In cultivated fields, the hazards of runoff and erosion are severe.

In this county the only soil in this unit is:

Marlton sandy loam, 5 to 10 percent slopes.

This soil is best suited to general farm crops. It is well suited to hay and pasture. Tomatoes, peppers, and apples are also produced.

Plow and plant approximately on the contour, but go off the contour enough to provide adequate drainage. Include sod crops in the rotation, and grow cover crops after all row crops. Eroded areas need additional organic matter to improve the structure of the soil. Treat the smaller areas with large applications of manure. Use a long rotation, in which sod crops are grown, to improve the larger areas.

Apply lime and fertilizer in the amounts determined by soil tests. This soil needs large amounts of lime. Fertilizer can be plowed down with little risk of leaching.

CAPABILITY UNIT IIIs-1

Capability unit IIIs-1 consists of nearly level to gently sloping soils that have a loamy sand surface layer. The subsoil is sandy loam to sandy clay loam. In most areas there is a hard layer at a depth of 2 feet, but in some the hard layer occurs only in places. The soils are well drained, but they are low in available moisture. Permeability is moderately slow or moderate in the subsoil and ranges from rapid to moderately slow in the substratum. The soils are low in natural fertility, and fertilizer that is added will easily leach through the loose surface soil.

The soils are:

Aura loamy sand, 0 to 5 percent slopes.
Aura-Sassafras loamy sands, 0 to 5 percent slopes.

These soils are suited to asparagus, peaches, apples, and other deep-rooted, long-lived crops and to sweetpotatoes, pumpkins, and other summer vegetables. Irrigation is needed for high-value crops. The Aura soils need not be irrigated below a depth of 2 feet, since few roots extend below this point. Because the soils are well drained, they are suitable for poultry ranges.

Plant peach trees and asparagus on the contour. Maintain the content of organic matter by growing heavily fertilized cover crops that are planted early enough to make good growth before winter. If early crops or sweetpotatoes are grown, use privet windbreaks to control erosion. Apply lime and fertilizer in amounts determined by soil tests.

Much of the area of these soils is covered with hardwoods and pines that, in most places, have been frequently cut and damaged by wildfires. The most profitable forest product on these soils is pine pulpwood.

CAPABILITY UNIT IIIw-1

Capability unit IIIw-1 consists of nearly level, poorly drained and very poorly drained, permeable loamy soils. These soils have a high water table. In some areas drainage has been improved. The soils have moderate natural fertility and are naturally extremely acid.

The soils are:

Fallsington loam.
Fallsington sandy loam.
Pasquotank fine sandy loam.
Pocomoke loam.
Pocomoke sandy loam.

If adequately drained, these soils can be used to grow annual summer vegetables and general farm crops, except alfalfa. The water table should be lowered to provide enough air for roots of such long-lived crops as peach trees, apple trees, and nursery plants. In unusually wet seasons, the soils may become saturated, even where normal drainage improvements have been made. Some of the areas are in frost pockets, and frost heaving is a problem.

Apply lime and fertilizer in amounts determined by soil tests. Because the Pocomoke soils are high in organic matter, they need large applications of lime to reduce the acidity.

Special care is needed to prevent the soils from sloughing when ditches are dug in the Pasquotank soil or other soils composed of uniform fine sands. Lay clay tile or bituminous pipes over boards, and cover them with salt hay or straw before filling the ditches. Be careful not to lay underdrains in layers of clay. In constructing open ditches, grade the ditchbanks properly and establish a cover of grass. This will prevent the ditches from filling with sediments.

Undrained areas are best suited to forest or wildlife use. Where layers of clay are not too close to the surface of the soils, these areas are suitable for dug ponds.

Some of the soils support many holly trees. These trees will bear crops of berries if weed trees and poorly shaped trees are cut to open up the stands so that the wind can get through and reduce the hazard of frost. Sprays of holly can be harvested for sale at Christmas. Bees, however, may be needed to insure pollination.

CAPABILITY UNIT IIIw-2

Capability unit IIIw-2 consists of nearly level to gently sloping soils that are mainly somewhat poorly drained to very poorly drained. The dense clay subsoil is slowly permeable to water and air, and it holds water near the surface. The soils are moderately fertile and hold a large amount of moisture. Crop roots, however, cannot easily penetrate the dense clay subsoil. The Kresson soil is not quite so dense as the Lenoir and Keyport soils. The Keyport soil is moderately well drained.

The soils are:

Bayboro loam.
Colemantown-Matlock loams.
Elkton loam.
Kresson sandy loam, 0 to 5 percent slopes.
Lenoir and Keyport loams, 0 to 5 percent slopes.

If adequately drained, these soils are suited to general farm crops, tomatoes, and pasture. Alfalfa does not do well.

In most places excess water is trapped on the surface. In some places, however, the underlying layers of clay alternate with saturated layers of sand; here, deeper outlets must be provided. These soils are hard to work because they are either too wet or too dry much of the time. If worked when wet, they become cloddy. Graded rows can be used where there is enough slope.

Much lime is needed to correct the acidity of these soils. Fertilizer can be plowed down without danger of loss by leaching.

Areas that cannot be drained are best suited to pasture, woodland, or wildlife uses. Good stands of sweetgum occur on these soils.

CAPABILITY UNIT IVe-1

Capability unit IVe-1 consists of deep, well-drained soils that are moderately steep or are moderately sloping and severely eroded. The soils have a sandy to very sandy surface layer. They are naturally acid and moderate to low in natural fertility. Runoff is rapid, and lime and fertilizer are easily carried away in runoff water. The soils are permeable to air and water and have good structure.

The soils are:

Aura-Sassafras sandy loams, 5 to 10 percent slopes, severely eroded.
Freehold soils, 10 to 15 percent slopes.
Freehold sandy loam, 5 to 10 percent slopes, severely eroded.
Sassafras soils, 10 to 15 percent slopes.
Westphalia soils, 10 to 15 percent slopes.

These soils are best suited to hay, pasture, and forest. They can be used for apple trees if a permanent cover is maintained. Most areas are too steep or too eroded to be used regularly for row crops. Small grains can be grown occasionally. If small grains are grown often, diversion terraces will be necessary on the long slopes to prevent severe erosion. Contour plowing and planting will help to control erosion. On eroded areas that are farmed, it will be necessary to fill some gullies and to apply manure to increase the content of organic matter.

On these strongly sloping soils, pine can be planted for Christmas trees, holly for Christmas greens, black locust for posts, and shrubs for wildlife food and cover.

CAPABILITY UNIT IVe-2

Capability unit IVe-2 consists of soils that are moderately steep or are moderately sloping and severely eroded. The soils have a clay subsoil that is slowly permeable to water. Natural drainage ranges from good to moderately good. In cultivated areas runoff is rapid and the hazard of erosion is severe. The soils are naturally moderately fertile. They will hold a moderate amount of moisture if measures are taken to slow the rate of runoff and permit more water to enter the soil.

The soils are:

Keyport sandy loam, 5 to 10 percent slopes, severely eroded.
Marlton sandy loam, 10 to 15 percent slopes.
Marlton sandy loam, 5 to 10 percent slopes, severely eroded.

These soils are suitable for limited cultivation of general farm crops, such as small grains in a rotation with corn and hay. If permanent cover is maintained, the Marlton soils can be used for apple trees.

To control erosion, plow and plant crops on the contour; also, construct diversion terraces approximately on the contour but go off the contour enough to provide adequate drainage. Eroded areas need additional organic matter. Use large applications of manure on the smaller areas; grow a sod crop for a number of years on the larger areas.

Lime requirements are high on these soils. Apply lime and fertilizer in amounts determined by soil tests. Plow down the fertilizer, since there is not much hazard of leaching on these soils.

These soils can be planted to pine, spruce, or fir to be used for Christmas trees; holly for Christmas greens; black locust for fenceposts; and shrubs for wildlife food and cover.

CAPABILITY UNIT IVs-1

Capability unit IVs-1 consists of nearly level to moderately sloping, very thick, loose sands. The soils are very low in natural fertility and in capacity to hold moisture that plants can use. Permeability is rapid. Wind erosion is severe if the soils are not protected by cover crops. The Freehold soil has a more clayey subsoil below a depth of 30 inches than the Lakeland soil. This clayey subsoil is too deep to provide additional moisture for most crops, but it does supply moisture for tree roots.

The soils are:

Freehold sand, thick surface variant, 0 to 10 percent slopes.
Lakeland sand, 0 to 10 percent slopes.

These soils are suitable for limited production of sweetpotatoes, peaches, melons, and pumpkins.

Cover crops should be seeded early. Lime and fertilizer should be used in amounts determined by soil tests and according to crop needs. Apply the fertilizer as side dressings.

Much of the acreage is in forests. Pine does better than hardwoods on these droughty soils.

CAPABILITY UNIT Vw-1

Capability unit Vw-1 consists of nearly level sands that are very wet. The water table rises within 1 foot of the surface in these poorly drained to very poorly drained soils. In some cultivated areas, drainage has been improved. In most places the soils have an organic deposit in the subsoil; the deposit is hard in spots. The color of the surface layer ranges from gray to black. These soils are very low to low in natural fertility and are extremely acid.

The soils are:

Leon sand.
St. Johns sand.

If drained, these soils are especially well suited to blueberries. St. Johns sand is more suitable than Leon sand for blueberries because of the higher content of organic matter. Drainage can be improved by installing open ditches or underdrains. Most growers control the water level at a depth of around 20 inches by ditches and gates.

Cover crops should be planted to maintain the content of organic matter. Apply fertilizer, as side dressings, in amounts determined by soil tests and crop needs.

Most areas are forested with pitch pine. Some areas are suitable for dug ponds.

CAPABILITY UNIT VIe-1

Capability unit VIe-1 consists of permeable soils that are steep or are moderately steep and severely eroded. These soils have a sandy loam or sandy clay loam subsoil.

The soils are:

Freehold sandy loam, 10 to 15 percent slopes, severely eroded.
Freehold, Colts Neck, and Collington soils, 15 to 25 percent slopes.
Sassafras sandy loam, 10 to 15 percent slopes, severely eroded.
Westphalia fine sandy loam, 10 to 15 percent slopes, severely eroded.

These soils are best suited to hay, pasture, forest, or wildlife uses. Some land shaping may be needed on the eroded areas, and diversion terraces can be constructed to reduce the hazard of gullying. Because of the hazard of erosion, fields must be kept permanently covered if the soils are to be productive. Lime and fertilizer should be applied to hay and pasture crops in amounts determined by soil tests.

These soils can be planted to pine, spruce, and fir for Christmas trees; holly for Christmas greens; black locust for fenceposts; and shrubs for wildlife food and cover.

CAPABILITY UNIT VIe-2

Capability unit VIe-2 consists of soils that are steep or are moderately steep and severely eroded. The clay subsoil is slowly permeable. These soils are generally well drained but have seepy spots in places. They are naturally moderately fertile. They hold a moderate amount of moisture, but runoff must be controlled so that moisture soaks in. These soils are naturally extremely acid.

The soils are:

Marlton sandy loam, 15 to 25 percent slopes.
Marlton sandy loam, 10 to 15 percent slopes, severely eroded.

These soils are not suitable for cultivated crops, because of steep slopes and the hazard of erosion. They are best suited to hay, pasture, forest, and wildlife uses.

Replenish the supply of organic matter in eroded areas and fill in gullies. Construct diversion terraces, where needed on these soils, to prevent gullies from reforming. Apply lime and fertilizer to hay and pasture crops in amounts determined by soil tests.

These soils produce satisfactory hardwoods. Eroded areas are suitable for pine and spruce grown for Christmas trees and for plants that provide wildlife food and cover. Black locust can be grown for fenceposts.

CAPABILITY UNIT VIIe-1

Capability unit VIIe-1 consists of moderately steep and steep soils. Runoff is very rapid. As a result, the hazard of erosion is severe, and the moisture-supplying capacity is low. In general, the soils are well drained, permeable, low in organic matter, and low in natural fertility. In places they contain an appreciable amount of clay, are slowly permeable, and are well drained to moderately well drained. These clayey soils have a greater capacity to hold moisture and are higher in natural fertility than the sandy soils.

The soils are:

Freehold, Colts Neck, and Collington soils, 25 to 40 percent slopes.
Sassafras soils, 15 to 40 percent slopes.
Westphalia soils, 15 to 40 percent slopes.

These soils are best used as woodland or as habitats for wildlife. Because they are steep and erodible, they need to be kept under permanent cover.

The soils produce moderate yields of hardwoods. Eroded spots can be planted to pine or spruce for Christmas trees or to shrubs to provide food and cover for wildlife.

CAPABILITY UNIT VIIe-2

Capability unit VIIe-2 consists of steep soils that have a slowly permeable, clayey subsoil. In general, the soils are well drained. They are moderately fertile and have a moderate capacity to hold water. Runoff is very rapid, and the hazard of erosion is severe. The soils are naturally acid.

The only soil in this unit is:

Marlton sandy loam, 25 to 40 percent slopes.

This soil is too steep for cultivated crops. If used for grazing, it requires special care. Most areas are in hardwood forest. Eroded spots can be planted to pine or spruce for Christmas trees, to black locust for fenceposts, or to plants that provide food and cover for wildlife.

CAPABILITY UNIT VIIs-1

Capability unit VIIs-1 consists of nearly level to gently sloping, deep, loose, sandy soils. The soils are very low in natural fertility and very low in capacity to hold moisture available to plants. Rainwater passes through the soil rapidly. The Lakewood soil is excessively drained, and the Lakehurst soil is moderately well drained to somewhat poorly drained.

The soils are:

Lakehurst sand, 0 to 5 percent slopes.
Lakewood sand, 0 to 5 percent slopes.

These soils are mostly in pine forest. They are too infertile or droughty to grow crops, pasture, or quality hardwoods. They are best suited to the production of pulpwood. Some protection against fire can be provided by reducing the mat of pine needles through prescribed burnings.

CAPABILITY UNIT VIIw-1

Capability unit VIIw-1 consists of wet soils that are subject to frequent overflow and of very wet organic soils. Ground water is near the surface throughout most of the year.

The soils are:

Alluvial land.
Muck.

Because of frequent overflow, these areas are generally unsuited to cultivation. They are most commonly used for woodland or for wildlife habitats. Small areas of Muck have been cleared and are used for cranberries and blueberries. Many areas provide suitable locations for dug ponds.

CAPABILITY UNIT VIIIw-1

Capability unit VIIIw-1 consists of tidal marshes and fresh water marshes that are too wet to grow crops, grass, or trees. The tidal marshes were formerly flooded daily by tides. Some areas were diked and farmed, but all of these have been abandoned.

The soils are:

Fresh water marsh.
Tidal marsh.

These marshes are best suited to wildlife uses. The tidal marshes once produced many muskrats, rail, ducks, and geese. The number of muskrats and waterfowl can be increased if the water level is controlled so that more of the surface is covered in the tidal marshes along streams.

Estimated Yields of Crops

Estimated average acre yields of the principal crops grown on the cultivated soils of Gloucester County are given for two levels of management in table 2. The yields given in columns A were obtained under the management practices followed by most of the farmers in the county; the yields given in columns B are those to be expected if the best current management practices are followed.

The best current management practices for production of individual crops are as follows:

Alfalfa: (1) Use of recommended varieties; (2) inoculation of seed; (3) fertilization in amounts determined by soil tests, or 500 pounds of 5–10–10 per acre at seeding time and an annual topdressing of 600 pounds of 0–10–20 per acre; (4) maintenance of a pH value of 6.0 or above; (5) use of insecticide to control the alfalfa weevil; and (6) adequate drainage provided to a depth of 30 inches.

Apples: (1) Use of recommended varieties; (2) proper spraying of trees; (3) fertilization in amounts determined by soil tests, or ½ to ¾ pound of 8–8–8 per tree for each year of growth; (4) adequate drainage provided to a depth of 30 inches; (5) maintenance of a pH value of 6.0; and (6) use of a winter cover crop or permanent cover.

Asparagus: (1) Use of recommended varieties; (2) fertilization in amounts determined by soil tests, or 1,000 pounds of 5–10–10 per acre before the cutting season and 1,000 pounds per acre after the cutting season; (3) use of insecticide; (4) adequate drainage provided to a depth of 30 inches in the soil; (5) contour planting on slopes of 5 percent or more; (6) control of weeds through cultivation or the use of herbicides; and (7) maintenance of a pH value of 6.0.

Corn: (1) Use of recommended varieties; (2) maintenance of a plant population of 10,000 to 14,000 plants per acre, depending on the available moisture capacity of the soil; (3) fertilization in amounts determined by soil tests, or 500 pounds of 5–10–10 per acre if manure is not added, or 300 pounds of 5–10–10 per acre if manure is added, and in addition to one of these applications, 50 pounds of soluble nitrogen per acre added at the last cultivation; (5) adequate drainage to a depth of 30 inches in the soil; and (6) maintenance of a pH value of 6.0.

Peaches: (1) Use of recommended varieties; (2) proper spraying of trees; (3) fertilization in amounts determined by soil tests, or ½ to 1 pound of 5–10–10 per tree for each year of growth (up to 10 pounds per tree); (4) adequate drainage to a depth of 30 inches; (5) contour planting on slopes of 5 percent or more; (6) maintenance of a pH value of 6.0; and (7) use of a winter cover crop.

Peppers: (1) Use of recommended varieties; (2) fertilization as indicated by soil tests, or 1,500 pounds of 5–10–10 per acre applied as a side dressing of 300 pounds, 500 pounds, and 700 pounds; (3) use of irrigation; (4) adequate drainage to a depth of 30 inches; (5) maintenance of a pH value of 6.0; and (6) use of a winter cover crop.

Sweetpotatoes: (1) Use of recommended varieties; (2) fertilization as indicated by soil tests, or 1,500 pounds of 3–9–12 per acre applied in two side dressings; (3) maintenance of a pH value of 5.4 or below; (4) proper treatment of seedbeds and sprouts for the control of disease; and (5) drainage to a depth of 30 inches.

Tomatoes: (1) Use of recommended varieties; (2) fertilization in amounts determined by soil tests, or 2,000 pounds of 5–10–10 per acre, and on the coarse-textured soils, two-thirds of this amount applied as a side dressing; (3) proper spraying; (4) use of irrigation if needed; (5) adequate drainage to a depth of 30 inches; (6) maintenance of a pH value of 6.0; and (7) use of a winter cover crop.

The estimated yields were based on information obtained through a survey of farmers throughout the county. Data on crop yields for 1957 and average yields for the 5 previous years were obtained. Yields of asparagus, tomatoes, peppers, and sweetpotatoes were obtained mainly from processor and market records. Acreages of fields and soils used for crops were determined. Nevertheless, where several different soils occurred in one field, it was difficult to get reliable estimates of the yields produced on each soil.

Estimated yields of soils for which no yield records were obtained were based on yields of similar soils. The county agricultural agents and other agricultural leaders helped to make the necessary adjustments. In 1957, drought drastically reduced the yields of corn, alfalfa, peppers, and tomatoes, but it had less effect on yields of apples, peaches, and sweetpotatoes. The asparagus crop had been harvested before the drought occurred. Irrigation was available in 1957 for most of the acreage of peppers, some of the acreage of tomatoes, and, in places, for sweetpotatoes.

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TABLE 2.—*Estimated average acre yields of principal crops grown under two levels of management*[1]

[Yields in columns A are to be expected under management commonly used; those in columns B are to be expected under the best current management practices; absence of a yield figure indicates the crop is not generally grown on the soil]

Map symbol	Soil	Asparagus (7-inch spear)		Tomatoes		Peppers (red and green)		Sweetpotatoes (U.S. No. 1)		Corn		Alfalfa		Apples		Peaches	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
		100 lb.	*100 lb.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
AmB	Aura loamy sand, 0 to 5 percent slopes	15	20	7	11	150	450	120	150	20	35	1.5	2.0	250	300	200	250
ArB	Aura sandy loam, 0 to 5 percent slopes	16	22	8	12	150	500	80	140	30	55	2.0	2.5	300	400	250	350
AsB	Aura-Sassafras loamy sands, 0 to 5 percent slopes	16	20	8	12	150	450	120	150	20	35	1.5	2.0	250	300	200	300
AsC	Aura-Sassafras loamy sands, 5 to 10 percent slopes	14	19	7	12	130	400	100	140	18	33	1.5	2.0	250	300	180	290
AuB	Aura-Sassafras sandy loams, 0 to 5 percent slopes	17	22	7	12	150	520	100	140	35	55	2.0	2.5	300	400	250	350
AuC	Aura-Sassafras sandy loams, 5 to 10 percent slopes	15	20	5	11	130	500	90	130	30	50	2.0	2.5	300	400	230	340
AuC3	Aura-Sassafras sandy loams, 5 to 10 percent slopes, severely eroded	12	17	4	10	100	400	70	100	25	40	1.8	2.2	250	350	200	320
Ba	Bayboro loam	----	----	----	----	100	300	----	----	25	50	----	----	----	----	----	----
Ck	Colemantown-Matlock loams	----	----	----	----	----	----	----	----	25	50	----	----	----	----	----	----
CmB	Collington loamy sand, 0 to 5 percent slopes	20	24	8	12	200	500	150	200	40	55	2.2	3.2	300	400	220	280
CmC	Collington loamy sand, 5 to 10 percent slopes	17	22	6	11	150	475	140	190	35	55	2.2	3.2	300	400	200	270
CnA	Collington sandy loam, 0 to 2 percent slopes	20	23	9	15	230	600	80	150	50	90	2.5	3.4	320	450	250	300
CnB	Collington sandy loam, 2 to 5 percent slopes	20	23	8	15	230	600	80	150	50	90	2.5	3.4	320	450	250	300
CnC	Collington sandy loam, 5 to 10 percent slopes	18	23	8	14	250	600	100	140	45	80	2.5	3.2	320	450	250	300
CoB	Colts Neck soils, 0 to 5 percent slopes	18	23	8	14	250	600	100	140	45	80	2.5	3.2	320	450	250	300
CoC	Colts Neck soils, 5 to 10 percent slopes	17	22	6	12	200	550	100	130	40	65	2.2	2.0	300	430	230	280
DoB	Downer loamy sand, 0 to 5 percent slopes	16	20	6	9	150	400	150	200	20	30	1.8	2.2	250	300	220	280
DsA	Downer sandy loam, 0 to 2 percent slopes	16	20	6	10	220	500	130	180	25	40	2.0	2.5	250	300	230	300
DsB	Downer sandy loam, 2 to 5 percent slopes	16	20	6	9	220	500	130	180	25	35	2.0	2.5	250	300	230	300
Ek	Elkton loam	----	----	8	12	170	400	----	----	25	50	----	----	----	----	----	----
Fa	Fallsington loam	10	18	6	10	150	550	----	----	45	65	2.0	3.0	150	350	----	----
Fd	Fallsington sandy loam	10	18	6	10	150	550	----	----	45	65	2.0	3.0	200	350	100	200
FhB	Freehold loamy sand, 0 to 5 percent slopes	20	23	9	12	200	600	150	200	40	55	2.0	3.0	300	400	220	280
FhC	Freehold loamy sand, 5 to 10 percent slopes	18	22	8	11	200	580	140	180	35	55	2.0	3.0	300	400	200	270
FnB	Freehold sand, thick surface variant, 0 to 10 percent slopes	10	16	----	----	----	----	140	160	----	----	1.5	2.0	----	----	----	----
FoA	Freehold sandy loam, 0 to 2 percent slopes	22	28	8	14	200	650	60	150	50	80	2.5	3.2	350	450	280	380
FoB	Freehold sandy loam, 2 to 5 percent slopes	21	28	7	14	230	650	60	150	50	80	2.5	3.2	350	450	280	380
FoC	Freehold sandy loam, 5 to 10 percent slopes	20	26	6	12	210	600	60	140	45	75	2.2	3.0	320	430	260	370
FoC3	Freehold sandy loam, 5 to 10 percent slopes, severely eroded	----	----	----	----	150	500	50	120	35	65	2.0	2.8	300	400	230	350
FoD3	Freehold sandy loam, 10 to 15 percent slopes, severely eroded	13	17	----	----	150	500	----	----	----	----	1.5	2.5	230	340	150	240
FsD	Freehold soils, 10 to 15 percent slopes	16	20	----	----	170	550	----	----	----	----	1.8	2.8	250	370	180	260

See footnote at end of table.

TABLE 2.—*Estimated average acre yields of principal crops grown under two levels of management*[1]—Continued

[Yields in columns A are to be expected under management commonly used; those in columns B are to be eqpected under the best current management practices; absence of a yield figure indicates the crop is not generally grown on the soil]

Map symbol	Soil	Asparagus (7-inch spear)		Tomatoes		Peppers (red and green)		Sweetpotatoes (U.S. No. 1)		Corn		Alfalfa		Apples		Peaches	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
		100 lb.	*100 lb.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
KpB	Keyport sandy loam, 0 to 5 percent slopes	18	23	10	12	150	400	----	----	40	50	2. 5	3. 2	300	400	----	----
KpC3	Keyport sandy loam, 5 to 10 percent slopes, severely eroded	----	----	6	8	120	350	----	----	25	40	2. 0	3. 0	250	350	----	----
KrB	Kresson sandy loam, 0 to 5 percent slopes	----	----	6	10	150	450	----	----	45	60	2. 5	3. 5	250	350	----	----
LaA	Lakehurst sand, 0 to 5 percent slopes	----	----	----	----	----	----	100	130	----	----	----	----	----	----	----	----
LdB	Lakeland sand, 0 to 10 percent slopes	12	16	4	6	----	----	120	160	20	25	1. 5	2. 0	----	----	----	----
LeB	Lakewood sand, 0 to 5 percent slopes	----	----	----	----	----	----	100	120	----	----	----	----	----	----	----	----
LkA	Lenoir and Keyport loams, 0 to 5 percent slopes	12	18	9	14	150	300	----	----	35	55	2. 0	3. 0	----	250	----	----
Lo	Leon sand	----	----	----	----	----	----	----	----	20	30	----	----	----	----	----	----
MrB	Marlton sandy loam, 0 to 5 percent slopes	18	22	7	10	150	400	100	120	40	70	3. 0	3. 8	300	400	200	300
MrC	Marlton sandy loam, 5 to 10 percent slopes	16	21	6	10	140	400	90	110	35	65	2. 8	3. 5	280	380	180	290
MrC3	Marlton sandy loam, 5 to 10 percent slopes, severely eroded	14	18	5	9	120	350	70	90	25	55	2. 5	3. 0	250	350	150	270
MrD	Marlton sandy loam, 10 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	2. 2	2. 8	270	370	170	280
MrD3	Marlton sandy loam, 10 to 15 percent slopes, severely eroded	----	----	----	----	----	----	----	----	----	----	2. 0	2. 5	220	330	140	260
NbB	Nixonton and Barclay soils, 0 to 5 percent slopes	18	25	9	12	250	550	120	180	50	75	2. 5	3. 5	350	500	200	300
Pa	Pasquotank fine sandy loam	10	18	5	10	150	550	----	----	45	70	1. 0	3. 0	150	350	----	----
Po	Pocomoke loam	----	----	----	9	100	500	----	----	35	70	----	----	----	----	----	----
Ps	Pocomoke sandy loam	----	----	----	8	100	450	----	----	30	65	----	----	----	----	----	----
Sa	St. Johns sand	----	----	----	----	----	----	----	----	20	35	----	----	----	----	----	----
SfB	Sassafras loamy sand, 0 to 5 percent slopes	16	20	6	10	170	400	150	200	25	40	1. 8	2. 2	250	300	220	280
SfC	Sassafras loamy sand, 5 to 10 percent slopes	14	18	6	9	130	380	140	180	20	35	1. 8	2. 2	250	300	200	270
SrA	Sassafras sandy loam, 0 to 2 percent slopes	16	24	6	11	200	500	150	180	50	70	2. 5	3. 0	300	400	250	320
SrB	Sassafras sandy loam, 2 to 5 percent slopes	16	24	6	11	200	500	150	180	50	70	2. 5	3. 0	300	400	250	320
SrC	Sassafras sandy loam, 5 to 10 percent slopes	14	22	5	10	180	450	140	160	35	55	2. 2	2. 8	280	380	230	300
SrD3	Sassafras sandy loam, 10 to 15 percent slopes, severely eroded	10	13	----	----	----	----	----	----	----	----	1. 2	1. 5	180	220	150	240
SsD	Sassafras soils, 10 to 15 percent slopes	12	16	----	----	----	----	----	----	----	----	1. 2	2. 0	200	250	180	260
WaD3	Westphalia fine sandy loam, 10 to 15 percent slopes, severely eroded	10	18	----	----	----	----	----	----	----	----	1. 2	2. 2	320	420	180	310
WhB	Westphalia soils, 0 to 5 percent slopes	18	24	10	15	200	550	150	200	45	70	2. 0	3. 0	400	500	250	350
WhC	Westphalia soils, 5 to 10 percent slopes	16	23	9	15	180	550	140	200	40	70	1. 8	3. 0	380	480	230	340
WhD	Westphalia soils, 10 to 15 percent slopes	12	20	----	----	----	----	----	----	----	----	1. 5	2. 5	370	470	220	330
WnA	Woodstown and Dragston loams, 0 to 2 percent slopes	18	25	10	14	250	550	70	100	40	75	3. 5	4. 0	350	500	200	300
WoB	Woodstown and Dragston loamy sands, 0 to 5 percent slopes	16	24	8	11	230	500	150	200	30	50	3. 0	3. 5	350	400	175	275
WsB	Woodstown and Dragston sandy loams, 0 to 5 percent slopes	18	25	9	12	250	550	80	130	35	65	3. 5	4. 0	400	450	150	250
WtB	Woodstown and Klej loamy sands, 0 to 5 percent slopes	17	20	5	8	150	400	150	200	25	35	2. 0	2. 5	300	350	200	300

[1] Estimated yields are not given for miscellaneous land types and steeply sloping soils that are unsuited to cultivation.

Some growers watered their peach and apple orchards in this extremely dry year. For the crops affected by drought, estimated yields were adjusted according to the average yield in the 5 years before 1957.

The estimated yields are average yields that can be expected over a period of years under defined levels of management and may not apply to specific tracts for any particular year. Management practices vary from farm to farm, and weather conditions vary from year to year. In years of favorable weather, yields of 30 tons of tomatoes and 100 bushels of corn per acre are common on some of the soils; at times, yields of 1,000 bushels of apples per acre are produced. Such yields, however, are far above average. Since irrigation is available for many crops, yields are lowest in wet years when disease, inadequate drainage, erosion, poor management, or a combination of these factors limit production. The effect of weather on yields of crops is discussed in more detail in the section "Climate."

Use of the Soils for Woodland

This section is designed mainly for woodland owners, foresters, and others who are interested in improving woodlands and woodland products. The first part of this section tells something about the history of woodlands in Gloucester County. The next part discusses the soil-woodland relationship in the county. In the third part, the soils are placed in woodland suitability groups and some of the factors that affect their use for woodland are given.

Woodland history

All of Gloucester County, except the tidal marshes, was originally forested. Now about 75,000 acres, approximately one-third of the county, is in forest. Before 1800, most of the large desirable trees had been cut. In the western part of the county, the land was cleared for farming. Timber that was not used locally or in nearby Philadelphia was exported.

In the eastern part of the county, the first forest products—lumber, pitch, tar, and resin—were obtained from pine. Later, both oak and pine were cut for fuel in industrial plants, such as the glass factory that was established at Glassboro in 1775. Not much land was cleared for farming in the early days, so sprout forests of oak became dominant in the area. Much timber was cut to make charcoal for iron furnaces and forges and to supply fuel to the cities. However, the land was cleared so slowly that forests continued to occupy up to 80 percent of the acreage in large areas. Since the early settlers had little regard for future timber needs, forested areas were continually cut and had frequent wildfires. After areas of forest burned, they seeded mostly to pitch pine.

Land clearing has greatly reduced the hazard of fire, but many areas still have slow growing, poor-quality sprout trees that grew up after fires. If fires can be controlled, the soils can produce much more wood than at present.

Soil-woodland relationships

In many parts of the county, there is a close correlation between kinds of soil and kinds of woodland. In the eastern part, however, this relationship has been almost obscured by severe fires and cutting.

Even in the eastern part, some relationship between the type of soil and the kind of tree is still evident. Atlantic white-cedar is the only abundant tree on areas of the highly organic, wet Muck. Pitch pine is the most abundant tree on the infertile, dry Lakewood and Lakeland sands and also on the infertile, wet Leon and St. Johns sands. This suggests that lack of fertility is the factor that controls the species of trees that grow on these sandy soils. The Downer, Sassafras, and Aura soils, which are slightly more fertile and not too droughty, produce better oaks but seldom produce yellow-poplar. Yellow-poplar is confined to the more fertile soils in the western part of the county.

In the western part of the county, an abundance of holly and yellow-poplar occurs on the fine sandy soils of the Westphalia, Nixonton, Barclay, and Pasquotank series. Holly and yellow-poplar occur on one kind of soil material, which ranges from well drained to very poorly drained. Yellow-poplar is more abundant on the well-drained soils than on the wet soils.

Mixed forests of red oak, white oak, and black oak are abundant on well-drained soils, whereas willow oak, pin oak, and sweetgum grow on the wet soils.

Beech and redcedar are numerous on clay soils. Yellow-poplar, red oak, pin oak, sweetgum, ash, elm, and sycamore are along the streams that overflow.

Woodland suitability groupings

In table 3, the soils of Gloucester County have been placed in seven woodland suitability groups, and the factors that affect the use of the soils in woodland are given. Miscellaneous land types that are not suitable for woodland have not been placed in a woodland suitability group.

Group 1 consists of shallow to deep, well drained to somewhat poorly drained soils that have a moderately coarse textured to moderately fine textured subsoil of low fertility. The soils can produce both pines and hardwoods. If desired, areas containing mixed stands can be converted to the more profitable pine forests. Plant competition may be severe in places where scrub oak has become firmly established.

Group 2 is made up of deep, well drained to somewhat poorly drained soils that have a moderately coarse textured to moderately fine textured subsoil of moderate fertility. Yellow-poplar grows well, especially on the Westphalia soils and on Nixonton and Barclay soils, but it may not reproduce satisfactorily. Plant competition generally is so severe for pines that these trees are rare except in old fields, where they grow in almost pure stands until hardwoods take over the sites.

Group 3 is made up of well drained to somewhat poorly drained soils with a fine-textured subsoil. The soils have developed from clay, but they are sloping and, therefore, are not extremely wet. They are best suited to hardwoods.

TABLE 3.—*Woodland suitability groups*

Map symbols	Woodland suitability groups and soil types	Estimated potential productivity	Species priority
	Group 1	High for pines; low for hardwoods.	1. Shortleaf pine. 2. Pitch pine. 3. Mixed oaks (black, white, scarlet, and, in places, southern red).
AmB	Aura loamy sand.		
ArB	Aura sandy loam.		
AsB, AsC	Aura-Sassafras loamy sands.		
AuB, AuC, AuC3	Aura-Sassafras sandy loams.		
DoB	Downer loamy sand.		
DsA, DsB	Downer sandy loam.		
SfB, SfC	Sassafras loamy sand.		
SrA, SrB, SrC, SrD3	Sassafras sandy loam.		
SsD, SsE	Sassafras soils.		
WnA	Woodstown and Dragston loams.		
WoB	Woodstown and Dragston loamy sands.		
WsB	Woodstown and Dragston sandy loams.		
WtB	Woodstown and Klej loamy sands.		
	Group 2	Moderate to high for hardwoods and for pines.	1. Mixed oaks (red, scarlet, black, and white). 2. Yellow-poplar. 3. Virginia pine on old fields.
CmB, CmC	Collington loamy sand.		
CnA, CnB, CnC	Collington sandy loam.		
CoB, CoC	Colts Neck soils.		
FhB, FhC	Freehold loamy sand.		
FnB	Freehold sand, thick surface variant.		
FoA, FoB, FoC, FoC3, FoD3.	Freehold sandy loam.		
FsD	Freehold soils.		
FtE, FtF	Freehold, Colts Neck, and Collington soils.		
NbB	Nixonton and Barclay soils.		
WaD3	Westphalia fine sandy loam.		
WhB, WhC, WhD, WhE	Westphalia soils.		
	Group 3	High for hardwoods	1. Mixed oaks (red, scarlet, black, and white). 2. Yellow-poplar. 3. Sweetgum on Lenoir and Keyport loams.
KpB, KpC3	Keyport sandy loam.		
KrB	Kresson sandy loam.		
LkA	Lenoir and Keyport loams.		
MrB, MrC, MrC3, MrD, MrD3, MrE, MrF.	Marlton sandy loam.		
	Group 4	Moderate to high for hardwoods; moderate for pines on only Fallsington, Pasquotank, and Pocomoke soils.	1. Oak-gum (pin oak, willow oak, and sweetgum). 2. Sweetgum in old fields. 3. Ash, red maple, sycamore, and elm on Alluvial land.
Ad	Alluvial land.		
Ba	Bayboro loam.		
Ck	Colemantown-Matlock loams.		
Ek	Elkton loam.		
Fa	Fallsington loam.		
Fd	Fallsington sandy loam.		
Pa	Pasquotank fine sandy loam.		
Po	Pocomoke loam.		
Ps	Pocomoke sandy loam.		
	Group 5	Low to high for Atlantic white-cedar.	Atlantic white-cedar.
Mu	Muck.		
	Group 6	Low to moderate for pines; very low for oaks.	1. Pitch pine. 2. Shortleaf pine.
LaA	Lakehurst sand.		
LdB	Lakeland sand.		
LeB	Lakewood sand.		
	Group 7	Low for pines; unsuitable for oaks.	1. Pitch pine. 2. Atlantic white-cedar in some areas of St. Johns soil.
Lo	Leon sand.		
Sa	St. Johns sand.		

[1] Ratings in this table prepared mainly by Silas Little, Northeastern Forest Experiment Station, U.S. Forest Service, and by James Cummings, principal forester, N.J. Forest Service.

and factors that affect woodland use [1]

Seedling mortality	Plant competition	Special products	Remarks
Moderate to slight.	Slight for hardwoods; slight to severe for pines.	Christmas trees; holly; laurel; posts from black locust.	Very few limiting factors on these soils, but use of equipment may be limited on Woodstown and Klej soils and on Woodstown and Dragston soils during wet periods; generally, the soils are of low fertility and are best suited to pines; prescribed burning may be done to reduce fire hazards and to prepare a seedbed favorable for the reproduction of pines.
Slight	Slight for oaks; slight to severe for pines.	Christmas trees; holly; laurel; posts from black locust.	Few limiting factors on these soils, but use of equipment may be limited on Nixonton and Barclay soils during wet periods; the steep slopes are short; the soils are best suited to hardwoods.
Slight	Slight	Christmas trees; holly; laurel; posts from black locust on Marlton soils.	Few limiting factors on these soils, but use of equipment may be limited on level areas of Lenoir and Keyport soils during wet periods; the steep slopes are short; the soils are considered fertile; beech trees are abundant on some areas of more clayey soils; seedling mortality may be severe on eroded Marlton soils.
Slight	Moderate to severe from trees; severe from shrubs.	Holly (avoid frost pockets); laurel.	Use of equipment limited on all soils during wet periods; windthrow hazard is moderate on the more clayey soils (the Bayboro, Colemantown-Matlock, and Elkton); windthrow hazard is slight on Alluvial land and the Fallsington, Pasquotank, and Pocomoke soils.
Slight	Severe from trees and shrubs	None	Use of equipment severely limited by high water table and spongy organic matter; severe windthrow hazard.
Severe	Slight to moderate	None	Use of equipment may be slightly limited on Lakehurst soil during extremely wet periods; seedling mortality severe because of the drying of sand at the surface.
Slight	Severe	None	Use of equipment is limited on these soils by a high water table during wet periods.

Group 4 consists of wet soils that have a moderately coarse textured or a fine textured subsoil. The soils are best suited to hardwoods.

Group 5 consists of very wet, mucky soils that have formed from organic matter. The areas are in Atlantic white-cedar unless fire or improper cutting has eliminated these trees. The forests must be clear cut because of the windthrow hazard and the risk of damage by snow, and because Atlantic white-cedar needs optimum conditions for reseeding.

Group 6 is made up of excessively drained to moderately well drained, infertile sands. Plant competition on these soils is mostly from scrub oaks. These are the soils on which wildfires have been most damaging. Control of wildfires is the most important management practice needed.

Group 7 is made up of poorly drained and very poorly drained, infertile sands. Shrub growth is dense on these soils. Pitch pine is common on the Leon soil, but the trees have inferior development. Under favorable conditions, Atlantic white-cedar grows on the St. Johns soil.

Following is an explanation of the ratings and interpretations shown in table 3.

Potential productivity of groups of soils is estimated for both hardwoods and pines. Productivity is estimated in terms of *high*, *moderate*, and *low*. These ratings are based on the use of at least fair management that includes the elimination of wildfires.

Species priority refers to the kinds of trees, listed in order of suitability, that can be grown on the soils of different groups.

Seeding mortality refers to the expected degree of mortality of natural or planted seedlings, as influenced by the kind of soil. The ratings are *slight*, *moderate*, and *severe*. A rating of slight means that adequate natural regeneration ordinarily will take place if seedbeds and seed sources are adequate. Losses expected because of soil influences do not ordinarily exceed 25 percent of the planted stock. Normally, one can expect satisfactory restocking by initial planting. A rating of moderate means that there is a regeneration problem. Losses expected because of soil influences are ordinarily between 25 and 50 percent of the planted stock. Normally, one can expect to do some replanting to fill openings. Natural regeneration can usually be relied on for adequate and immediate restocking if seedbeds, seed sources, and the weather are reasonably favorable. A rating of severe means that losses expected because of soil influences are often 50 percent or more of the planted stock. Natural regeneration can be relied on if seedbeds, seed sources, and the weather are favorable. If seedling mortality is severe, special management and site preparation are necessary.

Plant competition refers to the degree of competition and the rate that undesirable species invade different soils when openings are made in the canopy. This invasion is known as brush encroachment. Ratings for plant competition are *slight*, *moderate*, or *severe*. A rating of slight means that there is no special problem. A rating of moderate means that plant competition develops but that some simple management technique, such as site preparation or weeding, can be used to minimize the problem. A rating of severe means that plant competition is so severe that natural regeneration must be appreciably favored to provide adequate restocking of designated species. Special management and site-preparation treatments needed are controlled burning, disking, use of chemical sprays, girdling, and tree planting and replanting as necessary.

Special products refers to those products that each group of soils will produce most efficiently. Information on the establishment of plantations of Christmas trees and black locust is available from the Extension Service in Agriculture and Home Economics. Natural groves of holly can be developed on many of the soils of the county that already have dense stands. Less desirable trees should be cut to eliminate competition and to provide air drainage. These less desirable trees include hardwoods and excessive numbers of male holly trees.

Use of the Soils for Wildlife[4]

Wildlife production, as a primary land use, is suitable for the soils of Gloucester County. Use of land for wildlife is especially worth the consideration of landowners whose properties contain large acreages of the wet or very wet Pocomoke, Fallsington, Pasquotank, Leon, and St. Johns soils and Alluvial land, Muck, and Tidal marsh. Water developments, such as ponds for game fish, waterfowl, and furbearers, can be made at suitable sites on these soils.

Wildlife production provides an alternative use for the less fertile and sandy soils, especially the Lakewood, Lakeland, Downer, and Aura soils in the eastern part of the county. Here, owners of large properties might consider the development of areas for private or leased hunting of pheasants and rabbits.

A number of wildlife management practices that help to conserve soil and water can be used on farms on which fruit, vegetables, or general farm crops are the primary products. On the better soils, such as the Collington, Colts Neck, Freehold, Marlton, Sassafras, and Woodstown, the principal need of wildlife is winter cover. This cover can be provided by windbreaks and by hedgerows grown across the slope. Also, shrubs that provide both food and cover can be planted on steep slopes and eroded areas. These wildlife plantings are especially needed where there are large asparagus fields that are bare when disked late in winter. Small wet spots in the fields can be used to grow plants for wildlife. Living fences and plantings around the many irrigation ponds will add much food and cover for wildlife.

Various trees, shrubs, and herbaceous species are used for wildlife plantings in Gloucester County. In table 4 the soils of the county have been placed in groups and rated according to their suitability for the most important trees, shrubs, and native plants that provide food and cover. The suitability of groups of soils for small game, white-tailed deer, waterfowl and furbearers, and pond fish is also shown in this table.

[4] R. Franklin Dugan, biologist, Soil Conservation Service, had a major part in the preparation of this section.

The suitability of the various kinds of vegetation shown in table 4 can be defined as follows: (1) Conifers are suitable as wildlife plants if they grow well enough to provide cover and shelter; (2) most trees are suitable if they grow on the soils; to get abundant food from these trees, it may be necessary to remove competing plants so as to provide more light; (3) browse is suitable if it grows on the soils; and (4) shrubs are suitable if they grow well enough to provide food and cover when there is sufficient light and little competition from other plants.

Native vegetation that has special value for wildlife can be established on most of the soils. Information on cultural, mechanical, and biological techniques in the management of native plants is available through State and Federal agencies.

The principal kinds of game in the county are ducks, cottontail rabbits, quail, gray squirrels, ring-necked pheasants, ruffed grouse, and white-tailed deer. Farm ponds may be stocked with fish. Largemouthed bass and bluegill sunfish do well if the water is not extremely acid. The acidity of some ponds varies according to the amount of liming done in the watershed. Water in the upland areas, however, was originally strongly acid. The economic value of muskrats fluctuates. At one time, muskrats were an important farm resource, but they are no longer of significant value.

Engineering Applications[5]

This soil survey report for Gloucester County contains information that engineers can use to—

1. Make soil and land use studies that will aid in the selection and development of industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
3. Make estimates of runoff and sediment characteristics for use in the planning of dams, channels, and other structures.
4. Make reconnaissance surveys of soils and foundation sites that will help in selecting locations for highways and airports and in the planning of detailed soils investigations for these locations.
5. Locate probable sources of sand, gravel, and other construction materials.
6. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.
7. Determine the suitability of soil units for cross-country movement of vehicles and construction equipment.
8. Supplement information obtained from other published maps and reports and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.

It is not intended that this report will eliminate the need for sampling and testing of soils for specific engineering work. The soil maps and report are somewhat generalized and should be used only in planning more detailed investigations of specific sites.

The use of the data in tables 5, 6, and 7 and the soil maps will provide a preliminary evaluation of the engineering properties of the soils at any specific location in the county.

Some of the terms used by the soil scientists may be unfamiliar to the engineer, and some words, for example, soil, clay, silt, sand, gravel, and aggregate have special meanings in soil science. These and other special terms that are used in this soil survey report are defined in the Glossary.

Soil test data and engineering soil classifications

To be able to make the best use of the soil maps and the soil survey report, the engineer should know the physical properties of the soil materials and the in-place condition of the soil. He needs to be familiar with the Unified soil classification system (*10*) and the system approved by the American Association of State Highway Officials (*1*). Both systems are briefly explained in this section under the heading "Engineering Classification Systems."

SOIL TEST DATA

All engineering soil test data in this report are based on sampling and testing done by Rutgers University, College of Engineering (*6*, *7*).

In this engineering study, soil samples were taken at 70 locations in the county and were tested in the laboratory. It was possible to identify the soil at 42 of these locations in terms of mapping units that are shown on the detailed maps in the back of this report. The results of the tests of soil samples from the 42 locations are given in table 5. Also in table 5, soil materials are classified according to the ASSHO and Unified systems and the textural classification of the U.S. Department of Agriculture. In table 5 some of the soil names used in the original engineering study have been changed to agree with current soil science classification. The test data in table 5 have been expanded to cover all the mapping units except Made land and Pits. This expansion is shown in table 6, which gives estimates of physical properties of the soils and a brief description of each soil type.

[5] This section was prepared mainly by KENNETH S. WERKMAN, conservation engineer for New Jersey, and THEODORE VAIL, civil engineer, both of the Soil Conservation Service.

TABLE 4.—*Suitability of the soils for wildlife*

Wildlife groups, soils, and map symbols	Plants grown for cover	Plants grown for food		
		Mast trees[1]	Browse	
	Conifers	Oak, beech, hickory, dogwood, persimmon[2]	Atlantic white-cedar, red maple, bay magnolia	Oak
Group 1	Good for pine	Good	Not suitable	Good
Collington (CmB, CmC, CnA, CnB, CnC). Colts Neck (CoB, CoC). Freehold (FhB, FhC, FnB, FoA, FoB, FoC, FoC3, FoD3, FsD). Freehold, Colts Neck, and Collington (FtE, FtF). Westphalia (WaD3, WhB, WhC, WhD, WhE).				
Group 2	Good for pine	Good	Not suitable	Good
Aura (AmB, ArB). Aura-Sassafras (AsB, AsC, AuB, AuC, AuC3). Downer (DoB, DsA, DsB). Sassafras (SfB, SfC, SrA, SrB, SrC, SrD3, SsD, SsE).				
Group 3 Nixonton and Barclay (NbB). Woodstown and Dragston (WnA, WoB, WsB). Woodstown and Klej (WtB).	Good for pine	Good	Not suitable	Good
Group 4 Fallsington (Fa, Fd). Pasquotank (Pa). Pocomoke (Po, Ps).	Good for pine	Fair	Poor	Fair
Group 5	Good for pine and red cedar.	Good	Not suitable	Good
Keyport (KpB, KpC3). Kresson (KrB). Lenoir and Keyport (LkA). Marlton (MrB, MrC, MrC3, MrD, MrD3, MrE, MrF).				
Group 6	Fair for pine and spruce.	Good	Not suitable	Fair
Bayboro (Ba). Colemantown-Matlock (Ck). Elkton (Ek).				
Group 7 Alluvial land (Ad).	Good for pine	Fair	Fair	Fair
Group 8 Lakehurst (LaA). Lakeland (LdB). Lakewood (LeB).	Good for pine	Poor	Not suitable	Poor
Group 9 Leon (Lo). St. Johns (Sa).	Good for pine	Not suitable	Poor	Not suitable
Group 10 Muck (Mu).	Poor for pine, good for Atlantic white-cedar.	Not suitable	Good	Not suitable
Group 11 Tidal marsh (Tm).	Not suitable	Not suitable	Not suitable	Not suitable
Group 12 Fresh water marsh (Fw).	Not suitable	Not suitable	Poor	Not suitable

[1] Refers broadly to trees that furnish acorns, nuts, or berries.
[2] If not eliminated by wildfires, laurel and holly grow on most of the soils.

cover and food and for different kinds of wildlife

Plants grown for food—Continued		Small game[3]	White-tailed deer	Waterfowl and fur-bearers	Pond fish
Shrubs					
Tatarian honeysuckle, bayberry, multiflora rose, high-bush cranberry, silky cornel, viburnum	Autumn olive, shrub lespedeza				
Good	Good	Good	Good	Generally not suitable.	Generally not suitable.
Good	Good	Good	Good	Generally not suitable.	Generally not suitable.
Good	Good	Good	Good	Fair	Good to poor.[4]
Good	Poor	Good	Good	Good	Good to poor.[4]
Good	Good	Good	Good	Poor	Poor.[4]
Poor, even if drained	Not suitable	Fair	Good	Fair	Good to poor.[4]
Good	Poor	Good	Good	Good	Good to poor.[4]
Not suitable	Not suitable	Poor	Poor	Not suitable	Not suitable.
Not suitable	Not suitable	Poor	Good	Fair	Good to poor.[4]
Not suitable	Not suitable	Poor	Good	Fair	Poor.
Not suitable	Not suitable	Poor	Poor	Good	Good to poor.
Not suitable	Not suitable	Poor	Poor	Fair	Generally not suitable.

[3] Small game includes cottontail rabbits, ducks, quail, squirrels, ring-necked pheasants, and ruffed grouse.

[4] The acidity of water in dammed ponds varies according to the amount of lime applied to soils in the watershed and to the degree of acidity of seepage water. The suitability for fish must be determined at individual sites.

TABLE 5.—*Engineering*

Mapping unit symbol	Soil type	Sampling site: Site number	Sampling site: Latitude	Sampling site: Longitude	Depth from surface	Test results: Sieve analysis: Cumulative percentage passing—: ¾ inch	No. 4 (4.7 mm.)	No. 10 (2 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
			Degree, minutes, seconds	*Degree, minutes, seconds*	*Inches*					
AmB	Aura loamy sand	2	39	74	0 to 24	95	86	80	45	16
			38	58	24 to 35	80	55	48	18	7
			25	42	35 to 49	100	100	97	61	23
					49 to 121	100	100	99	84	11
		19	39	75	0 to 26	97	62	54	30	11
			38	02	26 to 44	96	77	65	38	29
			18	40	44 to 68	98	93	90	70	48
ArB	Aura sandy loam	6	39	75	0 to 8	100	98	97	64	20
			48	14	8 to 20	99	96	95	59	23
			10	00	20 to 60	100	98	98	54	25
		11	39	75	0 to 6	---	---	---	---	---
			42	16	6 to 18	83	58	52	39	24
			07	50	18 to 30	85	59	53	35	25
					30 to 48	95	76	67	40	32
CoB	Colts Neck soils	33	39	75	0 to 6	---	---	---	---	---
			43	20	6 to 36	100	100	100	83	15
			20	53	36 to 50	100	99	98	83	16
					50 to 66	100	99	99	75	10
					66 to 84	100	100	100	83	22
		36	39	75	0 to 8	100	100	99	86	36
			45	15	8 to 20	100	99	97	82	32
			30	37	20 to 60	97	93	88	72	28
		46	39	75	0 to 3	100	98	96	82	11
			44	17	3 to 15	99	99	98	79	36
			21	38	15 to 40	100	100	100	71	23
					40 to 64	100	100	100	78	14
DoB	Downer loamy sand	7	39	75	0 to 12	100	100	99	87	8
			47	20	12 to 36	100	100	100	86	10
			55	19	36 to 60	100	100	100	91	10
					60 to 96	100	98	95	78	5
		14	39	75	0 to 8	100	99	99	82	14
			39	10	8 to 36	100	100	99	80	13
			48	51	36 to 54	99	97	90	75	16
					54 to 72	99	92	92	73	49
					72 to 84	100	95	86	46	11
		17	39	75	0 to 30	100	100	98	88	20
			43	05	30 to 58	100	100	99	90	30
			37	49	58 to 84	96	78	70	49	10
Ek	Elkton loam	60	39	75	0 to 10	100	99	98	95	66
			42	13	10 to 28	100	100	99	98	84
			47	26	28 to 38	98	96	96	95	83
		62	39	75	0 to 8	100	99	98	93	80
			41	12	8 to 34	100	100	100	100	99
			23	03	34 to 60	100	100	100	98	95
					60 to 90	100	100	100	97	95

See footnotes at end of table.

soil test data [1]

Test results—Continued						Classification			
Hydrometer analysis		Liquid limit [2]	Plasticity index [3]	Maximum density [4]	Optimum moisture content [4]	AASHO [5]		Unified [6]	USDA texture [7]
0.05–0.005 mm.	<0.005 mm.					Group	Group index		
Percent	*Percent*	*Percent*	*Percent*	*Lb. per cubic foot*	*Percent*				
		NL	NP			A–1–b	0	SM	Loamy sand.
		23	4			A–1–a	0	SP–SM	Gravelly sand.
2	20	32	12			A–2–6	1	SM	Sandy loam.
		NL	NP			A–2–4	0	SP–SM	Loamy sand.
		NL	NP			A–1–b	0	SP–SM	Loamy sand.
9	20	56	23			A–2–7	2	SM	Sandy loam.
22	25	32	10			A–4	3	SC	Sandy clay loam.
		NL	NP			A–2–4	0	SM	Sandy loam.
		NL	NP			A–2–4	0	SM	Sandy loam.
6	18	30	10			A–2–4	0	SC	Sandy loam.
									Sandy loam.
		20	4			A–1–b	0	SM–SC	Gravelly sandy loam.
9	16	42	12	109	15	A–2–7	1	SM	Gravelly sandy loam.
10	21	51	20	110	17	A–2–7	2	SM	Sandy clay loam.
									Loamy sand.
		NL	NP			A–2–4	0	SM	Loamy sand.
		NL	NP			A–2–4	0	SM	Loamy sand.
		NL	NP			A–3	0	SP–SM	Sand.
		NL	NP			A–2–4	0	SM	Sandy loam.
		NL	NP			A–4	0	SM	Sandy clay loam.
		NL	NP			A–2–4	0	SM	Sandy loam.
8	20	29	12			A–2–6	1	SC	Sandy loam.
		NL	NP			A–2–4	0	SP–SM	Loamy sand.
10	23	33	11			A–6	1	SC	Sandy clay loam.
5	18	35	7			A–2–4	0	SM	Sandy loam.
		NL	NP			A–2–4	0	SM	Loamy sand.
		NL	NP			A–3	0	SP–SM	Sand.
		NL	NP			A–3	0	SP–SM	Loamy sand.
		NL	NP			A–3	0	SP–SM	Loamy sand.
		NL	NP			A–3	0	SP–SM	Sand.
		NL	NP			A–2–4	0	SM	Loamy sand.
		NL	NP			A–2–4	0	SM	Loamy sand.
		NL	NP			A–2–4	0	SM	Loamy sand.
27	21	25	9			A–4	3	SC	Sandy loam.
		NL	NP			A–1–b	0	SP–SM	Sand.
		NL	NP			A–2–4	0	SM	Sandy loam.
		NL	NP			A–2–4	0	SM	Sandy loam.
		NL	NP			A–1–b	0	SP–SM	Sand.
		31	9			A–4	6	ML–CL	Loam.
30	23	50	18	93	28	A–7–5	13	ML	Sandy clay loam.
45	26	48	18	87	26	A–7–5	13	ML	Loam.
		31	8			A–4	8	ML–CL	Loam.
40	55	59	35	91	26	A–7–6	20	CH	Clay.
42	43	44	21			A–7–6	13	CL	Clay.
62	28	43	21	96	25	A–7–6	13	CL	Silty clay loam.

TABLE 5.—*Engineering*

Mapping unit symbol	Soil type	Sampling site: Site number	Sampling site: Latitude	Sampling site: Longitude	Depth from surface	Test results — Sieve analysis — Cumulative percentage passing—: ¾ inch	No. 4 (4.7 mm.)	No. 10 (2 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
			Degree, minutes, seconds	*Degree, minutes, seconds*	*Inches*					
Fd	Fallsington sandy loam	20	39	75	0 to 12	100	99	96	65	35
			34	00	12 to 26	100	97	94	94	32
			27	24	26 to 40	100	98	95	55	11
		28	39	75	0 to 10	100	99	98	78	34
			48	15	10 to 30	100	100	99	79	38
			30	09	30 to 42	100	99	99	82	41
					42 to 60	100	98	92	56	15
					60 to 67+	100	97	97	87	35
FhB	Freehold loamy sand	9	39	75	0 to 12	100	100	100	78	21
			45	22	12 to 30	100	100	99	77	34
			58	01	30 to 50	100	96	93	60	10
					50 to 84	94	92	90	74	9
		37	39	75	0 to 10	100	100	100	88	16
			48	08	10 to 30	100	100	100	90	11
			08	35	30 to 48	100	100	100	92	17
FnB	Freehold sand, thick surface variant.	38	39	75	0 to 6	100	100	99	77	7
			48	07	6 to 30	100	100	99	72	5
			38	40	30 to 60	97	96	95	76	15
		39	39	75	0 to 26	100	99	99	83	9
			50	06	26 to 50	100	100	100	87	22
			01	02	50 to 96	100	100	99	82	12
LkA	Lenoir and Keyport loams	8	39	75	0 to 10	99	96	95	81	53
			47	18	10 to 18	98	97	96	89	73
			20	25	18 to 38+	99	98	98	91	74
		63	39	75	0 to 8	100	99	97	70	57
			46	19	8 to 36	100	100	99	78	64
			40	14	36 to 52	100	99	98	93	86
					52 to 80	100	100	99	94	83
LeB	Lakewood sand	41	39	74	0 to 13	100	100	100	61	2
			36	53	13 to 30	100	100	99	65	3
			25	24	30 to 48	100	91	89	52	1
		42	39	74	0 to 7	100	100	100	58	6
			40	55	7 to 27	100	100	98	73	5
			14	10	27 to 51	100	100	100	75	8
		43	39	74	0 to 10	99	99	97	69	8
			41	56	10 to 24	100	100	97	64	6
			33	38	24 to 48	100	100	98	62	3
MrB	Marlton sandy loam	54	39	75	0 to 20	100	100	99	94	86
			42	19	20 to 80	100	100	95	86	78
			34	40	80 to 110	100	99	88	71	48
					110 to 130	100	99	93	66	9
		56	39	75	0 to 10	98	92	83	67	40
			43	15	10 to 24	96	90	86	71	34
			20	48	24 to 46	98	96	95	86	57
		57	39	75	0 to 8	98	92	86	72	32
			47	07	8 to 24	100	98	98	86	51
			30	08	24 to 36	100	100	99	73	17
		58	39	75	0 to 14	67	43	39	32	17
			48	05	14 to 34	99	98	96	93	85
			07	12	34 to 48	100	100	100	84	51

See footnotes at end of table.

soil test data[1]—Continued

Test results—Continued						Classification			
Hydrometer analysis		Liquid limit[2]	Plasticity index[3]	Maximum density[4]	Optimum moisture content[4]	AASHO[5]		Unified[6]	USDA texture[7]
0.05–0.005 mm.	<0.005 mm.					Group	Group index		
Percent	*Percent*	*Percent*	*Percent*	*Lb. per cubic foot*	*Percent*				
		22	5			A-2-4	0	SM-SC	Sandy loam.
		21	4	116	13	A-2-4	0	SM-SC	Sandy loam.
		NL	NP	120	11	A-2-4	0	SP-SM	Sand.
		20	2			A-2-4	0	SM	Sandy loam.
		16	2			A-4	1	SM	Sandy clay loam.
		21	5			A-4	1	SM-SC	Sandy clay loam.
		NL	NP			A-2-4	0	SM	Sand.
8	26	33	10			A-2-4	0	SM-SC	Sandy clay loam.
		NL	NP			A-2-4	0	SM	Loamy sand.
		20	5			A-2-4	0	SM-SC	Sandy clay loam.
		NL	NP			A-3	0	SP-SM	Sand.
		NL	NP			A-3	0	SP-SM	Sand.
		NL	NP			A-2-4	0	SM	Loamy sand.
		NL	NP			A-2-4	0	SP-SM	Sand.
		NL	NP			A-2-4	0	SM	Loamy sand.
		NL	NP			A-3	0	SP-SM	Sand.
		NL	NP	104	15	A-3	0	SP-SM	Sand.
		NL	NP	112	14	A-2-4	0	SM	Loamy sand.
		NL	NP			A-3	0	SP-SM	Sand.
2	20	30	7			A-2-4	0	SM-SC	Sandy loam.
		NL	NP			A-2-4	0	SP-SM	Loamy sand.
		29	5			A-4	4	ML-CL	Loam.
34	38	37	10			A-4	8	ML	Clay loam.
33	38	34	15			A-6	10	CL	Clay loam.
		33	10			A-4	5	ML-CL	Loam.
28	32	48	17	98	22	A-7-5	10	ML	Clay loam.
34	48	53	22			A-7-5	15	MH	Clay.
40	39	66	24	81	37	A-7-5	18	MH	Clay loam.
		NL	NP			A-3	0	SP	Sand.
		NL	NP	109	12	A-3	0	SP	Sand.
		NL	NP	107	14	A-3	0	SP	Sand.
		NL	NP			A-3	0	SP-SM	Sand.
		NL	NP			A-3	0	SP-SM	Sand.
		NL	NP			A-3	0	SP-SM	Sand.
		NL	NP			A-3	0	SP-SM	Sand.
		NL	NP			A-3	0	SP-SM	Sand.
		NL	NP			A-3	0	SP	Sand.
		52	23			A-7-6	16	MH-CH	Clay.
		48	15			A-7-5	12	ML	Clay.
		51	15			A-7-5	6	MH	Sandy clay loam.
		NL	NP			A-3	0	SP-SM	Sand.
		28	7			A-4	1	SM-SC	Sandy loam.
11	23	29	13	116	13	A-2-6	1	SC	Sandy clay loam.
21	36	41	19	106	19	A-7-6	8	CL	Sandy clay loam.
		NL	NP			A-2-4	0	SM	Sandy loam.
17	30	35	18	107	18	A-6	6	CL	Sandy clay loam.
		NL	NP	119	13	A-2-4	0	SM	Sandy loam.
		30	7			A-2-4	0	GM-GC	Sandy loam.
		61	22			A-7-5	17	MH	Clay.
		38	8			A-4	3	ML	Sandy clay loam.

TABLE 5.—*Engineering*

Mapping unit symbol	Soil type	Sampling site: Site number	Sampling site: Latitude	Sampling site: Longitude	Depth from surface	Test results: Sieve analysis: Cumulative percentage passing— ¾ inch	No. 4 (4.7 mm.)	No. 10 (2 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
			Degree, minutes, seconds	*Degree, minutes, seconds*	*Inches*					
SfB	Sassafras loamy sand	18	39	75	0 to 17	96	91	83	63	12
			46	05	17 to 32	99	86	76	47	27
			22	10	32 to 64	96	88	77	29	15
					64 to 115	98	91	76	29	5
SrB	Sassafras sandy loam	15	39	75	0 to 6	76	69	65	49	29
			43	09	6 to 26	91	74	57	54	27
			45	55	26 to 66	99	95	90	28	17
		16	39	75	0 to 12	96	83	79	60	37
			42	06	12 to 28	96	78	67	52	27
			50	28	28 to 38	93	75	68	37	15
		21	39	75	0 to 10	100	97	91	49	28
			32	00	10 to 24	100	98	92	53	32
			26	29	24 to 44	100	99	95	57	24
					44 to 54	100	97	92	38	13
		22	39	75	0 to 12	98	96	95	70	40
			41	00	12 to 32	100	98	97	68	32
			13	09	32 to 48	90	71	63	36	09
		27	39	75	0 to 12	100	100	99	80	24
			50	12	12 to 34	100	100	100	90	55
			12	25	34 to 72	100	100	94	72	9
		30	39	75	0 to 8	100	99	98	69	24
			46	18	8 to 30	97	90	88	66	32
			25	57	30 to 48	95	85	79	46	15
WhB	Westphalia soils	49	39	75	0 to 8	100	99	97	86	29
			45	09	8 to 26	99	95	95	86	34
			10	50	26 to 36	---	---	---	---	---
		44	39	75	0 to 12	100	100	98	92	19
			46	04	12 to 30	98	91	85	74	16
			25	00	30 to 46	94	83	74	60	10
					46 to 56	99	98	97	96	15
		48	39	75	0 to 24	100	100	100	85	27
			43	18	24 to 60	100	100	99	76	12
			02	03	60 to 72	100	100	99	90	13
					72 to 84	93	78	72	58	6
WoB	Woodstown and Dragston loamy sands.	10	39	75	0 to 14	100	100	100	75	11
			46	23	14 to 40	100	100	99	82	13
			42	10	40 to 54	100	98	96	79	21
					54 to 72	100	96	84	57	25
		25	39	75	0 to 8	100	99	98	87	17
			48	11	8 to 16	100	99	97	85	22
			59	34	16 to 36	98	95	93	68	6
		29	39	75	0 to 3	100	96	93	76	18
			47	17	3 to 30	96	84	80	63	19
			50	49	30 to 48	97	82	78	57	24

See footnotes at end of table.

soil test data [1]—Continued

Test results—Continued: Hydrometer analysis: 0.05–0.005 mm.	Test results—Continued: Hydrometer analysis: <0.005 mm.	Liquid limit [2]	Plasticity index [3]	Maximum density [4]	Optimum moisture content [4]	Classification: AASHO [5]: Group	Classification: AASHO [5]: Group index	Unified [6]	USDA texture [7]
Percent	*Percent*	*Percent*	*Percent*	*Lb. per cubic foot*	*Percent*				
		NL	NP			A-2-4	0	SP-SM	Loamy sand.
8	17	48	21			A-2-7	1	SM-SC	Sandy loam.
1	13	36	13			A-2-6	0	SM-SC	Loamy sand.
		NL	NP			A-1-b	0	SP-SM	Sand.
		21	4			A-2-4	0	SM-SC	Sandy loam.
13	12	27	7			A-2-4	0	SM-SC	Sandy loam.
4	12	30	10			A-2-4	0	SC	Loamy sand.
		25	6			A-4	1	SM-SC	Sandy loam.
		23	5			A-2-4	0	SM-SC	Sandy loam.
		NL	NP			A-1-b	0	SM	Loamy sand.
		28	6			A-2-4	0	SM-SC	Sandy loam.
14	18	25	9			A-2-4	0	SC	Sandy loam.
6	17	28	9			A-2-4	0	SC	Sandy loam.
		NL	NP			A-1-b	0	SM	Loamy sand.
		22	6			A-4	1	SM-SC	Sandy loam.
		17	4			A-2-4	0	SM-SC	Sandy loam.
		NL	NP			A-1-b	0	SP-SM	Gravelly sand.
		NL	NP			A-2-4	0	SM	Sandy loam.
		20	5			A-4	4	ML-CL	Sandy clay loam.
		NL	NP			A-3	0	SP-SM	Sand.
		NL	NP			A-2-4	0	SM	Sandy loam.
7	23	27	10	121	13	A-2-4	0	SC	Sandy loam.
		NL	NP	122	11	A-1-b	0	SM	Loamy sand.
		NL	NP			A-2-4	0	SM	Fine sandy loam.
		NL	NP			A-2-4	0	SM	Fine sandy loam.
		NL	NP			A-2-4	0	SM	Loamy fine sand.
		NL	NP	108	12	A-2-4	0	SM	Loamy fine sand.
		NL	NP	109	12	A-3	0	SP-SM	Loamy sand.
		NL	NP			A-2-4	0	SM	Loamy sand.
		NL	NP			A-2-4	0	SM	Fine sandy loam.
		NL	NP			A-2-4	0	SP-SM	Loamy fine sand.
		NL	NP			A-2-4	0	SM	Loamy fine sand.
		NL	NP			A-3	0	SP-SM	Gravelly sand.
		NL	NP			A-2-4	0	SP-SM	Sand.
		NL	NP			A-2-4	0	SM	Loamy sand.
		NL	NP			A-2-4	0	SM	Loamy sand.
		21	3			A-2-4	0	SM	Sandy loam.
		NL	NP			A-2-4	0	SM	Loamy sand.
		NL	NP			A-2-4	0	SM	Sandy loam.
		NL	NP			A-3	0	SP-SM	Sand.
		NL	NP			A-2-4	0	SM	Loamy sand.
		NL	NP	122	10	A-2-4	0	SM	Loamy sand.
		NL	NP	125	10	A-2-4	0	SM	Sandy loam.

TABLE 5.—*Engineering*

Mapping unit symbol	Soil type	Sampling site			Depth from surface	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.)
			Degree, minutes, seconds	*Degree, minutes, seconds*	*Inches*					
WsB	Woodstown and Dragston sandy loams.	13	39	75	0 to 12	99	96	94	81	35
			44	12	12 to 26	97	81	74	63	40
			17	30	26 to 36	83	54	47	33	14
					36 to 44	100	97	94	89	81
					44 to 70	100	99	99	97	94
		26	39	75	0 to 12	100	100	100	87	33
			49	10	12 to 36	100	98	97	83	15
			30	36	36 to 44	100	100	100	62	42
					44 to 60	90	77	74	58	13

[1] Test data taken from "Engineering Soil Survey of New Jersey, Report Number 16, Gloucester County" (*6*). Tests performed in accordance with standard procedures of the American Association of State Highway Officials (*1*).

[2] In this column NL=Nonliquid.

[3] In this column NP=Nonplastic.

[4] Tests performed on fraction passing No. 4 sieve.

soil test data [1]—Continued

Test results—Continued						Classification			
Hydrometer analysis		Liquid limit [2]	Plasticity index [3]	Maximum density [4]	Optimum moisture content [4]	AASHO [5]		Unified [6]	USDA texture [7]
0.05–0.005 mm.	<0.005 mm.					Group	Group index		
Percent	*Percent*	*Percent*	*Percent*	*Lb. per cubic foot*	*Percent*				
--------	--------	NL	NP	--------	--------	A-2-4------	0	SM--------------	Fine sandy loam.
--------	--------	21	4	--------	--------	A-4--------	1	SM-SC----------	Sandy loam.
4	9	25	6	--------	--------	A-1-b------	0	SM-SC----------	Loamy sand.
11	68	52	21	--------	--------	A-7-5------	15	MH--------------	Clay.
--------	--------	50	15	--------	--------	A-7-5------	12	ML--------------	Clay.
--------	--------	23	5	--------	--------	A-2-4------	0	SM-SC----------	Fine sandy loam.
--------	--------	NL	NP	--------	--------	A-2-4------	0	SM--------------	Loamy sand.
23	16	22	7	--------	--------	A-4--------	1	SM-SC----------	Sandy loam.
--------	--------	NL	NP	--------	--------	A-2-4------	0	SM--------------	Loamy sand.

[5] Based on "Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1; ed. 6): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes," AASHO Designation M 145–49 (*1*).

[6] Based on "The Unified Soil Classification System," Tech. Memo. No. 3–357, v. 1, Waterways Experiment Station, Corps of Engineers, March 1953 (*10*).

[7] Based on field determination at sample site.

TABLE 6.—*Brief descriptions of the soils, and their*

Map symbols	Soil type	Depth to seasonally high ground water (before artificial drainage)	Brief soil descriptions[1]	Depth from surface
				Inches
Ad	Alluvial land	1 foot	2 to 2½ feet of stream deposits of silty sand; material is variable; upper 6 inches is high in organic matter; poorly to very poorly drained.	0–30
AmB	Aura loamy sand	10 feet or more	About 1 foot of sand over 1 foot of silty sand underlain by a mixture of clayey sand and fine, angular gravel that is hard when dry; well drained.	0–16 16–30 30–60
ArB	Aura sandy loam	10 feet or more	About 2 to 2½ feet of silty sand over a mixture of clayey sand and fine, angular gravel that is hard when dry; well drained.	0–14 14–24 24–60
AsB	Aura-Sassafras loamy sands: slopes of 0 to 5 percent.	5 to 10 feet or more	Mostly like Aura loamy sand	
AsC	Aura-Sassafras loamy sands: slopes of 5 to 10 percent.	10 feet or more	Mostly like Sassafras loamy sand	
AuB	Aura-Sassafras sandy loams: slopes of 0 to 5 percent.	10 feet or more	Mostly like Aura sandy loam	
AuC	Aura-Sassafras sandy loams: slopes of 5 to 10 percent.	10 feet or more	Mostly like Sassafras sandy loam	
AuC3	Aura-Sassafras sandy loams: slopes of 5 to 10 percent and severely eroded.	10 feet or more	Mostly like Sassafras sandy loam	
Ba	Bayboro loam	Ponded at surface	About 1 foot of organic silt over 3 feet of plastic clay; very poorly drained.	0–10 10–48
Ck	Colemantown-Matlock loams	Ponded at surface	About 1 foot of organic silt over 4 feet of plastic clay; in places clay is stratified with sand below a depth of 30 inches; poorly or very poorly drained.	0–12 12–60
CmB, CmC	Collington loamy sand	10 feet or more	1½ feet of poorly graded sand over 1½ feet of clayey sand that is underlain by loose silty sand; well drained.	0–18 18–34 34–60
CnA, CnB, CnC.	Collington sandy loam	5 to 10 feet or more	About 1 foot of silty sand over 1½ feet of clayey sand that is underlain by 2½ feet of silty sand; well drained.	0–14 14–32 32–60
CoB, CoC	Colts Neck soils	10 feet or more	About 1 foot of a sand-silt mixture over 2 feet of clayey sand that is underlain by 2 feet of silty sand; material contains ironstone in places; well drained.	0–12 12–40 40–60
DoB	Downer loamy sand	5 to 10 feet	About 1½ feet of a poorly graded sand over 1 foot of silty sand; beneath this is 2½ feet of poorly graded sand that, in places, is made up of as much as 10 percent round, hard pebbles; well drained.	0–20 20–30 30–60
DsA, DsB	Downer sandy loam	5 to 10 feet	2½ feet of sand-silt mixture over 2½ feet of silty sand that, in places, contains up to 10 percent round, hard pebbles; well drained.	0–16 16–30 30–60
Ek	Elkton loam	1 foot, but surface ponded at times.	About 8 inches of inorganic silt over 4 feet of plastic clay; in places clay is stratified with sand below a depth of 30 inches; poorly drained.	0–8 8–60
Fa	Fallsington loam	1 foot	About 2½ feet of silty or clayey sand over poorly graded sand or gravelly sand; in places layers of clay occur below a depth of 30 inches; poorly drained.	0–30 30–48
Fd	Fallsington sandy loam	Same as Fallsington loam		

See footnotes at end of table.

estimated physical properties for engineering work

Classification			Mechanical analysis				Percolation rate	Available water-holding capacity
			Percentage passing sieve—					
USDA texture	Unified	AASHO	No. 4	No. 10	No. 40	No. 200		
							Inches per hour	*Inches per foot*
Sandy loam to sandy clay	SM or SC	A-2 or A-4					0. 63-2. 0	
Loamy sand	SM or GM	A-1 or A-2	60-100	50-80	35-55	15-25	. 63-2. 0	1. 0
Sandy clay loam	SM, SC, or GM.	A-1 or A-2	60-100	55-85	35-55	20-30	. 63-2. 0	1. 3
Sandy clay loam	SM or SC	A-1 or A-2	75-100	70-100	40-60	20-30	. 02-. 63	. 5
Sandy loam or gravelly sandy loam	SM	A-1 or A-2	80-100	70-100	50-70	25-35	. 02-. 63	1. 5
Sandy clay loam	SM or SC	A-2 or A-4	80-100	70-100	50-70	30-45	. 63-2. 0	1. 3
Sandy clay loam	SM or SC	A-2	80-100	70-100	50-70	25-35	. 02-. 63	. 5
Loam or silty clay loam	ML or OL	A-4	98-100	98-100	90-100	60-80	. 02-. 63	2. 5
Clay	CL or CH	A-7	95-100	95-100	95-100	60-90	. 02-. 63	2. 0
Loam or silty clay loam	ML or OL	A-4	90-100	90-100	70-90	50-70	. 02-. 63	2. 5
Clay	CL or CH	A-7	90-100	85-100	70-90	45-90	. 02-. 63	2. 0
Loamy sand	SP-SM or SM	A-2	95-100	95-100	80-100	10-20	2. 0-6. 3	1. 0
Sandy clay loam to sandy clay	SM or SC	A-2 or A-4	95-100	95-100	80-90	25-40	. 63-2. 0	1. 5
Sandy loam	SM	A-2	95-100	90-100	80-90	15-30	2. 0-6. 3	1. 0
Sandy loam	SM	A-2	98-100	95-100	80-90	25-35	. 63-2. 0	1. 8
Sandy clay loam to sandy clay	SM or SC	A-2 or A-4	95-100	95-100	80-100	30-45	. 63-2. 0	1. 8
Sandy loam	SM	A-2	95-100	90-100	80-90	15-30	. 63-2. 0	1. 0
Sandy loam or loamy sand	SM	A-2 or A-4	98-100	95-100	80-90	15-40	. 63-2. 0	1. 3
Sandy clay loam or sandy clay	SM or SC	A-2 or A-4	98-100	95-100	80-90	25-45	. 63-2. 0	1. 8
Sandy loam	SM	A-2	95-100	85-100	70-80	10-30	. 63-2. 0	1. 0
Loamy sand	SP-SM or SM	A-2 or A-3	95-100	95-100	70-90	5-20	2. 0-6. 3	1. 0
Sandy loam	SM	A-2	95-100	95-100	60-90	15-25	. 63-2. 0	1. 3
Loamy sand	SP-SM or SM	A-1 or A-3	95-100	80-100	50-90	10-20	2. 0-6. 3	. 8
Sandy loam	SM	A-2	95-100	90-100	50-70	20-30	. 63-2. 0	1. 8
Sandy loam	SM	A-2	95-100	90-100	50-70	25-35	. 63-2. 0	1. 5
Loamy sand	SM	A-1 or A-2	90-100	90-100	40-70	20-30	2. 0-6. 3	. 8
Loam	CL or ML	A-4	98-100	98-100	90-100	60-80	. 02-. 63	2. 5
Clay	CH or MH	A-7	95-100	95-100	95-100	50-100	. 02-. 63	2. 0
Loam, sandy loam, or sandy clay loam.	SM or SC	A-2 or A-4	90-100	85-100	70-85	30-45	. 02-. 63	[2] 2. 0
Loamy sand	SM	A-2	95-100	90-100	50-80	15-40	2. 0-6. 3	1. 0

TABLE 6.—*Brief descriptions of the soils, and their*

Map symbols	Soil type	Depth to seasonally high ground water (before artificial drainage)	Brief soil descriptions[1]	Depth from surface
				Inches
FhB, FhC	Freehold loamy sand	10 feet or more	1½ feet of poorly graded sand over 2 feet of clayey sand that is underlain by silty sand; well drained.	0–20 20–40 40–60
FnB	Freehold sand, thick surface variant.	10 feet or more	2½ feet of poorly graded sand over 1 foot of silty sand that is underlain by poorly graded sand; well drained.	0–30 30–42 42–60
FoA, FoB, FoC, FoC3, FoD3.	Freehold sandy loam	10 feet or more	5 feet of silty sand over thick beds of sand; in places material contains up to 10 percent gravel; well drained.	0–16 16–40 40–60
FsD	Freehold soils	Same as Freehold loamy sand		
FtE, FtF	Freehold, Colts Neck, and Collington soils.	Mostly like Freehold loamy sand		
Fw	Fresh water marsh	At surface	2 to 2½ feet of a sand-silt mixture; uppermost 1 foot is high in organic matter; material is variable; very poorly drained.	0–30
KpB, KpC3	Keyport sandy loam	10 feet in sloping areas; surface is ponded on level areas.	About 1 foot of a sand-silt mixture, or inorganic silt, or clayey silt over 3 feet of plastic clay; moderately well drained and somewhat poorly drained.	0–8 8–48
KrB	Kresson sandy loam	2 feet, but surface is ponded in places.	1 foot of a sand-silt mixture or clayey silt over 3 feet of plastic clay that, in places, is stratified with sand below a depth of 30 inches; somewhat poorly drained.	0–10 10–48
LaA	Lakehurst sand	2 feet	5 feet of loose, poorly graded medium or coarse sand; moderately well drained or somewhat poorly drained.	0–60
LdB	Lakeland sand	5 to 10 feet or more	5 feet of poorly graded sand; excessively drained	0–60
LeB	Lakewood sand	Same as Lakeland sand		
LkA	Lenoir and Keyport loams	Similar to Keyport sandy loam		
Lo	Leon sand	1 foot	5 feet of sand that contains an organic hardpan between depths of 1 and 2 feet; poorly drained.	0–16 16–20 20–40
MrB, MrC, MrC3, MrD, MrD3, MrE, MrF.	Marlton sandy loam	5 to 10 feet or more	6 inches of a silt-sand mixture over 2½ feet or more of plastic clay that is high in glauconite; in places sand is stratified with clay below a depth of 2 feet; well drained or moderately well drained.	0–10 10–36
Mu	Muck	At surface	3 feet of material high in organic matter; very poorly drained.	0–36
NbB	Nixonton and Barclay soils	2 feet	5 feet of silty fine sand that is micaceous and poorly graded; in places silty fine sand contains up to 10 percent round, hard gravel; in places soil material is stratified with clay layers below a depth of 30 inches; moderately well drained or somewhat poorly drained.	0–60
Pa	Pasquotank fine sandy loam	1 foot	5 feet of silty fine sand that is micaceous and poorly graded; in places soil material is stratified with layers of clay below a depth of 30 inches; poorly drained.	0–60
Po	Pocomoke loam	At surface	About 6 inches of a sand-silt mixture, high in organic matter, over 2 feet of a sand-silt mixture or clayey sand; beneath this is silty sand; in places the soil material contains clay layers or hard pebbles below a depth of 30 inches; very poorly drained.	0–8 8–28 28–48

See footnotes at end of table.

estimated physical properties for engineering work—Continued

Classification			Mechanical analysis				Percolation rate	Available water-holding capacity
			Percentage passing sieve—					
USDA texture	Unified	AASHO	No. 4	No. 10	No. 40	No. 200		
							Inches per hour	*Inches per foot*
Loamy sand	SP–SM or SM	A–2 or A–3	100	95–100	80–90	10–20	2. 0–6. 3	1. 0
Sandy loam or sandy clay loam	SM	A–2	100	95–100	75–90	15–30	. 63–2. 0	1. 5
Loamy sand	SP–SM or SM	A–2	95–100	90–100	70–90	10–20	2. 0–6. 3	1. 0
Sand	SP–SM	A–2 or A–3	90–100	90–100	70–90	5–15	6. 3+	. 5
Sandy loam	SM	A–2	95–100	95–100	70–90	15–25	. 63–2. 0	1. 5
Loamy sand	SP–SM	A–2 or A–3	95–100	90–100	70–90	5–15	2. 0–6. 3	. 8
Sandy loam	SM	A–2	90–100	90–100	80–90	25–35	. 63–2. 0	1. 8
Sandy loam or sandy clay loam	SM or SC	A–2 or A–4	90–100	90–100	80–90	30–45	. 63–2. 0	1. 5
Sandy loam	SM	A–2	90–100	90–100	70–90	15–25	2. 0–6. 3	1. 0
Unclassified	Pt or OL	A–2						
Sandy loam, loam, or silty clay loam.	SM, ML, or OL.	A–4 or A–6	95–100	95–100	70–80	30–60	. 02–. 63	2. 0
Clay	ML or MH	A–7	95–100	95–100	80–95	60–90	. 02–. 63	2. 0
Sandy loam	SM, ML, or CL.	A–4 or A–6	90–100	80–100	60–90	30–60	. 63–2. 0	1. 8
Clay or clay loam	CL or MH	A–7	90–100	85–100	70–90	45–90	. 02–. 63	2. 0
Sand	SP or SP–SM	A–3	90–100	90–100	50–70	0–10	6. 3+	[2] . 5
Sand	SP–SM	A–2 or A–3	90–100	90–100	50–70	5–15	6. 3+	. 5
Sand or loamy sand	SP or SP–SM	A–1 or A–3	90–100	90–100	50–70	0–10	6. 3+	. 8
Loamy sand	SP–SM	A–2 or A–3	90–100	90–100	50–70	5–15	2. 0–6. 3	[2] . 8
Sand	SP or SP–SM	A–3	90–100	90–100	50–70	0–10	6. 3+	. 5
Sandy loam	SM or SC	A–2 or A–4	90–100	80–100	60–90	30–50	. 63–2. 0	1. 8
Clay or sandy clay	MH or CL	A–7	90–100	85–100	70–90	50–80	. 02–. 63	2. 0
Unclassified	Pt						. 63–2. 0	3. 0
Loamy fine sand or fine sandy loam	SM	A–2 or A–3	80–100	75–100	70–95	10–35	. 02– . 63	[2] 1. 3
Fine sandy loam	SM	A–2	85–100	85–100	80–100	20–40	. 02– . 63	[2] 1. 5
Loam or sandy loam	SM or SC	A–2 or A–4	95–100	90–100	75–85	30–40	. 63–2.0	2. 3
Sandy loam or sandy clay loam	SM or SC	A–2 or A–4	90–100	85–95	70–80	30–45	. 63–2.0	[2] 1. 8
Sandy loam	SM	A–2 or A–1	90–100	90–100	50–80	15–40	. 63–2.0	1. 0

TABLE 6.—*Brief descriptions of the soils, and their*

Map symbols	Soil type	Depth to seasonally high ground water (before artificial drainage)	Brief soil descriptions[1]	Depth from surface
				Inches
Ps	Pocomoke sandy loam	Same as Pocomoke loam		
Sa	St. Johns sand	At surface	5 feet of sand; uppermost ½ to 1 foot is high in organic matter; organic hardpan, 4 to 8 inches thick, occurs about 1 foot below the surface; loose sand and gravel underlie the pan; very poorly drained.	0–12 12–16 16–48
SfB, SfC	Sassafras loamy sand	10 feet or more	About 1½ feet of poorly graded sand over 1 foot of silty sand; beneath this is silty sand and gravel that, in places, contain layers of clay below a depth of 30 inches; in places the soil material is made up to 10 percent round, hard gravel; well drained.	0–18 18–30 30–48
SrA, SrB, SrC, SrD3,	Sassafras sandy loam	10 feet or more	About 1 foot of a silt-sand mixture over 1½ feet of a sand-silt mixture or clayey sand; beneath this is silty sand that, in places, contains layers of clay below a depth of 30 inches; in places the soil material is made up of 20 percent round, hard gravel; well drained.	0–14 14–34 34–60
SsD, SsE	Sassafras soils	Same as Sassafras sandy loam		
Tm	Tidal marsh	At surface	3 feet of highly organic silt and silty sand; areas subject to tidal flooding by brackish water; poorly drained.	0–36
WaD3	Westphalia fine sandy loam	10 feet or more	6 feet of silty fine sand that is micaceous and poorly graded; in places soil material contains up to 10 percent round, hard gravel; well drained.	0–72
WhB, WhC, WhD, WhE	Westphalia soils	Same as Westphalia fine sandy loam		
WnA	Woodstown and Dragston loams	2 to 3 feet	About 2½ feet of silty sand over poorly graded sand and gravel; moderately well drained or somewhat poorly drained.	0–16 16–30 30–48
WoB	Woodstown and Dragston loamy sands.	2 to 3 feet	1½ feet of poorly graded sand over 1 foot of silty sand that is underlain by poorly graded sand and gravel; moderately well drained or somewhat poorly drained.	0–20 20–30 30–48
WsB	Woodstown and Dragston sandy loams.	Same as Woodstown and Dragston loams		
WtB	Woodstown and Klej loamy sands	2 feet	4 feet of silty sand; moderately well drained to somewhat poorly drained.	0–20 20–60

[1] The reaction of all soils was orginally strongly acid; cultivated soils are now generally strongly acid below a depth of 36 inches.

ENGINEERING CLASSIFICATION SYSTEMS

Most highway engineers classify subgrade materials according to the system approved by the American Association of State Highway Officials. In this system, soil materials are classified in seven principal groups. The groups range from A–1, consisting of gravelly soils of high bearing capacity, to A–7, consisting of clay soils having low strength when wet. Within each group the relative engineering value as subgrade material is indicated by a group index number. Group index numbers range from 0, for the best materials, to 20, for the poorest. The AASHO classification of soil types in Gloucester County is shown in tables 5 and 6.

Some engineers prefer to use the Unified soil classification system. In this system, soil material is divided into 15 classes: 8 classes are for coarse-grained material (GW, GP, GM, GC, SW, SP, SM, SC), 6 for fine-grained material (ML, CL, OL, MH, CH, OH), and 1 for highly organic material (Pt). An approximate classification can be made in the field. For exact classification, mechanical analyses are used for GW, GP, SW, and SP soils, and mechanical analyses, liquid limit, and plasticity in-

estimated physical properties for engineering work—Continued

Classification			Mechanical analysis				Percolation rate	Available water-holding capacity
			Percentage passing sieve—					
USDA texture	Unified	AASHO	No. 4	No. 10	No. 40	No. 200		
							Inches per hour	*Inches per foot*
Sand or loamy sand	SP–SM	A–2 or A–3	98–100	95–100	50–70	5–15	6. 3+	1.0
Loamy sand	SP–SM or SM	A–2 or A–3	98–100	95–100	60–75	5–15	. 63–2.0	[2] . 8
Sand	SP or SP–SM	A–2 or A–3	90–100	90–100	55–75	3–13	6. 3+	. 5
Loamy sand	SP–SM or SM	A–1 or A–2	80–100	50–80	40–60	10–20	2. 0–6. 3	1. 0
Sandy loam or sandy clay loam	SM	A–2	90–100	90–100	50–70	15–25	. 63–2. 0	1. 5
Loamy sand or sandy loam	SM or SP–SM	A–2	90–100	90–100	50–70	10–20	2. 0–6. 3	1. 0
Sandy loam	SM	A–2	90–100	80–100	50–70	25–35	. 63–2. 0	1. 8
Sandy loam or sandy clay loam	SM or SC	A–2 or A–4	90–100	90–100	50–70	30–45	. 63–2. 0	1. 8
Loamy sand or sandy loam	SM	A–1 or A–2	90–100	90–100	40–70	15–25	2. 0–6. 3	1. 0
Unclassified	OL						. 02–. 63	3. 0
Loamy fine sand or fine sandy loam	SM	A–2	80–100	75–100	70–95	10–35	. 02–. 63	1. 3
Loam or sandy loam	SM	A–2	95–100	90–100	75–85	25–35	. 63–2. 0	1. 8
Sandy loam	SM	A–2	80–100	80–95	65–85	20–35	. 63–2. 0	1. 8
Loamy sand	SM	A–2 or A–1	70–100	70–100	40–60	15–25	2. 0–6. 3	[2] 1. 0
Loamy sand	SM	A–2	90–100	70–90	50–70	15–25	2. 0–6. 3	1. 0
Sandy loam	SM	A–2	80–100	60–80	50–70	20–30	. 63–2. 0	1. 3
Loamy sand	SM	A–2 or A–1	70–100	70–100	40–60	15–25	2. 0–6. 3	[2] 1. 0
Loamy sand	SP–SM or SM.	A–2 or A–3	95–100	95–100	75–85	10–20	2. 0–6. 3	1. 0
Sandy loam or loamy sand	SM	A–2	95–100	95–100	80–90	15–25	. 63–2. 0	[2] 1. 0

[2] The supply of available water is increased by capillary action from the water table.

dex data are used for GM, GC, SM, and SC soils and for the fine-grained soils. A plasticity chart, on which the liquid limit and the plasticity index may be plotted, is required for classification of the fine-grained soils and for identification of the secondary component of the silty and clayey sands and gravel. The Unified classification of soil types in Gloucester County is shown in tables 5 and 6.

Engineering properties of the soils

Some engineering information can be obtained directly from table 7. This table gives a rating to describe the suitability of each soil type for various engineering uses and lists soil features that affect engineering practices. The ratings and interpretations are based on information given in table 6, on actual test data shown in table 5, and on field experience and performance. The engineering practices listed in table 7 are common to Gloucester County.

At many sites, major soil variations occur within the depth of the proposed excavation, or several different soil mapping units occur within a short horizontal distance. The soil maps and profile descriptions elsewhere in this

TABLE 7.—*Engineering properties*

Map symbols	Soil series and miscellaneous land types	Susceptibility to frost action	Suitability for—			Features affecting engineering practices
			Winter grading	Road subgrade	Road fill	Dikes or levees
Ad	Alluvial land	Slight	Poor (high water table).	Fair	Fair	Unstable; pervious to impervious when compacted.
AmB, ArB	Aura	Slight to moderate.	Good	Good to fair	Good	Fairly stable; impervious when compacted.
AsB, AsC, AuB, AuC, AuC3.	Aura-Sassafras	Slight to moderate.	Good	Good to fair	Good	Fairly stable; impervious when compacted.
Ba	Bayboro	Moderate to severe.	Poor (excess surface water).	Poor	Fair	Weak because of clay; impervious.
Ck	Colemantown-Matlock.	Moderate to severe.	Poor (excess surface water).	Poor	Fair	Weak because of clay; impervious.
CmB, CmC, CnA, CnB, CnC.	Collington	Slight to moderate.	Good	Good to fair	Good	Fairly stable; impervious when compacted.
CoB; CoC	Colts Neck	Slight to moderate.	Good	Good to fair	Good	Fairly stable; impervious when compacted.
DoB, DsA, DsB	Downer	None to slight	Good	Good	Good	Stable, semipervious to impervious when compacted.
Ek	Elkton	Moderate to severe.	Poor (excess surface water).	Poor	Fair	Weak because of clay; impervious.
Fa, Fd	Fallsington	Slight to moderate.	Poor (high water table.	Fair	Good	Stable; impervious when compacted.
FhB, FhC, FnB, FoA, FoB, FoC, FoC3, FoD3, FsD.	Freehold [1]	None to slight	Good	Good	Good	Stable; semipervious to impervious when compacted.
Fw	Fresh water marsh	Moderate	Poor (high water table).	Not suitable	Not suitable.	
KpB, KpC3	Keyport sandy loam	Moderate to severe.	Fair to poor	Poor	Fair	Weak because of clay; impervious.
KrB	Kresson	Moderate to severe.	Fair to poor	Poor	Fair	Weak because of clay; impervious when compacted.
LaA	Lakehurst	None	Fair to poor (seasonally high water table).	Good	Good	Pervious; subject to piping
LdB	Lakeland	None	Good	Good	Good	Pervious; subject to piping
LeB	Lakewood	None	Good	Good	Good	Pervious; subject to piping

See footnote at end of table.

and interpretations of the soils

Features affecting engineering practices—Continued				
Impoundments		Land leveling	Agricultural drainage	Irrigation
Reservoir area	Embankment			
High water table prevents seepage.	Material variable	Impractical because of overflow.	Impractical because of overflow.	Constantly high water table.
Little seepage	Fairly stable; good for core, fair for shell.	Moderately slowly permeable substratum.		Low water-holding capacity; slow to moderate permeability.
Possible seepage	Fairly stable; good for core, fair for shell.	Aura has moderately slowly permeable substratum; Sassafras has permeable substratum.		Low to moderate water-holding capacity; slow to moderate permeability.
Clay prevents seepage	Fair to poor stability on flat areas; good for core, poor for shell.	Clay subsoil near surface.	Excess surface water; moderately slowly permeable.	High water-holding capacity; moderately slow permeability.
Clay prevents seepage	Fair to poor stability on flat areas; good for core, poor for shell.	Clay subsoil near surface.	Excess surface water; moderately slowly permeable.	High water-holding capacity; moderately slow permeability.
Possible seepage	Fairly stable; good for core and homogeneous fill.	Good on gentle slopes		Moderate water-holding capacity.
Possible seepage	Fairly stable; good for core, good for homogeneous fill.	Good on gentle slopes if no ironstone layers in soil.		Moderate water-holding capacity; moderate permeability.
Excessive seepage	Stable; fair to good for homogeneous fill.	No obstructions		Low water-holding capacity; moderate permeability.
Clay prevents seepage	Fairly stable on flat areas; good for core, poor for shell.	Clay subsoil	Excess surface water	High water-holding capacity; slow permeability.
High water table prevents seepage.	Fairly stable; good for core and homogeneous fill.	High water table	High water table; moderately permeable.	High water table; moderate permeability.
Possible seepage	Fairly stable; good for core and homogeneous fill.	No obstructions		Moderate to low water-holding capacity.
High water table		Very high water table	Usually not practical	High water table.
Clay prevents seepage	Fairly stable on flat slopes; good for core, poor for shell.	Clay subsoil near surface.	Excess surface water in low-lying areas.	High water-holding capacity; moderately slow permeability.
Clay prevents seepage	Fairly stable; good for core, poor for shell.	Clay subsoil near surface.	Excess surface water in most areas; high water table in places.	High water-holding capacity; moderately slow permeability.
Seasonally moderately high water table.	Fairly stable; poor for core, shell, and homogeneous fill.	No obstructions	Seasonally high water table.	Very low water-holding capacity.
Excessive seepage	Fairly stable; poor for core, shell, and homogeneous fill.	No obstructions		Very low water-holding capacity.
Excessive seepage	Fairly stable; poor for core, shell, and homogeneous fill.	No obstructions		Very low water-holding capacity.

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TABLE 7.—*Engineering properties*

Map symbols	Soil series and miscellaneous land types	Susceptibility to frost action	Suitability for— Winter grading	Road subgrade	Road fill	Features affecting engineering practices — Dikes or levees
LkA	Lenoir and Keyport	Same as for Keyport sandy loam (KpB, KpC3)				
Lo	Leon	None	Poor (high water table).	Fair	Good	Pervious; subject to piping
MrB, MrC, MrC3, MrD, MrD3, MrE, MrF.	Marlton	Moderate to severe.	Poor (slow permeability).	Fair to poor	Fair	Weak because of clay; impervious when compacted.
Mu	Muck	Moderate	Poor (high water table).	Not suitable	Not suitable.	Unstable
NbB	Nixonton and Barclay.	Slight to moderate.	Poor (moderately high water table).	Good	Good	Pervious; subject to piping
Pa	Pasquotank	Slight to moderate.	Poor (high water table).	Good	Good	Pervious; subject to piping
Po, Ps	Pocomoke	Moderate to severe.	Poor (high water table).	Fair	Good	Stable; impervious when compacted.
Sa	St. Johns	None	Poor (high water table).	Fair	Good	Pervious; subject to piping
SfB, SfC, SrA, SrB, SrC, SrD3, SsD, SsE.	Sassafras	None to slight	Good	Good to fair	Good	Stable; impervious when compacted.
Tm	Tidal marsh	Severe	Poor (daily flooding).	Not suitable	Not suitable.	Unstable
WaD3, WhB, WhC, WhD, WhE.	Westphalia	None to slight	Good	Good	Good	Pervious; subject to piping
WnA, WoB, WsB, WtB.	Woodstown, Dragston, and Klej.	Slight to moderate.	Fair to poor (seasonally high water table).	Good	Good	Fairly stable; pervious to impervious when compacted.

[1] The Freehold, Colts Neck, and Collington soils (FtE, FtF) have characteristics shown for the Freehold series; Freehold soils are dominant in these undifferentiated groups.

report, as well as the engineering data and recommendations given in this section, should be used in planning detailed investigations of soil conditions at construction sites. The use of the information in this report will enable the soils engineer to select a minimum number of soil samples for laboratory testing and to obtain an adequate soil investigation at minimum cost.

Soils and Suburban Development

This section has been prepared mainly for the use of suburban landowners, planners, and developers. Table 8 gives estimated suitability of the soils of the county for suburban uses. It shows some of the advantages and some of the disadvantages that might be expected in different groups of soils.

The soil maps in the back of the report show much detail, but they cannot be expected to be precise for every acre in the county. For example, not all small areas having ground-water problems are indicated on the map. Also, the occurrence of thin underground clay layers that alter considerably the percolation rate for septic tanks is most unpredictable. On well-drained sites, however, *and interpretations of the soils*—Continued

Features affecting engineering practices—Continued				
Impoundments		Land leveling	Agricultural drainage	Irrigation
Reservoir area	Embankment			
High water table	Fairly stable; poor for core, shell, and homogeneous fill.	High water table and organic hardpan.	High water table	High water table.
Clay prevents seepage	Fairly stable; good for core and homogeneous fill.	Clay subsoil near surface.	Generally not needed	High water-holding capacity; moderately slow permeability.
High water table	Unstable; poor for core, shell, and homogeneous fill.	Shallowness	Usually not practical	High water table.
Moderately high water table.	Fair to poor stability; poor for core, shell, and homogeneous fill.	No obstructions	Seasonally high water table.	Moderately high water-holding capacity; seasonally high water table.
High water table	Fair to poor stability; poor for core, shell, and homogeneous fill.	High water table	High water table	High water table.
High water table	Fairly stable; good for core and homogeneous fill.	High water table	High water table	High water table.
High water table	Stable; poor for core, shell, and homogeneous fill.	Organic hardpan about 1 foot from surface.	High water table; rapidly permeable.	High water table.
Subject to seepage	Fairly stable; good for core and homogeneous fill.	No obstructions		Low to moderate water-holding capacity.
High water table				
Seepage likely	Fair to poor stability; fair to poor for core, shell, and homogeneous fill.	No obstructions		Moderate water-holding capacity.
Moderately high water table.	Fairly stable; fair to good for core, shell, and homogeneous fill.	No obstructions	Seasonally high water table; moderately permeable.	Low to moderate water-holding capacity; seasonally high water table.

these thin clay layers can be cut through to improve percolation.

The ratings for landscaping are for soil in place and not for areas where the original soil layers have been mixed by a bulldozer. If plants that require a specific narrow range of acidity or alkalinity are to be grown, the soil should be tested and then treated according to the results of the tests. Fertilizer is needed in nearly all areas. The liming and fertilizing of lawns should be based on soil tests made after grading has been completed.

Although most of the soils are rated "good" for parks, it is expected that land available for parks will be limited almost entirely to areas that have steep slopes, such as those bordering streams.

The ratings for sanitary land fill are based on the ease of moving the soil and on natural drainage. Suitability of the soils for cemeteries is based on natural drainage and the ease of digging.

The ratings for water disposal are based on the permeability of the soil. These are included in table 8 to aid industrial concerns that may want to spread waste water on the land. The spreading of waste water is a growing practice in the area and is considered a good method of conserving water in the soil.

TABLE 8.—*Estimated suitability*

Map symbols	Soil groups and soil mapping units	Individual uses			
		Building sites	Septic tanks (percolation of water below a depth of 28 inches)	Landscaping	
				Trees and shrubs	Lawns
	Group 1	Good, but ground water may be a problem if clay layers are close to surface.	Good, unless clay layers are too close to surface; in places Colts Neck soils contain ironstone.	Good	Good
CnA	Collington sandy loam, 0 to 2 percent slopes.				
CnB	Collington sandy loam, 2 to 5 percent slopes.				
CoB	Colts Neck soils, 0 to 5 percent slopes.				
FoA	Freehold sandy loam, 0 to 2 percent slopes.				
FoB	Freehold sandy loam, 2 to 5 percent slopes.				
	Group 2	Good, but ground water may be a problem if clay layers are close to surface.	Good, unless clay layers are too close to surface.	Good	Good
DsA	Downer sandy loam, 0 to 2 percent slopes.				
DsB	Downer sandy loam, 2 to 5 percent slopes.				
SrA	Sassafras sandy loam, 0 to 2 percent slopes.				
SrB	Sassafras sandy loam, 2 to 5 percent slopes.				
	Group 3	Good	Good, unless clay layers are too close to surface.	Good	Good
CnC	Collington sandy loam, 5 to 10 percent slopes.				
CoC	Colts Neck soils, 5 to 10 percent slopes.				
FoC	Freehold sandy loam, 5 to 10 percent slopes.				
FoC3	Freehold sandy loam, 5 to 10 percent slopes, severely eroded.				
SrC	Sassafras sandy loam, 5 to 10 percent slopes.				
	Group 4	Good, but ground water may be a problem if clay layers are too close to surface.	Good, unless clay layers are too close to surface; installation more difficult and costly on slopes of 5 to 10 percent.	Good	Only fair because of droughtiness.
CmB	Collington loamy sand, 0 to 5 percent slopes.				
CmC	Collington loamy sand, 5 to 10 percent slopes.				
DoB	Downer loamy sand, 0 to 5 percent slopes.				
FhB	Freehold loamy sand, 0 to 5 percent slopes.				
FhC	Freehold loamy sand, 5 to 10 percent slopes.				
SfB	Sassafras loamy sand, 0 to 5 percent slopes.				
SfC	Sassafras loamy sand, 5 to 10 percent slopes.				
WhB	Westphalia soils, 0 to 5 percent slopes.				
WhC	Westphalia soils, 5 to 10 percent slopes.				
	Group 5	Good	Poor to fair; restricted by moderately slowly permeable substratum in Aura soils; this substratum can be cut through, but it may be 20 or more feet thick.	Good	Good
AmB	Aura loamy sand, 0 to 5 percent slopes.				
ArB	Aura sandy loam, 0 to 5 percent slopes.				
AsB	Aura-Sassafras loamy sands, 0 to 5 percent slopes.				
AsC	Aura-Sassafras loamy sands, 5 to 10 percent slopes.				
AuB	Aura-Sassafras sandy loams, 0 to 5 percent slopes.				
AuC	Aura-Sassafras sandy loams, 5 to 10 percent slopes.				
AuC3	Aura-Sassafras sandy loams, 5 to 10 percent slopes, severely eroded.				

of the soils for suburban uses

Community uses			Industrial use	Small farms and gardens
Parks	Sanitary land fill	Cemeteries	Water disposal	
Good	Good	Good, except that Colts Neck soils have ironstone layer in places.	Only fair because of clay in subsoil and because of underlying clay in some places.	Good; moderate natural fertility and slight erosion hazard.
Good	Good	Good	Good, unless underlain by clay.	Good; low natural fertility and slight erosion hazard.
Good	Good	Good	Good, unless underlain by clay.	Good; low to moderate natural fertility and moderate erosion hazard.
Good	Good	Good	Good to fair, unless underlain by clay.	Fair to good.
Good	Poor because of hard substratum in Aura soils.	Poor because of hard substratum in Aura soils.	Poor because of moderately slow rate of percolation in hard substratum in Aura soils.	Only fair because of low fertility and droughtiness.

TABLE 8.—*Estimated suitability of the*

Map symbols	Soil groups and soil mapping units	Individual uses: Building sites	Individual uses: Septic tanks (percolation of water below a depth of 28 inches)	Landscaping: Trees and shrubs	Landscaping: Lawns
	Group 6	Poor because of excess surface water.	Poor because of slowly permeable clay.	Only fair because of excess surface water.	Good.
Ba	Bayboro loam.				
Ck	Colemantown-Matlock loams.				
Ek	Elkton loam.				
KrB	Kresson sandy loam, 0 to 5 percent slopes.				
LkA	Lenoir and Keyport loams, 0 to 5 percent slopes.				
	Group 7	Poor because of high ground water.	Fair because of high ground water.	Good.	Fair because of high ground water.
Fa	Fallsington loam.				
Fd	Fallsington sandy loam.				
Pa	Pasquotank fine sandy loam.				
Po	Pocomoke loam.				
Ps	Pocomoke sandy loam.				
	Group 8	Good.	Good.	Poor because of very low fertility and droughtiness.	Poor because of very low fertility and droughtiness.
FnB	Freehold sand, thick surface variant, 0 to 10 percent slopes.				
LdB	Lakeland sand, 0 to 10 percent slopes.				
LeB	Lakewood sand, 0 to 5 percent slopes.				
	Group 9	Fair to poor because of moderate to high ground water.	Fair to poor because of moderate to high ground water.	Poor because of moderate to high ground water and very low fertility.	Poor because of very low fertility.
LaA	Lakehurst sand, 0 to 5 percent slopes.				
Lo	Leon sand.				
Sa	St. Johns sand.				
	Group 10	Only fair because of strong slopes.	Good, but installation difficult and costly because of strong slopes.	Good.	Fair because of low fertility and droughtiness.
FoD3	Freehold sandy loam, 10 to 15 percent slopes, severely eroded.				
FsD	Freehold soils, 10 to 15 percent slopes.				
SrD3	Sassafras sandy loam, 10 to 15 percent slopes, severely eroded.				
SsD	Sassafras soils, 10 to 15 percent slopes.				
WaD3	Westphalia fine sandy loam, 10 to 15 percent slopes, severely eroded.				
WhD	Westphalia soils, 10 to 15 percent slopes.				
	Group 11	Only fair because of moderately high ground water.	Fair, if drained to a depth of 3 feet and if clay layers are not too close to surface.	Good.	Good to fair.
NbB	Nixonton and Barclay soils, 0 to 5 percent slopes.				
WnA	Woodstown and Dragston loams, 0 to 2 percent slopes.				
WoB	Woodstown and Dragston loamy sands, 0 to 5 percent slopes.				
WsB	Woodstown and Dragston sandy loams, 0 to 5 percent slopes.				
WtB	Woodstown and Klej loamy sands, 0 to 5 percent slopes.				
	Group 12	Good, but excess surface water collects in low positions.	Poor because of clay.	Good, unless severely eroded.	Good, unless severely eroded.
KpB	Keyport sandy loam, 0 to 5 percent slopes.				
KpC3	Keyport sandy loam, 5 to 10 percent slopes, severely eroded.				
MrB	Marlton sandy loam, 0 to 5 percent slopes.				
MrC	Marlton sandy loam, 5 to 10 percent slopes.				
MrC3	Marlton sandy loam, 5 to 10 percent slopes, severely eroded.				
	Group 13	Only fair because of strong slopes.	Poor because of clay.	Good to poor.	Fair.
MrD	Marlton sandy loam, 10 to 15 percent slopes.				
MrD3	Marlton sandy loam, 10 to 15 percent slopes, severely eroded.				

soils for suburban uses—Continued

Community uses			Industrial use	
Parks	Sanitary land fill	Cemeteries	Water disposal	Small farms and gardens
Only fair because of excess surface water.	Not suitable because of clay and excess surface water.	Not suitable because of clay and excess surface water.	Not suitable because of clay and excess surface water.	Poor because of clay and excess surface water.
Not suitable because of high ground water.	Not suitable because of high ground water.	Not suitable because of high ground water.	Not suitable because of high ground water.	Only fair because of high ground water.
Fair	Good	Good	Good	Poor because of very low fertility and droughtiness.
Only fair because of moderate to high ground water.	Not suitable because of moderate to high ground water.	Not suitable because of moderate to high ground water.	Not suitable because of moderate to high ground water.	Poor because of low fertility and moderate to high ground water.
Good	Good	Poor because of strong slopes.	Poor because of excess runoff on strong slopes.	Only fair because of the erosion hazard on strong slopes.
Only fair because of moderately high ground water.	Not suitable because of moderately high ground water.	Not suitable because of moderately high ground water.	Not suitable because of moderately high ground water.	Good; moderately fertile but some drainage problems.
Good	Poor because of clay	Not suitable because of clay.	Not suitable because of clay.	Good; fertile but hard to work because of clay.
Good	Poor because of clay	Poor because of clay	Not suitable	Poor because of erosion hazard.

TABLE 8.—*Estimated suitability of the*

Map symbols	Soil groups and soil mapping units	Individual uses			
		Building sites	Septic tanks (percolation of water below a depth of 28 inches)	Landscaping	
				Trees and shrubs	Lawns
	Group 14	Poor because of steep slopes.	Fair, but installation difficult and costly because of steep slopes.	Fair	Fair because of erosion hazard on steep slopes.
FtE	Freehold, Colts Neck, Collington soils, 15 to 25 percent slopes.				
FtF	Freehold, Colts Neck, Collington soils, 25 to 40 percent slopes.				
SsE	Sassafras soils, 15 to 40 percent slopes.				
WhE	Westphalia soils, 15 to 40 percent slopes.				
	Group 15	Poor because of steep slopes.	Poor because of slow permeability.	Fair	Fair because of erosion hazard on steep slopes.
MrE	Marlton sandy loam, 15 to 25 percent slopes.				
MrF	Marlton sandy loam, 25 to 40 percent slopes.				

Formation and Classification of Soils

This section consists of three main parts. In the first part, the formation of the soils is discussed; in the second part, the soil series are classified by great soil groups; and in the third part, the results of soil analyses of two soil types are given.

Formation of the Soils

The important factors of the environment that have influenced the formation of the soils of Gloucester County are (1) parent material, (2) climate, (3) topography, (4) biological activity, and (5) time. A discussion of these factors follows.

Parent material

All the soils of Gloucester County have formed on unconsolidated beds of either sand or clay mixed with silt or gravel. These beds were laid down in a succession of ocean or river deposits. At times the water was deep; at other times it was shallow. In addition, the beds were tilted to the southeast. The elevation of the land increases in a southeasterly direction from the Delaware River (fig. 13).

Following the withdrawal of the ocean at different periods, there was a vast amount of wind and water erosion on the barren land. Although glaciers did not reach as far south as this county, it is believed that water from melting glaciers covered most of the county. Certainly, the climate of the area was affected by the great ice sheets that came within 70 miles of the northern border of the county.

The main geologic formations and the soil series developed from them are listed in table 9. This table gives characteristics of the formations and shows the different degrees of drainage under which the soils have developed. Blank spaces on table 9 indicate that a soil of the given drainage class on the formation named is not present in significant areas in this county. Except where the geologic materials are mixed, there is much relationship between geologic formation and the soil that has formed.

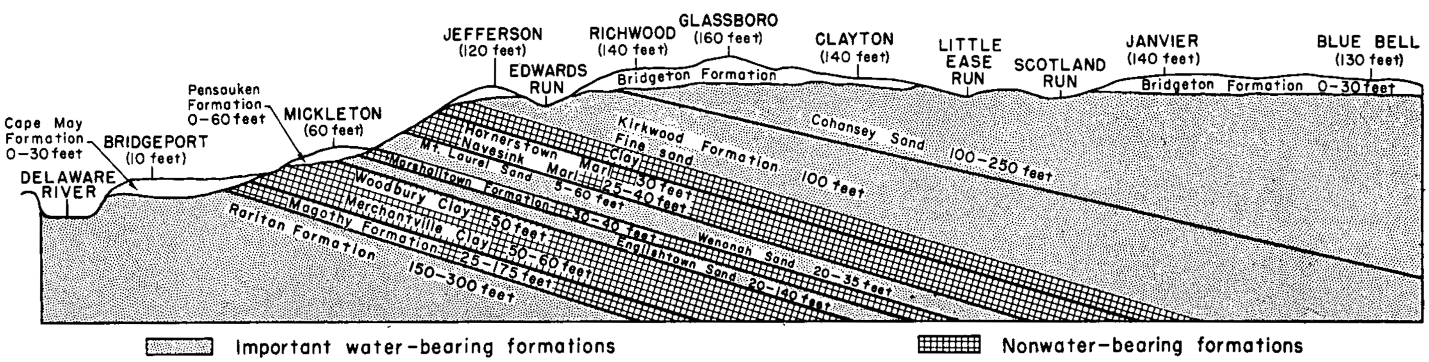

***Figure 13.*—Section from the Delaware River to Blue Bell showing the main geologic formations and their thicknesses. Vertical scale is exaggerated. Sketch is based on "Geologic Map of New Jersey" (*4*) and Bulletin 50, "The Geology of New Jersey" (*3*).**

soils for suburban uses—Continued

Community uses			Industrial use	Small farms and gardens
Parks	Sanitary land fill	Cemeteries	Water disposal	
Good	Poor because of steep slopes.	Poor because of steep slopes.	Not suitable because of steep slopes.	Poor because of erosion hazard.
Good	Poor because of clay	Poor because of clay	Not suitable because of slow permeability.	Poor because of steep slopes.

Some of the geologic formations consist of more than one type of material. The upper Kirkwood formation is composed of fine sands from which the Westphalia soils have developed. The lower Kirkwood consists of clay from which the Keyport and Elkton soils have formed.

Some of the soil series that developed from geologic material containing glauconite have distinct differences in fertility. Among these are the Collington series, developed from Marshalltown beds; the Freehold series, developed from Vincentown, Mt. Laurel and Wenonah, and Englishtown sands; and the Marlton series, developed from Hornerstown and Navesink beds.

One important basis for separating soils into series is the texture of the subsoil, or B horizon. Although the texture of the subsoil must cover a range to avoid the separation of innumerable units that could not be shown accurately on soil maps, the soils with sand, sandy clay loam, or clay subsoil are generally separated into different soil series. It is quite natural that Lakewood and Lakeland soils, which have very sandy subsoils, should have developed from the sands of the Cohansey formation. Similarly, the Keyport and Elkton soils which have clay subsoil, have developed primarily from the clay phase of the Kirkwood formation. The Sassafras and Freehold soils, which have a sandy loam to sandy clay loam subsoil, have developed from beds of mixed material.

In table 10 the soil series of Gloucester County are arranged according to the texture of the subsoil and to natural drainage. The series are arranged by catenas in this table. A catena is a group of soils developed from similar parent material but differing in profile characteristics because of differences in relief or drainage.

Climate and topography

The effects of climate and topography on the formation of the soils of the county are interrelated.

The climate of the area has changed several times, according to geologists (*3*), 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 soils on sloping topography lose some rainfall through runoff. The nearly level, high-lying soils absorb most of the rainfall; excess water soaks through the soil and into the water table. In addition to their normal rainfall, many nearly level, low-lying soils receive much runoff and possibly some underground seepage from the soils on higher slopes.

Differences in natural drainage of the soil reflect the length of time the soil remains wet after saturation. Nearly all degrees of drainage or wetness are common to soils of all textures. There are very poorly drained sands, just as there are very poorly drained clays. In some sandy soils, water is held up by layers of clay that lie deep in the profile.

Biological activity

In Gloucester County the effect of animals and vegetation on soil formation is not so apparent as the factors previously described.

Bleaching of the surface layer is a process that is related to soil texture, vegetation, and time. In this county, bleaching has been observed to extend deepest in soils under pitch pine. These trees are also most abundant where the soil texture is sandiest and the soil is infertile and dry.

The sandy Downer soils, which have developed along the Delaware River from the Cape May formation (most recent), are not bleached. The coarser textured Lakewood soils, developed from Cohansey sand, are bleached deeply—to a depth of 6 or more inches. However, there is much difference in the age of the two formations, and therefore the younger Cape May material may not have had enough time to become bleached.

Both bleached and unbleached soils have developed from Kirkwood fine sand. The soils under pines are bleached, but those under hardwoods are not. Under hardwoods,

TABLE 9.—*Geologic formations, some of their characteristics,*

Geologic formations [1]	Thickness	Probable yield of well water	Type of clay	Soils developed
				Excessively drained
	Feet	*Gallons per minute*		
Cape May formation	0–30	(2)		
Pensauken formation	0–60	(2)		
Bridgeton formation	0–30	(2)		
Cohansey sand	100–250	5–100	Kaolinite, some illite	Lakewood, Lakeland
Kirkwood formation:				
Fine sand	100	10–50		
Clay			Illite	
Vincentown sand	25–100			
Hornerstown marl [3]	30			
Navesink marl [3]	25–40			
Mt. Laurel sand	5–60	10–200		
Wenonah sand	35–20			
Marshalltown formation	30–40		Illite	
Englishtown sand	20–140	20–100		
Woodbury clay	50		Illite	
Merchantville clay	50–60			
Magothy formation	25–175			Not exposed at the surface
Raritan formation	150–300	10–1, 400		

[1] Listed in order, from youngest to oldest formation.

[2] In places small, shallow wells provide a moderate supply of water.

Westphalia soils have a distinct subsoil of fine sandy loam, and, under pines, Lakewood soils consist of loose fine sand. Field tests have not shown any significant difference in the acidity of soils developed under hardwoods or pines.

Since most undisturbed soils in upland woodlands contain very few earthworms, there is a minimum of soil mixing before the soil is limed and fertilized. Ants, termites, and, in places, the cicada are probably most active in destroying soil horizonation. In places ants bring up yellowish-brown subsoil almost as fast as rainfall bleaches the sand grains at the surface.

Time

In 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 of most of the readily soluble bases and thus make the soil strongly acid in reaction. Movement of clay out of the A horizon and into the B horizon has progressed far enough so that the increase of clay is apparent in the subsoil. These processes have had time to occur in all the soils except those developing in very recent alluvium.

The estimated maximum age (about 150 million years) of the oldest geological material is really of little significance to soil-forming processes because of the length of time that this material was covered by water or by other geologic beds.

Classification of Soil Series by Great Soil Groups [6]

In this section the soil series of the county have been placed in a higher category of classification—the great soil group. A great soil group is a broad group of soils, all of which have the same general chemical and physical properties and sequences of horizons.

Gray-Brown Podzolic soils

This great soil group consists of soils that have a comparatively thin organic covering and organic-mineral layers over a grayish-brown leached layer that rests upon an illuvial brown horizon. The soils appear to have developed under a deciduous forest in a temperate, moist climate.

Gray-Brown Podzolic soils intergrading to Red-Yellow Podzolic soils.— Unplowed areas of these soils have a thin covering of humus, an inch to a few inches thick; an A_1 horizon, stained with organic matter, 2 to 4 inches thick; a yellowish-brown or grayish-brown A_2 horizon that is slightly leached; and a textural B horizon of accumulated clay that is brown, strong brown, or yellowish brown (olive brown or olive in parts of the county where there is a considerable amount of glauconite in the soil). Under natural conditions, these soils have a pH of below 5.0.

[6] GRANVILLE A. QUAKENBUSH, State soil scientist for New Jersey, helped to prepare this section.

and soils that have developed from them

Soils developed—Continued				
Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
Sassafras, Downer	Klej, Woodstown	Klej, Dragston	Fallsington	Pocomoke.
Sassafras, Aura	Woodstown	Dragston	Fallsington	Pocomoke.
Aura, Sassafras, Downer.	Woodstown	Dragston	Fallsington	Pocomoke.
Downer	Lakehurst, Klej, Woodstown.	Lakehurst, Klej, Dragston.	Leon, Fallsington	St. Johns, Pocomoke.
Westphalia	Nixonton	Barclay	Pasquotank	
	Keyport	Lenoir	Elkton	Bayboro.
Freehold				
Marlton	Marlton	Kresson	Colemantown	Matlock.
Freehold				
Collington, Colts Neck				
Freehold				
in Gloucester County				

[3] This material, called marl, is highly glauconitic.

TABLE 10.—*Soil series arranged according to subsoil texture and natural drainage*

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; loamy sand or sand B horizon	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 or 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).	Lakewood, Lakeland.		Lakehurst, Klej.	Lakehurst, Klej.	Leon	St. Johns.
Sandy loam to sandy clay loam:						
Nonglauconitic material		Downer, Sassafras, Aura.	Woodstown	Dragston	Fallsington	Pocomoke.
Glauconitic material:						
Fine sandy loam		Westphalia	Nixonton	Barclay	Pasquotank	
Medium sandy loam to sandy clay loam.		Collington, Colts Neck, Freehold.				
Clay:						
Nonglauconitic material			Keyport	Lenoir	Elkton	Bayboro.
Glauconitic material		Marlton	Marlton	Kresson	Colemantown	Matlock.

[1] Subsoil texture listed in order of increasing content of clay.

The following are Gray-Brown Podzolic soils that intergrade toward Red-Yellow Podzolic soils.

Collington	Marlton
Downer	Sassafras
Freehold	Westphalia
Keyport	Woodstown

Collington, Freehold, and Marlton soils have more or less olive coloring because of the influence of glauconite.

Keyport and Marlton soils have formed from clayey materials, and the characteristics of the subsoil are more a result of the parent material than of processes of soil formation.

Keyport and Woodstown soils have a pale-brown subsoil that is lightly mottled because of periodic wetness.

Downer and Westphalia soils have only a little more clay in the B horizons than in the A horizons, and, therefore, they are somewhat similar to Regosols.

Gray-Brown Podzolic soils intergrading to Regosols.—Only the Nixonton series belongs to this group. The Nixonton series consists of Gray-Brown Podzolic soils with faint horizonation suggestive of Regosols. The contrast in brightness of colors in the A_2 and B_2 horizons is like that of the Sols Bruns Acides but is hardly as strong as that of the Red-Yellow Podzolic soils.

Red-Yellow Podzolic soils

Red-Yellow Podzolic soils (*8*) are a group of well-developed, well-drained acid soils. They have thin organic (A_0) horizons and organic-mineral (A_1) horizons over a light-colored bleached (A_2) horizon, over a red, yellowish-red, or yellow and more clayey (B) horizon. Parent materials are all more or less siliceous. Coarse reticulate streaks or red, yellow, brown, and light-gray mottles are characteristic of deep horizons of Red-Yellow Podzolic soils where parent materials are thick. The following soils are in the Red-Yellow Podzolic great soil group:

Aura	Colts Neck

The sandy upper horizon of Aura soils appears to have characteristics of the Gray-Brown Podzolic soils. This material overlies the firm to very firm deeper part of the profile, which is dominantly red sandy clay loam, like that typical of Red-Yellow Podzolic soils. These observations were made in the field and are supported by laboratory investigations reported by R. B. Krebs and J. C. F. Tedrow, Soils Department, New Jersey Agricultural Experiment Station (*2*).

Colts Neck soils have the red color typical of Red-Yellow Podzolic soils, and they have a textural B horizon, but the color is interpreted by some scientists as inherited from the parent material and of Gray-Brown Podzolic soils.

Low-Humic Gley soils

Low-Humic Gley soils are somewhat poorly to poorly drained (*8*). They have very thin surface horizons, moderately high in organic matter, over mottled gray and brown gleylike mineral horizons that have a low degree of textural differentiation. The following soils are in the Low-Humic Gley great soil group:

Barclay	Fallsington
Colemantown	Kresson
Dragston	Lenoir
Elkton	Pasquotank

These soils have grayish-brown and gray surface horizons, some of which are lightly mottled. The subsoils are pale brown and are faintly, distinctly, or prominently mottled.

The Barclay, Dragston, Kresson, and Lenoir soils are somewhat better drained than the other soils in this group. They have brown surface layers and subsoils, and the mottling or gray colors immediately below the plow layer are less distinct than in the Colemantown, Elkton, Fallsington, and Pasquotank soils.

The clayey B horizons in the Kresson and Lenoir soils may be due, in part, to fine-textured strata in the parent material in which these soils were formed.

Humic Gley soils

Humic Gley soils are poorly to very poorly drained hydromorphic soils that have dark-colored organic-mineral horizons of moderate thickness, underlain by mineral gley horizons (*8*). The following soils are in the Humic Gley great soil group:

Bayboro	Pocomoke
Matlock	

These soils have a black or nearly black surface layer, 5 or more inches thick, and a predominantly pale brownish-gray or gray subsoil. The subsoil is generally somewhat mottled with brown, but it is wetter and, consequently, grayer than the subsoil of Low-Humic Gley soils.

Regosols

The soils of this great soil group consist of deep unconsolidated rock (soft mineral deposits) in which few or no clearly expressed soil characteristics have developed (*8*). The following soils are in the Regosol great soil group:

Lakeland	Klej

These very sandy soils essentially lack horizonation, except for weak organic staining in the uppermost few inches of the profile. The Lakeland soils are excessively drained, and the Klej soils are moderately well drained to somewhat poorly drained.

Podzols

This great soil group is made up of soils that have an organic mat and a thin organic-mineral layer above a gray leached layer. Beneath this is an illuvial dark-brown horizon. Podzols develop under coniferous or mixed forest, or under heath vegetation, in a temperate to cold, moist climate. The following soils are in the Podzol great soil group:

Lakewood	Lakehurst

These soils have a very thin A_1 horizon (or none) and a very strongly bleached A_2 horizon that is several inches to 8 or more inches in thickness. The dark-brown B horizon consists of humus and possibly some iron, but it contains very little, if any, more clay than the A horizon. The B horizon of the Lakewood soils is only an inch to a few inches thick; in almost all places it is faint, and in spots it is absent. Because of this faint and discontinuous B horizon, the Lakewood soils are intergrades to Regosols.

The Lakewood soils are excessively drained. The Lakehurst soils are mainly moderately well drained, and they have some characteristics of Ground-Water Podzols.

Ground-Water Podzols

This great soil group consists of soils developed from imperfectly drained sandy deposits in humid regions. The soils have a thin organic layer over a light-gray, sandy leached layer that rests upon a dark-brown B horizon. The B horizon is irregularly cemented with iron or organic compounds, or both. The following soils are in the Ground-Water Podzols great soil group:

Leon	St. Johns

These soils have a dark-gray to black A_1 horizon, 5 to 8 or more inches thick, that consists of a mixture of humus and mineral particles. The very pale, bleached A_2 horizon extends to depths of 12 to 16 inches, but in places this horizon is absent. The strong, dark-brown B horizon is high in organic matter and is several inches to 8 or more inches thick. This horizon has very little or no mottling, and it contains little more, or no more, clay and silt than the A horizon. In general, the B horizon is slightly firm to firm, but in spots it is indurated. In some places the B horizon is lacking.

Unclassified organic soils and miscellaneous land types

The organic soils and miscellaneous land types in Gloucester County have not been classified into great soil groups. These are:

Alluvial land	Muck
Fresh water marsh	Pits
Made land, coarse materials	Tidal marsh
Made land, fine materials	

Soil Analyses

In table 11 are the results of soil analyses of Aura sandy loam and Downer sandy loam, both of which were sampled in Gloucester County. These data are from a cooperative study conducted by Rutgers University and the Soil Conservation Service. Six profiles of Aura sandy loam were sampled. Three were in woodland, and three in cropland. Four profiles of Downer sandy loam were sampled. Three of these were in woodland and one in cropland. At each site, bulk samples and 10 undisturbed 3-inch core samples (Uhland, O'Neil method) were taken of each horizon. The data reported in table 11 are averages of the 10 samples.

The following tests were made on the undisturbed samples: Bulk density, percolation rate, total porosity, and noncapillary porosity. Aggregate stability and wilting point were determined from disturbed samples. Field capacity was determined at the site. The amounts of gravel, sand, silt, and clay were determined by the hydrometer method. A discussion of the findings made in the analyses of woodland and cropland samples of the two soils follows.

Bulk density.—This is the mass or weight of a unit volume of dry soil, including air space, usually expressed in grams per cubic centimeter. In woodland samples bulk density generally increases from the surface downward in both the Aura and Downer soils, as shown in table 11. However, the bulk density of the A_p and A_2 horizons was much higher in the cropland samples than in the woodland samples; this reflects the compaction that takes place as a result of cultivation. Also, in the cropland samples, the density of the A_2 horizons in both soils was higher than in the A_p and the B horizons.

In cropland samples bulk density was consistently higher in samples of the A_p horizons taken between crop rows in both soils than in samples taken in the rows; this reflects compaction caused by traffic.

The bulk density of the lowest horizons, the C or D, was fairly uniform for all samples; it ranged from 1.65 to 1.74 grams per cubic centimeter for the six Aura samples and from 1.69 to 1.77 for the Downer samples. Much of this slight variation was due to differences in content of pebbles.

Field capacity.—This is the greatest amount of moisture a soil will hold against gravity when moisture is free to drain away. It is expressed in percentages. The data shown in table 11 are tentative because they represent sampling done on only one or two dates. The field capacity of the A_1 horizon of the Aura soils in woodland is almost double that of the A_p horizon in cropland. Also, the field capacity of the A_2 horizon is much higher in woodland than in cropland. In the Aura soils, the field capacity of the B, C, and D horizons in woodland does not differ appreciably from the field capacity of these horizons in cropland.

The lower horizons of the Downer soils have much lower field capacity than those of the Aura soils. In the Downer soils, these horizons consist mainly of loose, gravelly loamy sand, while in the Aura soils they consist of firm to very firm sandy clay loam. The data on field capacity follow the same pattern in the samples of each soil, but the pattern in the Aura soils differs from that in the Downer soils.

Wilting point.—This is the moisture content of soil, expressed in percent, at which plants wilt or fail to recover when placed in a dark, humid atmosphere. In the Aura soils, the amount of water present at the wilting point increases with depth; in the Downer soils, it decreases with depth.

Available water.—This is the amount of water in the soil that can be taken up by plants at rates significant to their growth; it is generally expressed in inches per foot. For the Aura soils, the amount of available water to a depth of 36 inches is less in the cropland samples than in the woodland samples, as shown in table 11.

Percolation rate.—This is the downward movement of water in soil expressed in inches per hour; it is also called permeability or hydraulic conductivity. In table 11, percolation rates for Aura soils indicate restricted permeability in the C and D horizons and in the A_2 horizons. Rates of the C and D horizons range from 0.5 to 1.6 inches per hour and average about 0.7 inch per hour. However, in two woodland sites the percolation rates in the A_2 horizon are almost as slow as the average rate for the C and D horizons. In cropland the slow percolation rate in the A_2 horizon is much more pronounced; in all samples the rate is slower in this horizon than in the firm underlying horizons. Also in cropland the percolation rate of the A_2 horizon ranges from 0.2 to 0.7 inch per hour and averages less than 0.5 inch per hour. These data help to explain why these soils erode so severely and why irrigation applications must be made at a slow rate on the Aura soils.

TABLE 11.—*Analytical data*

Soil	Horizon	Depth	Bulk density	Field capacity [2]	Wilting point	Available water	Percolation rate
		Inches	*Grams per cubic centimeter*	*Percent water*	*Percent water*	*Inches per horizon*	*Inches per hour*
Aura sandy loam:							
In a peach orchard near Richwood	A_p	0–9	[4] 1.44	12.0	4.2	1.04	[4] 3.3
			[5] 1.56				2.6
	A_2	9–14	1.70	8.3	2.2	.52	[6] .7
	B_2	14–23	1.66	13.8	8.7	.76	1.8
	D	23–36+	1.74	14.5	13.1	.32	1.6
In a pasture near Monroeville	A_p	0–9	1.57	12.5	3.6	1.25	.91
	A_2	9–13	1.75	11.9	4.0	.55	.24
	B_1	13–17	1.62	12.2	[2] 7.3	.32	1.1
	B_2–D	17–36+	1.70	12.0	[2] 9.8	.71	.76
In an asparagus field near Glassboro	A_p	0–6	[4] 1.51	11.7	2.6	.86	2.7
			[5] 1.58				.47
	A_2	6–9	1.75	10.0	3.3	.35	.17
	B_2	9–18	1.70	11.5	6.3	.79	.39
	B_3	18–28	1.73	12.9	8.8	.71	.77
	C	28–36+	1.68	13.3	9.7	.48	.54
In a woodlot near Janvier	A_1	0–4	1.09	22.4	3.8	.81	12.0
	A_2	4–10	1.23	16.7	4.8	.68	5.7
	B_2	10–14	1.51	14.4	4.9	.51	1.3
	B_3	14–20	1.65	13.4	4.0	.98	.78
	D	20–36+	1.70	12.8	8.6	.78	.69
In a woodlot near Blue Bell	A_1	0–3	1.29	21.6	3.8	.69	7.7
	A_2	3–9	1.42	15.6	3.9	1.00	.87
	B_1	9–13	1.64	13.0	3.4	.63	.70
	B_2	13–19	1.56	15.2	13.6	.15	.75
	B_{22}	19–36+	1.68	16.3	13.7	.74	.52
In a woodlot near Fries Mill	A_1	0–2	1.19	24.5	5.3	.46	5.7
	A_2	2–8	1.45	15.8	4.0	1.03	.74
	B_2	8–15	1.50	13.1	5.0	.85	1.8
	B_3	15–21	1.56	12.3	8.2	.38	1.3
	D	21–36+	1.65	14.3	11.9	.59	.66
Downer sandy loam:							
In a field, near Williamstown, used for continuous row crops	A_p	0–10	[4] 1.27	19.4	4.0	2.30	.16
			[5] 1.60				
	A_2	10–16	1.66	10.0	2.7	.73	.22
	B_1	16–23	1.62	10.7	3.0	.87	.96
	B_2	23–30	1.65	9.3	3.2	.70	1.9
	C_1	30–48	1.82	5.7	1.9	1.24	2.8
	C_2	48+	1.71	5.3	1.7	------------	15.5
In woodlot near Williamstown	A_1	0–2	1.21	21.4	2.8	.45	11.2
	A_2	2–11	1.44	14.1	2.9	1.45	5.1
	B_{21}	11–18	1.57	14.1	2.8	1.24	3.5
	B_{22}	18–25	1.72	11.7	3.7	.96	1.4
	B_{23}	25–38	1.82	6.7	2.7	.94	2.5
	D	38–48+	1.73	6.9	1.5	.93	8.7
In a woodlot near Franklinville	A_1	0–4	1.28	15.4	3.5	.61	6.1
	A_2	4–15	1.49	11.3	2.0	1.52	3.9
	B	15–30	1.54	10.9	3.5	1.71	4.1
	C	30–48+	1.69	7.1	1.5	1.70	8.6
In a woodlot near Fries Mill	A_1	0–1	1.33	18.7	3.7	.30	6.9
	A_2	1–14	1.37	15.0	4.2	1.85	6.6
	B_{21}	14–24	1.55	11.3	4.5	1.05	3.2
	B_{22}	24–32	1.73	8.0	3.1	.68	4.5
	D	32–48+	1.77	5.1	2.1	.85	2.0

[1] Sampling and test data by Soils Department, Rutgers University.

[2] Tentative; insufficient data.

[3] Determined by hydrometer method.

of two soils [1]

Aggregate stability	Total porosity	Noncapillary porosity	Gravel	Sand	Silt [3]	Clay [3]	Reaction	Organic matter	Cation exchange capacity
Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*pH*	*Percent*	*Milliequivalents per 100 grams*
88	[4] 42.2	[4] 17.7	33.3	71	21	8	5.2	2.8	4.1
	38.6	13.5							
49	32.9	17.3	44.4	78	13	9	5.1	.1	1.6
41	37.8	17.2	48.6	75	4	21	5.3	.1	6.0
45	35.1	12.1	0	73	6	21	4.3	.1	5.9
91	41.1	11.4	30.2	65	25	10	5.4	2.2	3.9
36	36.7	10.8	39.7	58	26	16	5.9	.7	3.3
31	41.8	15.1	33.6	63	26	11	6.2	.4	5.7
40	35.0	11.3	29.7	72	5	23	4.5	.2	4.9
59	39.3	16.4	7.5	75	13	12	6.0	1.3	3.4
	36.9	12.0							
30	32.7	9.7	18.7	67	21	12	6.5	.4	3.0
32	36.0	13.6	18.9	67	15	18	6.3	.4	5.2
40	33.2	12.3	23.8	71	7	22	6.3	.4	4.3
42	35.5	11.2	22.2	74	5	21	5.9	.2	4.0
----------	56.3	18.6	2.6	71	24	5	3.7	4.3	5.4
70	50.6	20.0	5.3	67	26	7	4.2	1.5	3.5
84	42.0	15.8	8.6	63	25	12	4.3	.7	6.6
56	36.4	14.3	12.5	61	18	21	4.3	.5	4.5
41	35.6	10.5	3.1	64	6	30	4.4	.2	7.2
95	45.0	14.4	24.7	70	24	6	3.7	3.3	7.2
84	43.7	17.4	28.3	66	25	9	4.3	2.7	4.7
73	37.8	15.0	17.9	63	22	15	4.2	.8	3.3
71	38.0	11.4	11.9	----------	----------	----------	----------	----------	----------
48	36.0	8.2	10.2	61	15	24	4.2	.5	5.3
93	51.6	18.3	7.3	61	32	7	3.9	2.1	7.4
70	42.2	19.0	30.7	65	24	11	4.2	1.1	5.9
70	40.0	16.1	12.7	67	22	11	4.3	.4	2.9
61	39.0	15.0	1.8	56	26	18	4.2	.5	6.6
45	37.2	9.2	4.0	67	15	18	4.6	.2	5.5
49	43.9	18.2	1.5	64	26	10	5.2	2.4	6.4
	36.3	9.2							
44	32.6	11.6	2.2	74	17	9	5.2	.6	2.8
30	31.8	14.3	3.3	75	16	9	5.2	.4	2.6
29	35.1	13.4	4.7	80	10	10	5.5	.2	2.7
----------	27.6	13.7	22.4	89	6	5	5.0	.1	1.3
----------	32.4	22.3	21.5	93	2	5	4.8	.1	.9
----------	45.8	28.2	----------	73	19	8	4.5	1.2	.4
92	39.7	22.7	1.2	74	19	7	4.5	1.1	3.2
78	34.5	21.8	1.5	70	22	8	4.5	.7	2.2
63	28.4	17.8	1.0	70	20	10	4.4	.5	2.9
60	25.0	12.9	6.5	84	9	7	4.4	.3	2.2
----------	29.3	13.5	2.2	93	2	5	4.6	.2	.8
87	44.4	28.8	----------	84	13	3	3.8	3.9	3.3
89	40.3	29.8	2.8	82	11	7	4.5	.7	1.6
74	36.0	19.4	1.5	77	12	11	4.4	1.6	2.7
----------	32.0	19.1	4.5	93	2	5	4.3	.1	1.2
90	40.5	23.7	0	81	14	5	3.7	6.0	6.8
94	40.9	27.8	.7	66	25	9	4.4	1.7	3.7
90	34.9	21.7	4.2	65	23	12	4.2	.5	4.1
83	27.5	13.7	2.2	81	11	8	4.4	.3	2.4
61	25.9	10.3	11.0	87	7	6	4.5	.4	1.6

[4] Sampled in crop rows.
[5] Sampled between crop rows.
[6] Variable.

The percolation rate varies in the wooded Downer soils, but it is relatively high in all samples. The data show a slower percolation rate in the A_2 horizon than in the surface soil, but the difference is not nearly so pronounced as in the Aura soils.

The cropland sample of Downer soil was taken in a site that for many years had been cropped intensively to vegetables, without the benefit of a rotation that included sod crops. As was expected, the percolation rate in the plow layer was extremely slow (0.16 inch per hour). This rate is only about one-thirtieth as fast as the average rate of the A_2 horizon in the three wooded Downer soils. The percolation rate in the B horizon of the cropland sample is slower than the average rate in the B horizon of the woodland samples.

As shown by table 11, the percolation rate of the A_2 horizon of the Downer soil in cropland is only a little greater than that of the A_p horizon. Also, the percolation rate of the Downer soil, to a depth of 24 inches, is slower in the cropland sample than in the woodland samples.

Aggregate stability.—This is a measure of the stability of soil structure. In the woodland samples of Aura soils, the percentage of aggregates drops sharply in the A_2 horizon and again in the C and D horizons. In the cropland samples, the proportion of aggregates in the A_p horizon is about 10 percent lower than that in the A_1 horizon of the woodland samples. Also, aggregation in the A_2 and B horizons is about 50 percent lower in cropland samples than in these horizons in woodland samples.

The percentage of aggregates throughout the profile of the cropland sample of the Downer soil is about half as great as that in the woodland samples.

Total porosity.—The total porosity in the A_1 and A_2 horizons of the wooded Aura soils is slightly higher than in these horizons of wooded Downer soils. The cropland samples of both Aura and Downer soils have about 25 percent less total porosity than the woodland samples. Total porosity of the B and the C or D horizons, however, is similar in the woodland and cropland samples.

Noncapillary porosity.—This refers to the degree to which a soil is permeated with pores or cavities that are so large that they do not hold water. In the A_1 and A_2 horizons of wooded Aura soils, noncapillary porosity is about one-third less than that in the same horizons of wooded Downer soils. Noncapillary porosity is lower in the A_p and A_2 horizons of cropland samples of Aura soils than in the corresponding horizons of woodland samples. The noncapillary porosity in the A_2 horizon of cropland samples of Aura and Downer soils is about 60 percent of that in the woodland samples. Both noncapillary porosity and total porosity are lower in soil between crop rows than in soil in the rows.

Texture.—There is more silt than clay in most of the A_p, A_1, A_2, and B horizon of Aura soils. In the C or D horizons, the amount of silt decreases and the amount of clay increases; in most samples these horizons contain more clay than silt. In the Downer soils, the content of both clay and silt decreases in the C or D horizons.

Reaction.—In wooded Aura and Downer soils, the pH ranges from 3.7 to 4.6. In the cropland soils, which have been limed heavily for many years, the pH ranges from 5.0 to 6.0. The lowest horizons (extending to a depth of 36 inches) of cropland samples of Aura soils are nearly as acid as the woodland samples.

The cropland sample of Downer soil has a pH of 4.8 at a depth of 48 inches. This is slightly higher than the pH at the same depth in the woodland samples.

Cation exchange capacity.—This is a measure of the total amount of exchangeable cations that can be held by the soil. It is expressed in terms of milliequivalents per 100 grams of soil at neutrality. The exchange capacity is low in the Aura soils and especially low in the Downer soils. In the A_1 and A_2 horizons of wooded Downer soils, the exchange capacity is only about half as high as in the same horizons of wooded Aura soils. In the substratum of wooded Downer soils, it is less than one-fifth of that in the substratum of Aura soils.

General Information About the County

This section consists of information about the climate, water supply, agriculture, and history of Gloucester County.

Climate

Gloucester County has a humid, temperate climate. Data on temperature and precipitation, compiled at the U.S. Weather Bureau Station in Clayton, are given in table 12.

On the average, monthly precipitation is well distributed throughout the year. Generally, the most rainfall occurs in July and August, the period during which plants use the most water. Although average precipitation is evenly distributed by months, there may be wide fluctuations within any single year. In many summers and in some springs and falls, long dry periods greatly reduce the yields of crops. Consequently, most summer vegetables are irrigated. Most of the rainfall in summer comes as short, but intense, thundershowers that cause much of the water erosion in the county.

A rainfall of one-half inch in a 5-minute period can be expected once every 6 years and a rainfall of 1 inch in a 10-minute period, once every 14 years. An inch of rainfall in 30 minutes can be expected three times every 4 years. Since most of the intense rainfall comes in summer, when plants need water and when much of the land is exposed to erosion, the proper storage and use of water are very important.

About 5 percent of the yearly precipitation comes as snow. The snow covers the land for only short periods and provides little protection against deep freezing. Warmer weather often brings rain that takes the frost out of the ground.

In winter the temperature normally averages a little above freezing. Summers are warm and sometimes hot; the temperature averages about 73° F.

The average freeze-free growing season is 179 days. Vegetable growers, however, have extended the length of the growing season considerably by the use of frost-tolerant varieties. The average date of the last killing frost in spring is April 24, and the first in fall is October 16. Killing frosts have occurred as late as May 29 and as early as September 23.

TABLE 12.—*Temperature and precipitation at Clayton, Gloucester County, N.J.*

[Elevation, 120 feet]

Month	Temperature			Precipitation			
	Average	Absolute maximum	Absolute minimum	Average	Driest months (shown by year)	Wettest months (shown by year)	Average snowfall
	°*F.*	°*F.*	°*F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	35.0	71	−6	3.58	0.27 (1955)	7.20 (1957)	4.8
January	32.6	74	−12	3.47	.68 (1955)	6.49 (1915)	6.5
February	32.3	73	−13	3.31	.84 (1901)	8.69 (1956)	6.0
Winter	33.3	74	−13	10.36			17.3
March	41.8	88	7	3.70	.80 (1915)	8.36 (1912)	2.8
April	51.4	94	20	3.55	1.32 (1942)	6.94 (1913)	1.1
May	62.0	99	30	3.57	.37 (1903)	8.96 (1948)	0
Spring	51.7	99	7	10.82			3.9
June	70.2	101	38	3.60	.26 (1949)	7.63 (1902)	0
July	75.4	104	44	4.63	.79 (1940)	12.22 (1897)	0
August	73.3	106	43	5.06	.57 (1943)	15.62 (1901)	0
Summer	73.0	106	38	13.29			0
September	67.2	99	32	3.58	.21 (1914)	11.95 (1940)	0
October	56.7	95	22	3.11	.65 (1952)	9.25 (1917)	.1
November	45.0	82	8	3.11	.24 (1917)	6.27 (1898)	.9
Fall	56.3	99	8	9.80			1.0
Year	53.6	106	−13	44.27	(1)	(2)	22.2

[1] The driest year, 1916, had 33.56 inches of precipitation.

[2] The wettest year, 1958, had 62.90 inches of precipitation.

Unfavorable weather frequently limits the yields of crops. Low rainfall in summer may drastically reduce the yields of important crops, such as alfalfa, corn, tomatoes, and peppers. Also reduced, but to a lesser degree, are yields of apples, peaches, sweetpotatoes, asparagus, and small grains. Sweetpotatoes are not very sensitive to summer droughts. Asparagus and small grains are harvested early, at a time when the moisture content of the soil is generally favorable.

Most fields of tomatoes and peppers are irrigated when necessary. Yields of these crops are frequently highest in dry seasons because diseases and losses of nutrients are easier to control when water is added according to schedule. In wet years, disease and inadequate drainage reduce yields of tomatoes and peppers, and, in extremely wet years, cause the loss of peach and apple trees and asparagus, tomatoes, peppers, alfalfa, corn, and many other crops. During wet years the grower needs to apply more fertilizer because of the loss of plant nutrients through leaching.

Although hailstorms are not very common in the area, they can be extremely damaging to nearly all crops, especially to fruit.

Heavy rainfall during the fruit-blossoming period reduces pollination and fruit set. Temperature may also have a bearing on ultimate yields of crops. Low temperature during the blossoming period reduces fruit set and, in some years, may destroy the entire crop. High temperature limits the set of tomatoes. Tomatoes and peppers are damaged by scald if the temperature of the soil gets too high. Soil temperature differs from year to year and affects the date when asparagus shoots appear above the ground. Extremes in climate frequently control the population of insects in the soil.

Winds have an effect on crop production in the area. Table 13 gives the prevailing wind direction and the average number of hours in each month that have wind velocities of 15 miles or more per hour and 25 miles or more per hour.

The critical period for wind erosion is from November to April. On the average, March has the greatest wind velocity. Most of the wind comes from the northwest. By March, cover crops have already 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 remove organic matter, which is a source of fertility in very sandy soils.

During March, high gusts of wind sometimes reduce visibility so much that motor traffic is hazardous.

TABLE 13.—*Prevailing wind direction and average number of hours per month of different wind velocities*

Month	Prevailing 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

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Water Supply

Gloucester County has ample water for farm, urban, and industrial uses. All of the major streams flowing into the Delaware River are perennial streams. These include Oldmans, Raccoon, Mantua, and Big Timber Creeks and their tributaries. Tide from the Delaware Bay affects the rate of stream flow in the last few miles of these streams. Tests of the water show that the salt content is so low that tidewater from these streams can be used for irrigation with no harmful effects on crops or soils.

Along the upper reaches of the streams, where the flow is inadequate at times, there are many sites where a landowner or a group of landowners could construct dams to impound water for irrigation. Sites not suitable for dams could be developed as bypass ponds. These ponds are reservoirs that are excavated beside streams and are fed by water that is piped in.

In the eastern part of the county, the perennial streams are Great Egg Harbor River, Hospitality Branch, and the tributaries of the Maurice River. Here, many sites are practical for ground-water ponds. Soils that have thick layers of clay close to the surface are not suitable sites, however.

Almost everywhere in the county, wells can be dug to supply ample water. The depths of the wells range from 30 to 350 feet, according to the particular location. See table 9 for expected yields of water from the various geologic formations that underlie the county.

Agriculture

Agriculture is diversified in Gloucester County. Vegetables, grown for processing or for sale in the market, have long been the main agricultural products of the county. Fruit, poultry, hogs, and horticultural products are also important. Unless otherwise indicated, the statistics used in this section are from reports published by the U.S. Bureau of the Census. The 1959 census statistics are preliminary and are subject to revision.

Land use and types of farms

In 1959, a total of 91,231 acres, or about 43 percent of the county, was farmland. The farmland was divided according to use as follows: Cropland, 70 percent; forest, 15 percent; idle land, 13 percent, and pasture, 2 percent. In addition, about 60,000 acres of forests were not a part of farms. There were 1,266 farms in the county in 1959; the average-sized farm was about 72 acres. Since 1950, urbanization has increased rapidly. The number and total acreage of farms are consistently being reduced as a result, but the average size of farms is increasing slowly.

In 1959, farms were classified by type as follows:

	Number	Percent
Vegetable	315	26
Poultry	215	18
Dairy	75	6
Livestock (mostly hogs)	112	9
Fruit	76	6
Others (cash grain and other field crops, general, nurseries, and unclassified)	432	35

A total of 4,141 acres was being irrigated in 1959; this is slightly less than the acreage irrigated in 1954.

Although the number of farms and acreage of farmland have decreased, agricultural income in the county has not dropped much. This is due, in part, to higher yields of crops, a shift to higher value crops, and the raising of more livestock.

TABLE 14.—*Acreage of principal crops in stated years*

Crop	1949	1954	1959
	Acres	*Acres*	*Acres*
Corn for all purposes	9, 353	9, 406	5, 673
Harvested for grain	7, 536	7, 543	4, 444
Small grains threshed or combined:			
Wheat	1, 095	906	804
Oats	160	185	41
Barley	1, 070	1, 343	1, 722
Rye	1, 076	1, 158	756
Soybeans for all purposes	2, 172	1, 398	2, 243
Hay, total	6, 819	6, 404	4, 474
Alfalfa, alone and mixed	3, 645	4, 221	2, 838
Clover, timothy, and mixtures of clover and grasses	2, 284	1, 013	958
Small grains cut for hay	125	234	124
Other hay	518	553	375
Grass silage	247	383	179
Irish potatoes	[1] 466	[2] 148	[3] 117
Sweetpotatoes	[1] 4, 905	[2] 4, 759	[1] 3, 468
Vegetables harvested for sale	22, 917	24, 901	23, 897
Asparagus	7, 799	11, 199	12, 028
Sweet corn	862	724	865
Cucumbers and pickles	413	361	300
Dry onions	363	187	124
Sweet peppers and pimentos	2, 178	2, 217	2, 590
Squash	266	261	426
Tomatoes	8, 110	7, 543	4, 841
Other vegetables	2, 926	2, 409	2, 723
Apple trees of all ages	[4] 3, 300	[4] 2, 900	[4] 2, 347
Peach trees of all ages	[5] 2, 400	[5] 2, 900	[5] 4, 650
Nursery products, flowers, and other horticultural specialties	80	566	1, 697

[1] Does not include acreage for farms with less than 15 bushels harvested.
[2] Does not include acreage for farms with less than 20 bushels harvested.
[3] Does not include acreage for farms with less than 10 hundredweight.
[4] An average of 70 trees per acre.
[5] An average of 95 trees per acre.

Crops

The acreage of principal crops grown in Gloucester County are shown in table 14 for 1949, 1954, and 1959.

The acreage of asparagus, the largest in the county, continued to increase in 1955 and 1956, but the rate of increase was less in 1957 and 1958. The acreage in peach trees is increasing. Potatoes, once an important crop, are not grown extensively. Eggplants and carrots are important crops in local areas. The acreage of cultivated blueberries is increasing slowly.

The acreage in hay crops has declined considerably. Much of the decrease has been in acreage used for clover, timothy, and mixed clover and grasses. Of the small grains, barley has increased consistently in importance. The small acreage of spring oats has been replaced by winter oats.

Yields of corn are increasing rapidly, and yields of wheat, rye, and barley are about twice as high as those of 1920. Yields of apples and peaches are about twice as high as those of 1930. Irrigated vegetables are also producing higher yields. At present, however, yields of asparagus are declining. See table 2 in the section "Estimated Yields" for yields of principal crops that can be expected under two levels of management.

Livestock

The number of livestock on farms of Gloucester County is given for stated years in table 15. The number of hogs has increased considerably in recent years.

TABLE 15.—*Number of livestock on farms in stated years*

Livestock	1945	1950	1954	1959
	Number	*Number*	*Number*	*Number*
Horses and mules	2, 587	1, 747	911	636
Cattle and calves	6, 155	6, 360	6, 525	5, 050
Milk cows	(1)	3, 676	3, 692	2, 735
Hogs and pigs	64, 039	59, 858	70, 370	84, 632
Chickens	[2] 383, 875	[2] 450, 952	[2] 645, 305	[2] 636, 024
Turkeys raised	12, 486	19, 470	25, 471	(1)

[1] Not reported.
[2] Over 4 months old.

History

The area that is now Gloucester County was inhabited by the Lenni Lenape Indians, also called the Delawares, when the first settlement was established by Swedes and Finns at Raccoon (now Swedesboro) in about 1640. Other Swedish settlements were established at Repaupo and Mullica Hill. By 1670, English Quakers had settled in the vicinity of Woodbury. Settlements made later in the area consisted mainly of Quakers. Gloucester County was organized on May 26, 1686, at Arwarmes (Gloucester City, now part of Camden County).

The early settlers grew corn, pumpkins, gourds, tobacco, and beans. Because early transportation was mostly by boat, trade centers were located on the navigable streams. By 1702, Kings Highway was extended from Woodbury to Swedesboro. Stage coaches were first used to transport freight; later they provided passenger service.

In 1775, the Stanger Glass Factory was established at Glassboro. This factory continued to operate for a hundred years. Between 1776 and 1777, forts were constructed at Billingsport and Red Bank for the protection of nearby Philadelphia. In 1778, the county seat was moved from Gloucester City to Woodbury.

By 1836, the railroad was extended into the county from nearby Camden, and, in 1848, a turnpike company was formed to construct and to maintain toll roads.

Around 1865, many farmers of Italian descent came into the county from the Hammonton area. They settled in the county, and their descendents now own and operate many of the farms.

The establishment of food-processing plants in the area has had a great effect on the agricultural development of the county. In 1854, a canning plant was established at Bridgeton, Cumberland County, and, in 1865, a soup company began operations at nearby Camden. Over the years these two companies have processed a great deal of the farm products of Gloucester County. A food-processing plant was opened by J. V. Sharp in Williamstown in 1870. This plant, which is still in operation, was originally operated in conjunction with a glass factory. Many packing plants were established in or near the county. In 1913, a packing plant was opened by Edgar Hurf in Swedesboro. This plant processes a large part of asparagus and tomatoes grown in the county.

In addition to providing a market for farm products, processors have contributed a great deal to the agricultural education of growers, especially in the field of soil fertility. Nearly all processors have for many years provided a free soil-testing service to their contract farmers. As a result, fertilization and other soil management practices are at a high level in the county.

Commercial fertilizers were introduced in the county in about 1880 and have increased yields of crops. About the same time, a large industrial plant that manufactured dynamite was established at Gibbstown. In recent years, oil refineries and chemical plants have been located along the Delaware River.

Cooperative agricultural marketing services, located at Glassboro and Swedesboro, are important to growers who market fresh fruit and vegetables.

Glassboro State College, in Glassboro, was founded in 1923 as a teachers college.

As a result of recent increases in population, parts of Gloucester County are rapidly changing from rural to suburban areas.

Glossary

Acidity. *See* Reaction, soil.

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 materials but with unlike soil characteristics because of differences in relief or drainage.

Clay. (1) As a soil separate, the mineral soil particles less than 0.002 millimeter (0.000079 inch) in diameter. (2) 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 soil material that is expressed by the resistance of the individual particles to separating 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.

Fertility, soil. The inherent or natural quality of a soil that enables it to provide compounds in adequate amounts and in proper balance for the growth of specified plants, when other factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Glauconite. A dark-green, iron-potassium silicate mineral 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 term applied to soil material that contains various amounts of glauconite. The texture of the material ranges from sand to clay.

Horizon, soil. A layer of soil, approximately parallel to the soil surface, with characteristics produced by soil-forming processes. The relative positions of the several soil horizons in the soil profile and their nomenclature are as follows:

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 which 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 A_1 horizon; if cultivated, it is called the A_p 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 layer of unconsolidated material, relatively little affected by the influence of organisms and presumed to be similar in chemical, physical, and mineralogical composition to the material from which at least part of the overlying solum has developed.

Horizon D. Any statum underlying the C, or the B if no C is present, which is unlike the C, or unlike the material from which the solum has been formed.

Gleyed horizon. A horizon that shows prominent signs of gleying (the producing of gray and olive colors as the result of long period of waterlogging and the presence of organic matter). In this report a gleyed horizon is indicated by the subscript *g* just after the horizon symbol; for example, B_g.

Leaching. The removal of materials by the passage of water through the soil. This process takes place in all soils of this area but not to the same degree. Strongly leached soils are light gray at the surface.

Liquid limit. The moisture content at which a soil passes from a plastic to a liquid state.

Loam. The textural class name for soil having a moderate amount of sand, silt, and clay. Loam soils contain 7 to 27 percent of clay, 28 to 50 percent of silt, and less than 52 percent of sand. *See also* Texture, soil.

Micropodzol horizons. Thin horizons, totaling several inches in thickness, of a podzol soil over thicker, well-developed horizons. Micropodzol horizons normally consist of A_1, A_2, 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.

Mottling, soil. 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.

Native vegetation. The natural vegetation that is found growing in most places on a given soil. In this report only the dominant trees used commercially are listed.

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, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained.

Organic matter (content). Ratings used in this report have the following limits: Very low—below 1 percent of volume; low—1 to 2 percent; moderate—2 to 4 percent; and high—more than 4 percent. (These groups 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 and air. The permeability of a soil is governed by the least permeable horizon. Terms used to describe permeability indicate estimated rates at which water percolates through the soil: 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—0.02 to 0.63 inch per hour; and very slow—less than 0.02 inch per hour.

Plasticity index. The numerical difference between liquid limit and plastic limit. *See* 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 material. 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 (*9*):

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

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. Sand is the textural class name of any soil having 85 percent or more of 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. A series may include two or more soil types that differ from one another in the texture of the surface soil.

Silt. (1) 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). (2) Soil of the textural class called silt contains 80 percent or more of silt and less than 12 percent of clay. (3) Sediments deposited from water in which the individual grains are approximately of the size of silt, although silt is sometimes applied loosely to sediments containing considerable sand and clay.

Soil. A natural body occurring on the surface of the earth; it is made up of conformable horizons that result from modification of parent materials by physical, chemical, and biological forces through various periods.

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).

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.

Platy. Aggregates are arranged in thin sheets roughly paralleling the surface of the soil.

Subsoil. Technically, the B horizon of soils with distinct profiles; roughly, that part of the profile below plow depth.

Substratum. The soil material below the surface layer and the subsoil; the C or D horizon.

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 stream.

Terracing. A conservation practice on sloping soils whereby a low embankment of earth is constructed on a designed grade to carry excess runoff water safely across slopes.

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. The 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 based on the texture of the surface soil.

Watershed. In the United States, this term refers to the total area above a given point on a stream that contributes water to the flow at that point. Synonyms are "drainage basin" and "catchment basin."

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GUIDE TO MAPPING UNITS AND CAPABILITY UNITS

Map symbol	*Mapping unit*	*Described on page*	*Capability unit*	*Described on page*
Ad	Alluvial land	4	VIIw-1	38
AmB	Aura loamy sand, 0 to 5 percent slopes	6	IIIs-1	35
ArB	Aura sandy loam, 0 to 5 percent slopes	7	IIs-2	33
AsB	Aura-Sassafras loamy sands, 0 to 5 percent slopes	7	IIIs-1	35
AsC	Aura-Sassafras loamy sands, 5 to 10 percent slopes	7	IIIe-2	34
AuB	Aura-Sassafras sandy loams, 0 to 5 percent slopes	7	IIs-2	33
AuC	Aura-Sassafras sandy loams, 5 to 10 percent slopes	7	IIIe-1	34
AuC3	Aura-Sassafras sandy loams, 5 to 10 percent slopes, severely eroded	7	IVe-1	36
Ba	Bayboro loam	8	IIIw-2	36
Ck	Colemantown-Matlock loams	9	IIIw-2	36
CmB	Collington loamy sand, 0 to 5 percent slopes	10	IIs-1	32
CmC	Collington loamy sand, 5 to 10 percent slopes	10	IIIe-2	34
CnA	Collington sandy loam, 0 to 2 percent slopes	10	I-1	32
CnB	Collington sandy loam, 2 to 5 percent slopes	10	IIe-1	32
CnC	Collington sandy loam, 5 to 10 percent slopes	10	IIIe-1	34
CoB	Colts Neck soils, 0 to 5 percent slopes	10	IIs-1	32
CoC	Colts Neck soils, 5 to 10 percent slopes	11	IIIe-1	34
DoB	Downer loamy sand, 0 to 5 percent slopes	11	IIs-1	32
DsA	Downer sandy loam, 0 to 2 percent slopes	11	I-1	32
DsB	Downer sandy loam, 2 to 5 percent slopes	11	IIe-1	32
Ek	Elkton loam	13	IIIw-2	36
Fa	Fallsington loam	13	IIIw-1	35
Fd	Fallsington sandy loam	14	IIIw-1	35
FhB	Freehold loamy sand, 0 to 5 percent slopes	14	IIs-1	32
FhC	Freehold loamy sand, 5 to 10 percent slopes	14	IIIe-2	34
FnB	Freehold sand, thick surface variant, 0 to 10 percent slopes	14	IVs-1	36
FoA	Freehold sandy loam, 0 to 2 percent slopes	14	I-1	32
FoB	Freehold sandy loam, 2 to 5 percent slopes	15	IIe-1	32
FoC	Freehold sandy loam, 5 to 10 percent slopes	15	IIIe-1	34
FoC3	Freehold sandy loam, 5 to 10 percent slopes, severely eroded	15	IVe-1	36
FoD3	Freehold sandy loam, 10 to 15 percent slopes, severely eroded	15	VIe-1	37
FsD	Freehold soils, 10 to 15 percent slopes	15	IVe-1	36
FtE	Freehold, Colts Neck, and Collington soils, 15 to 25 percent slopes	15	VIe-1	37
FtF	Freehold, Colts Neck, and Collington soils, 25 to 40 percent slopes	15	VIIe-1	37
Fw	Fresh water marsh	15	VIIIw-1	38

GUIDE TO MAPPING UNITS AND CAPABILITY UNITS—Continued

Map symbol	*Mapping unit*	*Described on page*	*Capability unit*	*Described on page*
KpB	Keyport sandy loam, 0 to 5 percent slopes	16	IIw–3	34
KpC3	Keyport sandy loam, 5 to 10 percent slopes, severely eroded	16	IVe–2	36
KrB	Kresson sandy loam, 0 to 5 percent slopes	17	IIIw–2	36
LaA	Lakehurst sand, 0 to 5 percent slopes	18	VIIs–1	37
LdB	Lakeland sand, 0 to 10 percent slopes	18	IVs–1	36
LeB	Lakewood sand, 0 to 5 percent slopes	19	VIIs–1	37
LkA	Lenoir and Keyport loams, 0 to 5 percent slopes	19	IIIw–2	36
Lo	Leon sand	20	Vw–1	36
Mc	Made land, coarse materials	20	(1)	
Mf	Made land, fine materials	20	(1)	
MrB	Marlton sandy loam, 0 to 5 percent slopes	21	IIe–2	32
MrC	Marlton sandy loam, 5 to 10 percent slopes	21	IIIe–3	35
MrC3	Marlton sandy loam, 5 to 10 percent slopes, severely eroded	21	IVe–2	36
MrD	Marlton sandy loam, 10 to 15 percent slopes	21	IVe–2	36
MrD3	Marlton sandy loam, 10 to 15 percent slopes, severely eroded	21	VIe–2	37
MrE	Marlton sandy loam, 15 to 25 percent slopes	21	VIe–2	37
MrF	Marlton sandy loam, 25 to 40 percent slopes	21	VIIe–2	37
Mu	Muck	22	VIIw–1	38
NbB	Nixonton and Barclay soils, 0 to 5 percent slopes	23	IIw–1	33
Pa	Pasquotank fine sandy loam	23	IIIw–1	35
Pg	Pits	23	(1)	
Po	Pocomoke loam	24	IIIw–1	35
Ps	Pocomoke sandy loam	24	IIIw–1	35
Sa	St. Johns sand	25	Vw–1	36
SfB	Sassafras loamy sand, 0 to 5 percent slopes	25	IIs–1	32
SfC	Sassafras loamy sand, 5 to 10 percent slopes	26	IIIe–2	34
SrA	Sassafras sandy loam, 0 to 2 percent slopes	26	I–1	32
SrB	Sassafras sandy loam, 2 to 5 percent slopes	26	IIe–1	32
SrC	Sassafras sandy loam, 5 to 10 percent slopes	26	IIIe–1	34
SrD3	Sassafras sandy loam, 10 to 15 percent slopes, severely eroded	26	VIe–1	37
SsD	Sassafras soils, 10 to 15 percent slopes	26	IVe–1	36
SsE	Sassafras soils, 15 to 40 percent slopes	26	VIIe–1	37
Tm	Tidal marsh	26	VIIIw–1	38
WaD3	Westphalia fine sandy loam, 10 to 15 percent slopes, severely eroded	27	VIe–1	37
WhB	Westphalia soils, 0 to 5 percent slopes	27	IIs–1	32
WhC	Westphalia soils, 5 to 10 percent slopes	27	IIIe–2	34
WhD	Westphalia soils, 10 to 15 percent slopes	27	IVe–1	36
WhE	Westphalia soils, 15 to 40 percent slopes	27	VIIe–1	37
WnA	Woodstown and Dragston loams, 0 to 2 percent slopes	28	IIw–2	33
WoB	Woodstown and Dragston loamy sands, 0 to 5 percent slopes	28	IIw–1	33
WsB	Woodstown and Dragston sandy loams, 0 to 5 percent slopes	29	IIw–2	33
WtB	Woodstown and Klej loamy sands, 0 to 5 percent slopes	29	IIw–1	33

1 Not placed in a capability unit.

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