

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE DELAWARE COLLEGE AND AGRICULTURAL EXPERIMENT STATION, H. HAYWARD, DEAN AND DIRECTOR.

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SOIL SURVEY OF KENT COUNTY,  
DELAWARE.

BY

J. E. DUNN, IN CHARGE, AND J. M. SNYDER, OF THE U. S.  
DEPARTMENT OF AGRICULTURE, AND ELWOOD HOFFECKER,  
OF THE DELAWARE AGRICULTURAL EXPERIMENT STATION.

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HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

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[Advance Sheets—Field Operations of the Bureau of Soils, 1918.]



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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., August 20, 1919.*

SIR: During the field season of 1918 a soil survey was made of Kent County, Del. This work was done in cooperation with the State of Delaware, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this area and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1918, as provided by law.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

Hon. D. F. HOUSTON,  
*Secretary of Agriculture.*

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### MAP.

Soil map, Kent County sheet, Delaware.



# SOIL SURVEY OF KENT COUNTY, DELAWARE.

By J. E. DUNN, In Charge, and J. M. SNYDER, of the U. S. Department of Agriculture, and ELWOOD HOFFECKER, of the Delaware Agricultural Experiment Station.—Area Inspected by HUGH H. BENNETT.

## DESCRIPTION OF THE AREA.

Kent County occupies the central part of Delaware. It is approximately 60 miles east of Baltimore, and about 75 miles southwest of Philadelphia. It is bounded on the east by the Delaware River and Delaware Bay. The northern boundary is formed in part by the Smyrna River, which flows in a northeasterly course. The greatest length of the county north and south is about 35 miles, while the average width east and west is about 20 miles. The county comprises about one-third of the State of Delaware, and has a total land area of 594 square miles, or 380,160 acres.

All of Kent County is embraced within the physiographic division known as the Atlantic Coastal Plain, and has a flat to nearly level surface. Topographically the county can be divided roughly into three divisions, viz, the poorly drained, treeless tidal marshes along Delaware Bay; second, a broad belt of well-drained fertile farming land which extends in a general north and south direction through the central part of the county; third, the western section, which is flat and frequently very poorly drained.

The tidal-marsh belt lies nearly at sea level and is subject to inundation during high tides. It contains numerous sloughs and ponds. This belt is quite irregular in outline, with a maximum width of over 4 miles and a minimum of less than 1. It extends several miles up the streams entering the bay as tidal-marsh estuaries. In places in the southern part it is separated from the bay by a narrow sand barrier.

Back of this foreland a plain slowly rises to the central part of the county, where the maximum elevation is about 65 feet. The



FIG. 1.—Sketch map showing location of the Kent County area, Delaware.

stream courses here have sufficient fall for adequate drainage. In contrast to this, the western belt includes many depressions and flats near the heads of streams. The channels are frequently indefinite, and the drainage of much of the land is very imperfect.

The drainage of about three-fourths of the county is into Delaware Bay through the Smyrna River, Murderkill River, Duck, Little Duck, St. Jones, and Mispillion Creeks and their tributaries, while the western fourth is drained into Chesapeake Bay through the Chester and Choptank Rivers and Marshyhope Creek. The streams are rather sluggish, and in most places their banks are not over 10 to 15 feet below the general upland level. They usually flow through very narrow strips of flood plain, more or less swampy, and covered with trees and a dense undergrowth. Along many of the larger streams in the upland the water is stored in dams and used to operate mills. Navigation is possible along the tidal streams from the bay to Milford, Frederica, Florence, Little Creek, Leipsic, and Smyrna.

Very little settlement had been made in what is now Kent County prior to 1664, when the Dutch settlements of Delaware were surrendered to the English. The early settlers were principally English, Swedish, and Dutch. The 1840 census gives the population of Kent County as 19,872. The population increased to 32,874 in 1880, but fell in 1910 to 27,812, of which 4,909 was urban and 22,903 rural. The percentage of rural population decreased from 91.4 in 1880 to 86.2 in 1900 and 82.3 in 1910. In the latter year the rural population averaged 37.1 persons per square mile.

Dover, the largest town in the county, is located in the central portion, and has a population of 3,720. It is the capital of the State as well as the county seat of Kent County. Milford, with a population of 2,604, situated partly in Sussex County does some shipbuilding, and is a distributing point for a large agricultural section. Smyrna is the principal shipping point for the northern part of the county. Harrington, Clayton, Camden, Wyoming, Frederica, and Felton are rather important local towns.

The Pennsylvania Railroad runs north and south through the center of the county and affords good transportation to Wilmington, Philadelphia, and other points north. From Harrington one branch runs through Milford to Franklin City, Va., and another branch goes from Clayton to Oxford, Md. Frederica has passenger-boat service to Philadelphia.

The county is well supplied with wagon roads, which are kept in moderately good condition. A few of the farmers have telephone service.

Numerous canning factories are scattered throughout the area, while milk and cream are bought at the more important towns.

## CLIMATE.

The climate of Kent County is quite similar to that of the whole region lying between the Delaware and Chesapeake Bays. During the summer the days are hot, but excessively so only for short periods, and the nights are usually comfortable. However, the humidity is very high, which has a tendency to make the heat oppressive. July, the hottest month, has an average temperature of 76.7° F., with an absolute maximum of 104° F. During the winter months the atmosphere is generally damp and penetrating. Zero weather may occur, but it is usually of short duration. February is the coldest month, with an absolute minimum of 12° below zero and a mean of 34.6° F. In some years considerable freezing and thawing occurs during the late winter and early spring, which frequently is injurious to wheat on the heavy-textured and poorly drained soils. Near the water front the range in temperature is not so great as over the remainder of the area.

The mean rainfall is 43.69 inches, precipitation being distributed evenly throughout the year. The driest year on record at Milford was 1895, with a total of 36.54 inches, while 1903 was the wettest, with 54.22 inches. The average snowfall is 24.1 inches. Periods of drought, as well as wet periods, sometimes occur during the growing season and decrease crop yields, but entire failures from these causes are very unusual. Wind and hailstorms are of rare occurrence, though at times local damage has resulted from these causes.

The normal growing season is about 187 days in length, as the average date of the last killing frost in the spring is April 20 and that of the first in the fall, October 24. The latest frost in the spring on record occurred on May 14, while the earliest recorded in the fall occurred on October 2. Entire failures of fruit crops are seldom caused by frost.

The following table, compiled from the records of the Weather Bureau station at Milford, shows the normal monthly, seasonal, and annual temperature and precipitation:

*Normal monthly, seasonal, and annual temperature and precipitation at Milford.*

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1895).	Total amount for the wettest year (1903).	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December .....	37.5	71	4	3.86	1.74	4.52	6.9
January .....	36.5	77	-3	3.37	4.85	3.35	8.2
February .....	34.6	76	-12	3.88	1.60	6.82	6.4
Winter .....	36.2	77	-12	11.11	8.19	14.69	21.5

*Normal monthly, seasonal, and annual temperature, etc.—Continued.*

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1895).	Total amount for the wettest year (1903).	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
March.....	43.9	88	8	3.87	2.69	8.21	1.3
April.....	53.2	97	23	3.32	5.38	3.68	0.2
May.....	63.4	97	33	3.88	4.48	2.31	0.0
Spring.....	53.5	97	8	11.07	12.55	14.20	1.5
June.....	72.0	101	44	3.80	2.11	4.93	0.0
July.....	76.7	104	52	3.64	3.17	3.93	0.0
August.....	74.8	99	48	3.96	3.65	5.35	0.0
Summer.....	74.5	104	44	11.40	8.93	14.21	0.0
September.....	68.2	97	35	3.70	2.96	3.70	0.0
October.....	56.9	90	27	3.39	2.42	6.06	0.0
November.....	45.8	80	17	3.02	1.49	1.36	1.1
Fall.....	57.0	97	17	10.11	6.87	11.12	1.1
Year.....	55.3	104	-12	43.69	36.54	54.22	24.1

#### AGRICULTURE.

Since the earliest settlement, the principal industry of Kent County has been agriculture. During the early days wheat and corn were the principal products, grown for home use. Tobacco soon became an important crop and continued so for a long period, but its production had been entirely abandoned before the Civil War. Prior to 1860 oats were produced extensively, and the annual production reached 300,000 bushels. Production gradually declined from this high average and now is less than 10,000 bushels.

About 1820 peach growing began to develop. The first orchards were seedlings, but during the thirties budded fruit was introduced and the acreage was gradually increased until Delaware became widely noted as a peach-growing State. The crop was very profitable until the early eighties, when the disease known as the yellows made its appearance. Since that time the industry has declined; thus from 1890 to 1910 the orchards decreased from 2,335,740 to 182,615 trees.

Corn and wheat have always been prominent crops, and they rank first in importance at the present time. In 1909 there were 56,049 acres in corn, according to the census, with a production of 1,597,835 bushels; and 45,813 acres in wheat, with a production of 622,975

bushels. In 1879 the total production of corn was 1,289,285 bushels, and that of wheat, 446,542 bushels. Some oats, rye, and buckwheat are grown, but they are minor crops, their combined area in 1909 being less than 2,000 acres. The total value of the cereal crops produced in 1909 was \$1,595,616.

Hay is also an important crop. It consists largely of clover, or timothy, or a mixture of the two. In 1909 a total of 21,810 tons of clover and timothy were produced, from 17,906 acres, and 7,880 acres of marsh hay were cut, with an estimated total production of 4,699 tons. Most of the hay is used locally, but small quantities are baled and shipped. The county has a small acreage of alfalfa. Millet and cowpeas are grown to a minor extent for hay.

Tomatoes are the most important canning crop. They are grown throughout the county, and by most of the farmers. The Stone and Greater Baltimore are the principal varieties, but many other kinds, such as the Delaware Beauty, Paragon, Matchless, and Ponderosa, are also grown. Practically all the crop is taken by the local canneries. Many of the farmers contract their entire crop, while others sell when picked at the prevailing prices. Peas and sugar corn also are produced in a small way for canning.

In 1909 the production of sweet potatoes was 238,023 bushels, the area planted being 1,834 acres. Many varieties are grown, but the best yields seem to be obtained with the Imperial Big Stem, Big Stem, and Goldskin. Most of the farmers have potato houses, and the crop is usually stored and held for higher prices. Considerable quantities of sweet potatoes are canned by local factories.

Irish potatoes are grown by practically all the farmers in sufficient quantities for home use. In 1909 there were produced 138,255 bushels, from 1,313 acres.

Cantaloupes, watermelons, asparagus, beans, cabbage, peppers, and many other vegetables are produced on most of the farms, mainly for home use, but to a small extent for sale on the local markets.

The fruit belt of the county is largely restricted to a region between Frederica and the central part of the northern boundary. Local conditions are well adapted to the production of apples, and failures seldom occur. Many varieties are grown. The principal late varieties are Stayman Winesap, Nero, Paragon, Rome Beauty, and Ben Davis.

Though the peach industry has declined until the orchard area is only 8 per cent of what it was 30 years ago, the production is still considerable. The principal varieties are the Carmen, Belle of Georgia, and Elberta. Most of the peaches are shipped to northern markets. The growing of pears is greatly handicapped by the blight, but the more resistant Kieffer variety is grown quite extensively and is used largely for canning. Grapes are grown to some

extent mostly in the vicinity of Smyrna and Camden. The Concord, Niagara, and Moore Early are the principal varieties.

Strawberries, dewberries, blackberries, and raspberries grow well and are produced in a small way for market. More strawberries are produced in the western part of the county than elsewhere.

The live-stock industry is not very important, though many of the farmers sell a few calves or beef cattle each year. They are bought by the local meat markets. On some farms the raising of cattle is of more importance. Hogs are raised in sufficient quantity to meet the local demand.

The value of dairy products, exclusive of those used in the home, amounted to \$184,753 in 1909. Milk is produced on most of the farms, and many of the farmers sell small quantities of milk, cream, and butter. The grade of dairy cows is gradually improving, and dairying is on the increase.

Poultry is kept on practically all the farms, and a few farmers make a specialty of poultry and egg production.

While the general farm crops are grown on almost all the soils, the farmers recognize that the Sassafras loam and silt loam are the best types for the production of corn, wheat, and hay. Fruit growing has been confined generally to the Sassafras sandy loam and loam, while strawberries are planted mostly on the Portsmouth soils. Wheat and grass are said to be the best crops for the Elkton soils, though corn and tomatoes are also produced extensively. Wheat is seldom grown on the sandier soils of the county, but sweet potatoes, watermelons, and cantaloupes do well on these types.

Young apple and peach orchards are usually intercropped for 5 or 6 years, generally with corn, potatoes, or tomatoes. Many of the farmers grow beans, cowpeas, or soy beans for seed. Sometimes rye is sown to be turned under as a cover crop.

Practically all of the corn crop is cut for fodder. Frequently it is topped and the blades removed from the remainder of the stalk. In some cases a corn cutter is used in harvesting the crop, but usually it is cut by hand.

The land for corn is plowed to a depth of about 4 to 6 inches, the seed bed prepared by harrowing and rolling, and the seed planted in checks about the 1st of May. The crop usually receives 3 to 4 cultivations. In the fall much of the corn land is used for wheat. It is usually rebroken and the seed bed worked up in about the same way as for corn. Wheat is sown from September 20 to the middle of October.

Peas for the cannery are usually drilled with a wheat drill or sown broadcast on a well-prepared seed bed. The crop is cut between the 1st and the 15th of June and hauled to the factory, where the peas

are hulled. After the peas are harvested the land is used for sugar corn or tomatoes.

In general, the farms are supplied with adequate machinery and have fairly good buildings. The number of silos is increasing. A few farmers are using tractors and many own automobiles.

Considerable attention is given to crop rotation. A 3-year rotation consisting of corn, wheat, and clover is popular. The corn is followed in the fall by wheat, and clover sown broadcast in the wheat fields the following March. The next year the clover is cut for hay or pastured, and the field is usually left until the following spring before being broken for corn. Sometimes a crop of hay is cut before the land is plowed for corn. A 5-year rotation, consisting of corn for one year, followed with wheat for one or two years, and this by clover for two or three years, is also used. In this rotation the clover is cut for hay the first year, and used for pasture the second. On some farms the general crops are changed from year to year, but no regular rotation is followed. In truck farming also no fixed rotation is followed, but the usual practice is to grow sweet potatoes for a number of seasons on the same land, while peas are usually grown 2 or 3 years in succession.

According to the census, over 79 per cent of all the farms in Kent County used commercial fertilizer in 1909, with a total expenditure of \$254,750, or \$102.81 each. The application of fertilizer is determined more by the crop grown than by the character and condition of the soil. The fertilizer is obtained from dry-mixing plants scattered throughout the county which mix it according to the farmer's demand, or from the large city dealers who ship ready mixed standard brands. About 300 to 400 pounds per acre of a 1-10<sup>1</sup> mixture is generally used for wheat, but many farmers prefer 14 to 16 per cent rock phosphate. Corn as a rule is not fertilized. About 800 to 1,200 pounds per acre is used for sweet potatoes, and 800 to 1,000 pounds for Irish potatoes. An acreage application of 400 to 600 pounds of a 2-10 mixture is made for tomatoes, and one of about 400 pounds for peas. Manure is used when available, and legumes are often grown for enriching the soil. Cover crops are also turned under occasionally. Lime is applied on most of the soils and is used extensively in the western part of the county. The applications are quite variable, but many farmers apply 700 to 1,000 pounds per acre every 3 or 4 years, while 2,000 pounds per acre is not uncommon on some of the poorly drained areas. Under ordinary conditions potash is frequently an important part of the fertilizers.

The 1910 census reports \$464,645 spent for labor in 1909, on 1,958 farms. In normal times it is not difficult to obtain labor. Many of the farm laborers are negroes.

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<sup>1</sup> One per cent ammonia and 10 per cent available phosphoric acid. Little or no potash was obtainable in 1918.

The average size of the farms of Kent County is gradually decreasing. In 1880 the average farm contained 129 acres; in 1900, 120.19 acres, and in 1910, 107.5 acres. In 1910, 49.6 per cent of the farms were operated by owners. Most of the farms that are rented are handled on a share system, the owner usually receiving one-half of the crop.

Land values vary according to the location, the general improvements, and the character of the soil, and are subject to a wide range. The best farms, consisting of the Sassafras soils, sell for over \$100 an acre, while some of the inferior farms on the poorly drained soils sell as low as \$15 an acre. The census of 1910 gives the average assessed land value per acre as \$33.20.

#### SOILS.

Kent County lies entirely in the Coastal Plain province. This region was at one time submerged in the sea, during which stage various sediments washed down from the older land regions accumulated. Later the land surface was elevated above sea level and the deposits subjected to change through ages of weathering, erosion, and plant growth.

The soils of this county, all of which have been derived from these sedimentary materials, are classified in 13 types, with 2 phases, and 4 miscellaneous types. The types and phases are grouped in four series. A series includes types which are similar in color, origin, structure, and mode of formation. The types in a series differ solely in texture—that is, in the proportion of the various-sized particles which make up the soil mass. When a difference is not sufficient to warrant establishing a distinct type the material is recognized as a phase of an existing type. The miscellaneous materials, which are not classified on a textural basis, consist of Meadow, Swamp, Tidal marsh, and Coastal beach. They represent the most recent deposits and include areas which, in their present condition, are mainly nonagricultural.

In this county topographic position and drainage have probably been the greatest factors in determining soil differences. Where the best drainage conditions have existed the Sassafras series of soils has been developed; where drainage has been less adequate the materials give rise to soils of the Elkton series, and where drainage has been very imperfect the soils have the characteristics of the Portsmouth series. The Leonardtown soils have good surface drainage, but the internal drainage is similar to that of the Elkton soils.

The soils of the Sassafras series are brown to gray, and the subsoils yellowish brown to reddish yellow, the material usually becom-

ing redder in the lower part of the 3-foot profile. The material is slightly micaceous and quite permeable. The surface soil is moderately low in organic matter, but friable and retentive of moisture. The upper subsoil, except in the sand and loamy sand types, is heavier and more compact than the surface soil, but the lower subsoil is lighter textured, sometimes gritty or gravelly, and in all cases more open and porous than the overlying material. The topography is level to undulating or slightly rolling in places, and the drainage as a whole good. These are among the best soils in the county. They are mapped in most parts of the county, but are most prominent in the eastern half.

The Leonardtown soils are generally brown to grayish brown in color, with a tendency to become grayish when dry. The surface soil is usually rather friable. The subsoil is pale yellow or brownish yellow, heavier in texture than the surface soil, and mottled with gray or pale yellow below 20 inches. The lower subsoil generally shows a more gray color and frequently consists of lighter textured, sandier material than the upper portion. Pockets or thin strata of material of variable texture may occur throughout the 3-foot section. A level to slightly undulating topography characterizes these soils. The surface drainage is good to moderate, but that of the subsoil is imperfect.

The types of the Elkton series typically have gray surface soils with subsoils showing more or less mottling with various colors, usually gray, light gray, and pale yellow. The types are usually silty, very low in organic matter, and deficient in lime. The subsoil is heavier and more compact than the surface soil, but in the lower depths of the 3-foot section it passes into sandier material which frequently is quite moist, or even saturated. The topography of these soils is flat, and both the surface drainage and underdrainage are poor. This apparently has affected the physical condition of the soil mass. The timber growth consists largely of deciduous trees, with white oak the principal variety.

The surface soil of the Portsmouth types is black or very dark gray, and high in organic matter. The subsoil is prevailingly gray, more or less mottled with yellow, and as a whole heavier in texture than the surface. In many places the lower subsoil is more sandy than the overlying material, and it is usually saturated. The Portsmouth soils are confined to wet, depressed areas where drainage is very imperfect both on the surface and internally. Ditching or tiling is necessary before they can be used for agriculture.

In the following chapters of this report the various soils of Kent County are described in detail and their agricultural value discussed.

The following table gives the name and the actual and relative extent of each soil:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Sassafras sandy loam.....	104,896	} 28.9	Elkton silt loam.....	12,096	3.2
Deep phase.....	4,864		Swamp.....	10,688	2.8
Elkton sandy loam.....	51,392	13.5	Meadow.....	8,512	2.2
Tidal marsh.....	45,568	12.0	Portsmouth loam.....	6,400	1.7
Sassafras loam.....	30,976	8.2	Leonardtown sandy loam.....	2,752	.7
Sassafras silt loam.....	19,648	} 6.3	Leonardtown loam.....	2,368	.6
Level phase.....	4,416		Sassafras sand.....	2,304	.6
Sassafras loamy sand.....	24,000	6.3	Coastal beach.....	704	.2
Portsmouth sandy loam.....	17,920	4.7			
Elkton loam.....	16,128	4.3			
Portsmouth silt loam.....	14,528	3.8			
			Total.....	380,160	.....

#### SASSAFRAS SAND.

The Sassafras sand, to a depth ranging from 2 to 8 inches, is predominantly a brownish-gray medium-textured sand, though in patches it carries small quantities of gravel and is coarser in texture. The soil is very loose and is low in organic matter. The subsoil is a yellowish-brown to orange-colored loose sand, which usually continues uniform to depths below 36 inches or becomes more reddish and in many places coarser. In places it approaches the color of the Norfolk sand; that is, it has a more grayish surface soil and a yellow lower subsoil, but it always retains a tinge of brown and is slightly more loamy than the typical Norfolk. In the vicinity of Williamsville the type as mapped includes small bodies of the deep phase of the Sassafras sandy loam. Here a clay subsoil is sometimes encountered at a depth of 30 to 36 inches.

The Sassafras sand occurs only in the southern part of the county. Small areas are mapped northeast and northwest of Milford, the latter near Church Hill School. The type also occurs around Williamsville, in the vicinity of Harrington, south of Murderkill River, southwest of Killen Pond, and along the western boundary of the county.

The Sassafras sand occupies the more rolling and undulating areas of the county. It usually lies on the slightly higher elevations, for the most part on knolls and ridges, in close association with the other Sassafras soils. The drainage is excessive, and the type as a whole is adapted only to the growing of special crops or to the general crops in wet seasons.

Practically all the Sassafras sand is in cultivation, only a small proportion being covered with the original timber, which consisted largely of pine, with some oak, dogwood, sassafras, and various other deciduous trees. The tree growth is not so vigorous as that on the other Sassafras types.

This is an excellent soil for sweet potatoes, cantaloupes, and water-melons, but it is of little importance for the general farm crops. Sweet potatoes, the principal crop, yield 250 to 300 baskets per acre. Berries, Irish potatoes, cucumbers, tomatoes, and other special crops do well. Cowpeas and soy beans are grown to some extent as cover crops. The soil is well aerated and easily penetrated by roots. It is warm, early, and easily tilled, but it needs more liberal fertilization than the other Sassafras soils. It responds well to stable manure and green manure. Fertilizer is applied at the rate of 1,000 pounds or more per acre in growing sweet potatoes.

A few small bodies of Norfolk sand, occurring south of Murderkill River, 3 miles south of Felton, and  $2\frac{1}{2}$  miles southwest of Houston, are included with the Sassafras sand. The soil consists of a grayish sand underlain at 3 to 6 inches by a yellow sand, slightly loamy in places, which continues uniform in color and texture to depths below 36 inches. In places the subsoil has a faint tinge of brown. The soil is a cleaner, less loamy sand than the Sassafras sand and contains a larger percentage of quartz particles. This soil occurs in close association with the Sassafras soils and occupies slightly undulating areas which are moderately well drained. It is adapted to the same general crops as the Sassafras sand and is of similar agricultural value, but needs the addition of organic matter.

#### SASSAFRAS LOAMY SAND.

The surface soil of the typical Sassafras loamy sand consists of a loose sand to loamy sand, grayish brown to light brown in color. Frequently the surface material has a distinctly grayish appearance when dry. The soil is usually of medium texture, but it is not uncommon to find small areas of coarse-textured material as well as patches where the gravel content is quite pronounced. The soil has a low content of organic matter. At 6 to 10 inches it grades into a yellowish-brown or reddish-yellow loamy sand, which usually continues uniform in texture to a depth of 24 to 30 inches, where the material has a tendency to become coarser, often gravelly, and more porous. Also the lower subsoil is frequently more reddish.

There are a number of variations in this soil. In places in the southern part of the county the surface 2 to 6 inches is frequently a gray sand or loamy sand, much like the surface soil of the Norfolk sand. In a few areas, such as that northeast of Milford, the upper subsoil is quite heavy textured, consisting in some instances of a light sandy loam. Crops in such places usually do better than elsewhere, as the soil is able to retain more moisture. In the section south of Williamsville and Harrington the type in places has poorer drainage than the average. The surface soil and upper subsoil here are much like those of the Norfolk soils, but the reddish-yellow

lower subsoil, which is a prominent feature of the Sassafras series, is quite well developed. In a few places very small areas of the deep phase of the Sassafras sandy loam are included.

The Sassafras loamy sand is largely confined to the southern part of the county, but small irregular areas are encountered along stream courses in various parts of the county where the Sassafras soils predominate. The most extensive bodies occur north and northeast of Harrington and in the vicinity of Houston. Small areas are mapped northwest of Milford, along Cow Marsh Ditch and Tanner Branch, and near the western boundary in the vicinity of Marydel. The type is also encountered along stream courses in the vicinity of Canterbury and Marshyhope Creek in the southwestern part of the county.

On the whole, the surface is undulating, even on many of the slopes adjacent to the stream courses, but some of the areas are nearly level and even contain slight depressions, and here the drainage is poorer. The greater part of the type has good to excessive drainage, and during short periods of drought crops often suffer.

The type is not so extensively used for agriculture as the heavier textured Sassafras soils; probably 25 per cent of it is yet covered with timber. The natural growth consists of pine intermixed with such trees as oak, hickory, red haw, dogwood, and sassafras. Corn is grown quite extensively, and some wheat is produced. Sweet potatoes, an important crop, yield exceptionally well. Considerable quantities of tomatoes are produced, and peas and sweet corn are also grown for canning. The soil is warm natured and early and well adapted to truck crops. Berries do well, and considerable fruit is grown. Cowpeas, soy beans, and rye are grown by many farmers as cover crops.

About the same amounts of fertilizer are applied for the various crops as on the Sassafras sandy loam. On the whole, the yields of the general farm crops are lower, but the soil is easily tilled and can be satisfactorily cultivated under a wide range of moisture conditions.

Land prices are prevailingly lower than on the sandy loam type.

The productiveness of the Sassafras loamy sand can be increased by the more extensive growing of legumes, which would increase the nitrogen and organic content of the soil and increase its power to hold moisture.

#### SASSAFRAS SANDY LOAM.

The Sassafras sandy loam in its most typical development is a light-brown to brown loamy sand or sandy loam, underlain at 8 to 10 inches by reddish-yellow or yellowish-brown heavy sandy loam to sandy clay loam. This passes abruptly into reddish-yellow to yellowish-red friable sandy clay, which in turn gives way at any depth from 20 to 30 inches to dull-red or reddish-yellow sandy loam, coarse sandy loam, or coarse loamy sand. Frequently the soil is a heavy sandy

loam, making it difficult to draw sharp boundaries between this type and the Sassafras loam. Small flakes of mica are often noticeable through the soil and subsoil, as is true of all the Sassafras soils.

As a rule, the surface is free from gravel, but occasionally small areas are encountered which are quite gravelly. They usually occur on the slopes near the stream courses. The gravel consists of rounded quartz, flint, and chert. The upper subsoil is much more compact than the surface soil, but the lower part of the 3-foot section is looser than the upper subsoil, on account of its coarser texture. Clayey, sandy, and gravelly strata, of variable thickness, compose the substratum; that is, the material below the 3-foot section.

In various places the type includes small bodies of the Elkton sandy loam, which occupies slight depressions that can not well be separated on the map. Such inclusions are quite common in the region southwest of Cheswold and along the western boundary northwest of Hartley. In an area north of Dover the lower subsoil in a few places contains gray mottlings and resembles the subsoil of the Leonardtown series. In the southern part of the county many areas occur where the surface soil is deeper than typical and in which the subsoil frequently is not so heavy in texture as the average of the type. In places these areas approach the Sassafras loamy sand in appearance.

The Sassafras sandy loam is the most extensive soil in the county, and it is quite important agriculturally. It is developed in numerous large areas in the vicinity of Milford, and important bodies also are mapped in the locality east of the Pennsylvania Railroad, between St. Jones Creek and Murderkill River. This is the predominating soil between Leipsic and Smyrna, and between Smyrna and Kenton, while small irregular areas occur northwest of Kenton and west of Petersburg. A narrow belt extends south of Harrington to the county line, and the type is quite extensive near the State boundary in the locality of Whiteleysburg. Numerous areas are found along Marshyhope Creek south of Anderson School.

The Sassafras sandy loam occupies flat to slightly undulating positions which range from the level of Tidal marsh to the highest elevations in the county. In general, the surface is not so smooth as that of the loam and silt loam types, but it is not sufficiently rolling to cause erosion. The drainage is generally good, owing in large part to the coarse, porous, open substratum, but this does not result in droughtiness, as the friable, heavy-textured subsoil is retentive of moisture. The type can be tilled under a wide range of moisture conditions, and it is not uncommon to see farmers begin cultivation a few hours after a heavy rainfall.

This is recognized as one of the most important soils of the county. Probably 70 to 75 per cent of it is under cultivation. The rest is in

forest. In its native state the type supports a growth consisting mostly of pine, with more or less oak, poplar, and other deciduous trees. The principal general-farm crops consist of corn, wheat, clover, and timothy hay. Tomatoes for canning are a very important crop, and sweet corn and peas are grown to some extent for the same purpose. Numerous peach, pear, and apple orchards have been developed, and grapes are grown in some localities. Berries of all kinds, Irish potatoes, watermelons, cantaloupes, and other garden truck do well, but are of little commercial importance. Considerable quantities of sweet potatoes are grown, but the soil is not so well adapted to this crop as are the lighter textured types. Alfalfa is grown to a small extent and appears to do well.

Crop yields are subject to much variation, depending upon the weather conditions, the fertilizers used, and the soil management, but under average conditions the ordinary yield of wheat per acre is estimated at 15 to 18 bushels, corn 25 to 35 bushels, hay three-fourths to 1½ tons, and tomatoes 4 to 8 tons. Alfalfa is cut three to four times during the season and yields from three-fourths to 1 ton per cutting.

The same general farming methods are followed as on the other Sassafras soils. While more easily tilled, the type probably requires more liberal fertilization than the heavier members of the series. About 300 to 400 pounds per acre is used for wheat and heavier applications for sweet potatoes and tomatoes. Corn is seldom fertilized. Stable manure is used where available. Lime is sometimes applied at the rate of 800 to 1,000 pounds per acre.

The selling value of this land varies according to the location, the improvements, and the soil fertility, but usually ranges from \$50 to \$100 an acre.

The growing of more legumes would probably be a great aid in increasing crop production on this soil.

*Sassafras sandy loam, deep phase.*—The deep phase is characterized by a greater depth to clay and by a prevailingly lighter colored surface soil than the typical Sassafras sandy loam. From 6 to 8 inches it is a brownish-gray to gray sand or loamy sand, which when dry becomes distinctly gray at the immediate surface, much like the Norfolk soils. It is lower in organic matter and less retentive of moisture than the typical sandy loam. The surface soil is underlain by a grayish-brown or yellowish-brown, sometimes yellow, loamy sand which passes at 18 to 24 inches into reddish-brown or reddish-yellow material ranging in texture from light sandy loam to sandy clay. Usually at about 30 inches the subsoil becomes much redder and more porous, changing to a coarse sand or coarse sandy loam. In many places gravel is encountered at about 3 feet.

The deep phase is confined to the southern part of the county and is found in the vicinity of Houston, northwest of Milford, and east

and northeast of Canterbury. The topography is about the same as that of the typical sandy loam, though in a few places it is more undulating. The drainage is good. The soil is used for the same general crops as the typical sandy loam, but the yields are generally somewhat lower.

#### SASSAFRAS LOAM.

The soil of the Sassafras loam is a brown, mellow loam, generally free from gravel and having a good supply of organic matter. It is underlain at an average depth of about 10 inches by reddish-yellow or yellow clay loam to sandy clay loam, which grades into reddish-yellow to yellowish-red friable silty clay or sandy clay. At 24 to 36 inches the subsoil passes into a more friable, coarse layer of material consisting of sandy loam, loamy sand, or coarse loamy sand, which has a more reddish color than the overlying material. This lower subsoil is a marked feature of the type, there being very few places where it is not reached within the 3-foot section. In places it contains some gravel. Frequently this coarser subsoil is more compact than the upper subsoil, but upon removal it is rather loose.

In some places the Sassafras loam and sandy loam are so closely associated that the boundaries between the two types are indefinite, and doubtless small parts of the sandy loam are included with this type. On the north and south sides of Sewell Branch, near the county boundary where the type occupies rolling areas, small patches of sandy loam occur on the higher elevations.

The Sassafras loam is largely confined to a belt extending northwest from Murderkill Neck to the county boundary. It is most extensive in the locality west and southwest of Dover, while numerous irregular-shaped areas occur south and southwest of Smyrna. Other bodies are found southeast of Cheswold, in the vicinity of Magnolia, and north of Canterbury.

In places the surface is level or nearly so, but the type in general is undulating to slightly rolling and well drained. It lies higher than the silt loam, and the air circulation is good. The type retains moisture quite well, and it is able to withstand droughts better than the sandy loam or loamy sand. The surface soil is seldom subject to baking or clodding except in a few of the flatter areas, and cultivation is rather easy.

Agriculturally, the type is very similar to the Sassafras silt loam, but it is a warmer soil and crops have a tendency to mature earlier. On the whole, the yields are smaller. This is ranked by farmers as the principal fruit soil of the county, and it is used rather extensively for the production of apples, peaches, and pears. Berries and grapes are produced to a small extent. Wheat, corn, and hay are the principal farm crops. Corn yields 30 to 35 bushels per acre; wheat, 16 to 20 bushels; and hay, consisting of clover and timothy, about 14 to 1½ tons. Yields of 30 bushels or more of wheat per acre are not

uncommon in the best years on well-managed farms. Some alfalfa, buckwheat, cowpeas, soy beans, and potatoes and various other vegetables are produced. Tomatoes are a very important crop, giving slightly heavier yields than on the sandy loam. Many of the farmers keep a few dairy cows, but dairying is not a well-developed industry.

Land of the Sassafras loam used for general farm crops sells for \$85 to \$120 an acre. Land in orchards brings higher prices, which vary widely with the condition and character of the trees.

#### SASSAFRAS SILT LOAM.

The Sassafras silt loam consists of a brown to slightly yellowish-brown friable silt loam, in many places containing a relatively large proportion of very fine sand. In practically all places the type is free from gravel. The content of organic matter is higher than in any other member of the Sassafras series. At 8 to 12 inches the soil passes into a smooth yellowish-brown to almost yellow silty clay loam which merges with slight increase in depth into a reddish-yellow, friable silty clay or clay loam. In places the upper subsoil contains a small amount of gritty material and it is more compact than the surface soil, though friable when dry if not previously puddled. At depths of about 28 to 36 inches the material changes in color to yellowish red or dull red and in texture to sandy loam or loamy sand, or into a reddish-yellow silty clay loam, silt loam, or even very fine sandy loam.

The Sassafras silt loam is not so extensive as the sandy loam, but it is an important soil. It is largely confined to a belt bordering the marsh in the eastern part of the county, extending from Murderkill Neck north to the county boundary. Irregular-shaped bodies occur on Raymonds Neck north of Leipsic, while similar areas are found between Leipsic and Little Creek. The type predominates on St. Jones Neck in the locality east and southeast of Dover. Small tracts are encountered on the extreme point of Murderkill Neck, while a few minor areas are mapped bordering the Tidal marsh north of Bowers Beach.

The type as a whole occupies lower positions than the sandy loam, being most extensive on the necks which extend into the Tidal marsh between the drainage ways. It occupies faintly undulating to level areas which are nevertheless well drained. It retains moisture exceptionally well and is probably more drought resistant than any other soil in the county. The surface of unplowed fields tends to harden and bake more readily than in the Sassafras loam, but plowing is not difficult, and the soil pulverizes quite readily with cultivation.

Practically all this soil is under cultivation, and exceptionally high yields of the general farm crops are obtained. Corn, wheat, clover, and timothy hay are the principal crops. Corn yields 35 to 40

bushels per acre, wheat 20 bushels or more, and hay from 1 to 2 tons. The soil is partly well adapted to certain truck crops. Tomatoes are an important crop, yielding 6 to 8 tons per acre. Some potatoes are grown, but the yields are not as large as on the lighter textured types. Alfalfa, cowpeas, and soy beans are grown to a small extent. The soil is well suited to fruits, and most farms have small orchards of apples, peaches, and pears. Peaches and pears, however, appear to do better on the lighter textured soils. Some of the farmers have a few dairy cows. This soil is exceptionally well adapted to dairying, since it affords good pasturage and gives good yields of hay.

The same general methods of cultivation, crop rotation, and fertilization are practiced on this type as on the loam and sandy loam. Fertilizers give more lasting results than on the soils of lighter texture.

Land values are subject to much variation, but over the greater proportion of the type they range from \$75 to \$120 an acre.

In places this soil could probably be improved by using more lime and by growing the legume crops more extensively. Where transportation conditions permit, the dairy industry would be profitable and would incidentally be a means of increasing the soil productivity.

*Sassafras silt loam, level phase.*—A level phase of the Sassafras silt loam is mapped in the vicinity of Leipsic. It differs chiefly in its more nearly level surface, and in its lighter-colored lower subsoil. In most places the soil is a brown friable silt loam to a depth of 10 to 12 inches, overlying a brownish-yellow or yellow silt loam which passes quickly into a yellow silty clay loam, and this in turn into reddish-yellow friable silty clay. At 28 to 30 inches the material is usually pale yellow or yellowish gray in color and a very fine sandy loam or fine sand in texture.

This phase is found near the Tidal marsh or adjacent to stream courses in the same general locality as the typical Sassafras silt loam. It is highly productive and adapted to the same general crops as the silt loam.

#### LEONARDTOWN SANDY LOAM.

The soil of the Leonardtown sandy loam is a light-brown to grayish-brown sandy loam with an average depth of about 10 inches. It is friable and easy to cultivate. The subsoil is predominantly a light brownish-yellow or pale-yellow sandy loam or heavy sandy loam, which in most areas passes into a mottled-grayish and yellowish sandy-clay loam at a depth of about 20 inches. This lower subsoil is more compact than the upper portion, and the lower part of the 3-foot section is generally more sandy in texture and grayer in color. It is not uncommon to find thin strata or pockets of material of variable texture and color throughout the subsoil.

The type is closely associated with the Elkton soils, and as mapped includes numerous small flats occupied by the Elkton sandy loam. In several places the subsoil does not have the pale-yellow color to a depth of 20 to 28 inches, the type being much like the Sassafras loamy sand and sandy loam in both texture and color, but below this it grades into a mottled gray and yellow sandy clay or clay loam.

The Leonardtown sandy loam occurs in small irregular areas, most of which are widely separated. They are most numerous in the country west of Harrington and southwest of Houston. Several areas lie in the vicinity of Wesleys Schools, as well as around Petersburg and south of Little Creek. A small one lies on the point of Raymonds Neck and another southeast of Smyrna, while a few are mapped along Sewell Branch.

The type usually lies a little higher than the Elkton soils and a little lower than the Sassafras soils. Its surface is slightly undulating, and the surface drainage is moderate to good, but the subsoil is imperfectly drained. However, the imperfect drainage has been relieved somewhat by the digging of drainage ditches in various places. The type is not very important agriculturally on account of its small extent. Corn, wheat, and hay are the principal crops, but the yields are lower than on the Sassafras sandy loam.

The following table gives the results of mechanical analyses of the soil, subsoil, and lower subsoil of the Leonardtown sandy loam:

*Mechanical analyses of Leonardtown sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
190336.....	Soil.....	3.0	15.8	11.7	27.2	9.4	28.9	4.0
190337.....	Subsoil.....	2.3	12.0	10.1	33.6	11.0	22.5	8.6
190338.....	Lower subsoil...	.7	4.8	4.4	57.0	9.0	14.6	9.4

#### LEONARDTOWN LOAM.

The Leonardtown loam to a depth of 6 to 12 inches is predominantly a brown or light-brown rather friable silty loam. When dry, the surface soil in cultivated fields has a grayish appearance, but it becomes deeper brown when wet. The subsoil typically consists of a pale-yellow or slightly brownish yellow clay loam to silty clay, usually mottled with grayish and yellowish colors at depths of 16 to 24 inches. Commonly the gray is more in evidence in the lower subsoil. At 30 to 36 inches sandy loam or loamy sand is reached. The subsoil contains in many places strata or pockets of lighter or darker colored material which is always lighter or heavier in texture than the remainder of the mass. As a rule, the mottled subsoil is more compact than the surface soil or upper subsoil. Some included areas, as that 3 miles northwest of Leipsic, consist of Leonardtown silt loam.

The Leonardtown loam is not very extensive. The largest bodies occur on Milford Neck and in the vicinity of Sour Apple Tree School. One area is mapped east of Dover and another southwest of Leipsic.

The Leonardtown loam usually lies a little above the Elkton soils, and in places it includes small depressions occupied by those types. These are not shown, as they are too small to map on the scale of 1 inch to the mile. The surface is flat or only slightly undulating, but the surface drainage is for the most part adequate. Subsoil drainage, however, is more or less restricted, and in many places drainage ditches have been found necessary.

Like the sandy loam, this soil is unimportant agriculturally on account of its small extent. Corn, wheat, hay, and tomatoes are the principal crops grown. The soil is somewhat cold. Crops make a slow growth during the early spring and usually are later in maturing than on the Sassafras soils.

#### ELKTON SANDY LOAM.

The Elkton sandy loam consists of a light-gray sandy loam or heavy sandy loam, underlain at 8 to 10 inches by white or light-gray silty clay to sandy clay which shows some pale-yellow mottling. In places near the Portsmouth soils, and frequently in the timbered regions, the surface material is slightly darker in color in the first few inches, owing to a slightly higher organic content. When dry, the surface has an almost white color, and it is much inclined to harden in dry weather. In places the lower subsoil ranges from a white, compact sandy clay or sandy loam, usually saturated, to a stiff, impervious, light-gray or bluish-gray silty clay, with some yellow mottling, and it is not uncommon for the lower subsoil, where in general of light texture, to contain pockets or thin strata of heavy material.

In some areas the type is rather heavy in texture, closely approaching a loam or silt loam, and as mapped it doubtless includes small bodies of soil of those textures. In a few localities, as near Tanner Branch, the subsoil becomes yellowish gray, somewhat like that of the Norfolk sandy loam.

The sandy loam is the most extensive of the Elkton soils, and it is very prominent throughout the western and southern parts of the county. Large well-defined areas lie south of Harrington and in the vicinity of Farmington, while others occur near the head and west of Marshyhope Creek. The type occurs in numerous irregular-shaped areas west and northwest of Berrytown, along Cow Marsh Ditch and Tanner Branch, and near Hartly.

The Elkton sandy loam in general has a flat, nearly level topography. In many places it occupies small flats within areas of the lighter textured Sassafras soils, as well as the larger depressions at the heads of many of the stream courses. The poor drainage and the

high water table in many places have seriously affected the physical condition of the soil. A considerable part of the type, however, has been improved by the construction of drainage ditches.

While this soil is used quite extensively for agriculture, much of it still remains in timber. The typical growth consists of several varieties of oak, mostly white oak, along with black gum, sweet gum, maple, dogwood, and other trees. Corn, wheat, and hay are the principal farm crops. Considerable quantities of tomatoes are grown, and strawberries are produced for market to some extent in the vicinity of Hartly. Buckwheat and cowpeas are grown in a small way. The type is not well adapted to tree fruits, but some of the farmers have home orchards. In ordinary years corn yields around 18 bushels per acre, wheat, 10 bushels, and hay, 1 ton. Land prices range from \$15 to \$40 an acre.

The soil is much more difficult to handle than the Sassafras soils, and crop failures are more frequent. The type is difficult to handle in wet weather, and it does not resist drought well. It could be greatly improved by tiling or ditching, by the use of lime, and by increasing the content of organic matter through the growing of legumes, the occasional turning under of a cover crop, and the liberal use of manure.

On account of their small extent, a few areas of Norfolk sandy loam are included with the Elkton sandy loam. The Norfolk sandy loam consists of a gray sand to loamy sand, passing at 3 to 6 inches into pale-yellow loamy sand to sandy loam, which at 10 to 20 inches becomes heavier in texture, passing into pale-yellow sandy loam, sandy clay loam, or sandy clay. The lower subsoil is coarser, as a rule, containing more sand, and sometimes gravel. Frequently at about 36 inches the subsoil is moist, and in places it is more or less mottled with red and yellow. The included areas of Norfolk sandy loam are confined to the southern part of the county, in the vicinity of Harrington and Houston, and northwest of Milford. They are flat to nearly level and have rather poor drainage, especially in the subsoil. On the whole, the drainage is better than that of the adjacent Elkton and Portsmouth soils, but not so good as that of the associated Sassafras or Norfolk sands. Corn, wheat, hay, sweet potatoes, tomatoes, and garden truck can be grown quite successfully, but yields are lower than on the Sassafras soils. Also, the Norfolk sandy loam is not so warm natured, and crops are usually planted later in the spring. The soil is low in organic matter.

#### ELKTON LOAM.

The soil of the Elkton loam is a gray to ashen-gray rather silty loam which becomes light gray, almost white, when dry. It is low in organic matter, subject to baking on the surface, and more or less cloddy when tilled. The subsoil, beginning at depths of about 8 to

10 inches, is a light-gray compact sandy clay or clay highly mottled with yellow and occasionally with some reddish yellow. In places the subsoil has the texture of a sandy loam. In the lower part of the 3-foot section the mottling is usually less intense, and the material becomes more sandy, but it is always quite sticky and plastic. The lower subsoil is always moist, sometimes saturated, and ranges in texture from a sandy clay to a sticky sand.

The Elkton loam is most prominent in the northwestern and central parts of the county. It is well developed in numerous areas west and southwest of Smyrna, west of Dover, and in the vicinity of Pearson. Irregular-shaped bodies occur north of Felton and southwest of Wyoming, while a few others are found southeast of Frederica on Milford Neck.

The type is confined to low, poorly drained flats and saucerlike depressions with restricted drainage. Open ditches have been cut in many places and have much improved the physical condition of the soil.

The type is not very important agriculturally. Probably over one-half of it is covered with timber, mainly white oak, willow oak, black gum, sweet gum, maple, and other deciduous trees. The soil is locally known as "white-oak land."

The Elkton loam is adapted to the same general crops as the sandy loam and is handled in a similar manner. On the whole, it is more difficult to cultivate. Corn in ordinary seasons yields about 15 bushels per acre, wheat, 12 bushels, and hay, 1 $\frac{1}{4}$  tons. The type affords good pasturage, and much of it is used for this purpose. Land prices vary from \$20 to \$35 an acre.

This soil can be made more productive by improving the drainage, correcting acidity, and increasing the content of organic matter.

#### ELKTON SILT LOAM.

The surface soil of the Elkton silt loam typically consists of a smooth, heavy-textured, light-gray silt loam 6 to 14 inches deep. It is low in organic matter and is generally tilled with difficulty. The unplowed fields are hard when dry, and frequently the cultivated soil is cloddy, with a nearly white, chalklike appearance. The subsoil consists of a very light gray, drab, or bluish-gray silty clay loam, which passes quickly into a plastic silty clay containing mottlings of brown or yellow. The mottling becomes more pronounced with increase in depth. At 28 to 36 inches the material is more sandy and quite variable in texture, usually ranging from a sandy clay to a light sandy loam, but in places consisting of a white sand saturated with water.

The Elkton silt loam is largely confined to the eastern part of the county and generally occurs in close association with other heavy-textured soils. Numerous areas are mapped east of Smyrna on Ray-

monds Neck, east of Dover on St. Jones Neck, and in the eastern part of Milford Neck in the southeastern part of the county. Small bodies are located near the county boundary in the vicinity of Sewell Branch, as well as several miles northwest of Masten.

The native vegetation consists mostly of white oak, willow oak, sweet gum, black gum, and maple. In places hickory and red oak are present. Moss is quite common on the surface of some areas. The land is locally styled "white oak land" in the Delaware-Maryland-Virginia peninsula.

This soil occupies low, flat areas, frequently representing slight depressions throughout the Sassafras silt loam. The poor drainage has greatly impaired the physical condition of the soil and greatly reduced its productiveness. The aeration is imperfect, and in places the soil has a tendency to run together and bake upon drying.

Agriculturally, this soil ranks low, but a considerable proportion of it is under cultivation, and in favorable seasons rather high yields are obtained. However, it is an uncertain soil, upon which crops are very susceptible to injury either from an excess or deficiency of rainfall, and low yields and even failures are quite common. Wheat and hay are the principal crops, while corn and tomatoes are grown to some extent. Timothy, alsike clover, and redtop grow well, and the hay crops frequently yield  $1\frac{1}{2}$  tons per acre. The type affords excellent pasture, and much of it is used for this purpose. The soil is rather cold, and crops usually have to be planted late in the spring.

The same methods of cultivation and fertilization are followed as on the other Elkton soils. The silt loam is more difficult to till, however, than either the sandy loam or loam.

Land values ranges from about \$20 to \$45 an acre, depending upon the location, the general improvements, and the condition of the soil.

The type as a whole is very deficient in lime. The physical condition of the soil can be greatly improved by increasing the organic content.

#### PORTSMOUTH SANDY LOAM.

The Portsmouth sandy loam to a depth of 8 to 15 inches is a black or extremely dark-gray sandy loam, high in organic matter. The upper subsoil consists of a light-gray or almost white sandy loam or sand, which passes quickly into a sandy loam. It is frequently mottled with yellow and may contain pockets or thin strata of heavier textured material. The sandy loam often grades into mottled bluish-gray and yellowish sandy clay. At depths of 30 to 36 inches the subsoil passes into a white compact sand or light-gray sandy loam, which is generally saturated with water.

The Portsmouth sandy loam is confined to the western part of the county. The largest areas are in the vicinity of Hartly and north-

west of Berrytown. Others are found north of Tanner Branch, near Downs Chapel, northwest of Harrington, and southeast of Farmington. The type occurs in close association with the Elkton soils and the other members of the Portsmouth series. It occupies flats, swales, and depressions, and the imperfect drainage has greatly restricted its use. However, numerous drainage ditches have been dug, and a considerable proportion of the type is now farmed.

Corn is the principal crop grown, and good yields are obtained on land which has been well drained. Tomatoes are grown to some extent, and strawberries are produced on some farms. The type is not well adapted to wheat, and very little is sown. Some of the land is used for pasture, but a rather large proportion still remains in forest, consisting principally of willow oak, swamp white oak, black gum, sweet gum, ash, maple, ironwood, chestnut, and willow. Forested areas ordinarily have a dense undergrowth, consisting of azalea, buttonbush, high-bush huckleberry, and other similar plants.

Few farms consist wholly of the Portsmouth sandy loam, and land values are difficult to determine, but they probably range from \$15 to \$30 an acre.

#### PORTSMOUTH LOAM.

The soil of the Portsmouth loam, in its typical development, consists of a black to very dark gray medium to light textured loam, 8 to 18 inches deep. The organic content in all areas is high, and in a few places organic matter is present in such quantities as to give the soil a mucky character. The subsoil is somewhat variable in texture, but for the most part consists of a light-gray sandy loam or a white sticky sand, which passes into a light-gray plastic sandy clay or silty clay. It is usually mottled with gray, yellow, brown, and bluish gray, and may contain pockets or seams of either heavier or lighter textured material. At 30 to 36 inches it passes into a sandy loam, sticky sand, or quicksand, which is quite compact in places and is saturated with water.

In a few areas the surface soil passes directly into silty clay or clay, while in others the lower sandy subsoil may rest on heavier material within the 3-foot section. Four miles northwest of Kenton a very compact, hardpanlike stratum occurs at a depth of 15 to 38 inches, the soil here being very similar to the St. Johns soils found farther south in the Coastal Plain.

The Portsmouth loam is developed in the western part of the county, and is most extensive in that section lying west and southwest of Hazletville. It is also encountered south of Blackiston and south of Tanner Branch. Many long irregular bodies occur northeast of Whiteleysburg and between Whiteleysburg and Harrington. Other areas are mapped northwest of Farmington and north of Hickman.

The Portsmouth loam usually occupies a lower position than the Portsmouth sandy loam or the Elkton soils. Areas frequently lie in the long, narrow, shallow depressions at the heads of streams. The type is flat and the drainage very poor, water often standing on the surface during wet seasons. Much of the soil is nonagricultural, but parts of it have been reclaimed, drainage being accomplished by ditches.

The Portsmouth loam is unimportant agriculturally. Most of it is covered with a mixed forest, including willow oak, sweet gum, black gum, and alder. A characteristic is the dense growth of underbrush, which is always much thicker than that on the Elkton soils.

The same crops are grown on this soil as on the Portsmouth sandy loam, and as a rule a little larger yields are obtained.

#### PORTSMOUTH SILT LOAM.

The surface soil of the Portsmouth silt loam consists of 8 to 14 inches of black, mellow silt loam, very high in organic matter, and in swampy places mucky. The subsoil usually consists of a dark-gray to light-gray silty clay loam or sandy clay, which passes downward into stiff bluish-gray silty clay. In places, however, the lower subsoil consists of white compact sandy clay or sandy loam, saturated with water. The subsoil is always more or less mottled and in many places contains pockets of variably textured material.

In a few places, mainly in depressions, the type is semiswampy, being much like the areas mapped as Swamp or Meadow. It is closely related to the Portsmouth loam and sandy loam, and as mapped probably includes small bodies of those soils.

The silt loam, like the other Portsmouth types, is confined to the western part of the county. The largest areas lie north of Berrytown and in the vicinity of Willow Grove. Irregular-shaped bodies occur northwest of Blackiston, near Downs Chapel, in the vicinity of Pearson, and around Dupont.

Owing to the low, flat surface and the many included depressions, this soil has very inadequate drainage, and most of its area remains in the forest. The tree growth is vigorous and much like that on the Portsmouth loam; the underbrush is probably a little more dense.

Parts of the type have been reclaimed by ditching, and where good drainage has been established the soil is fairly productive. It is adapted to the same general crops as the other Portsmouth soils.

#### MEADOW.

Narrow strips of poorly drained alluvium occur along practically all the drainage ways of the county. Generally they are less than one-eighth of a mile in width and extend all the way from the source to the mouth of a stream, or to the Tidal marsh. These

strips are classified as Meadow and Swamp, the better drained portions being mapped as the former. In area and agricultural value the Meadow is of minor importance. It is not an individual soil type, but represents numerous kinds of soil subject to much variation in color, texture, and structure. Along Cow Marsh Ditch, about  $1\frac{1}{4}$  miles northwest of Petersburg, the soil is a brown heavy sandy loam to a depth of 20 to 24 inches, where it grades into a brown to dark-brown loamy sand which contains pockets or strata of gray to white loose sand. Three miles west along this same stream, three different soil types, a sandy loam, loam, and silty clay loam, were encountered in a distance of less than 25 yards. The surface color of all was brown, with a brown to light-gray subsoil. The subsoil ranges from a sand to a sandy clay, mottled with yellowish-brown to rusty brown. Along Marshyhope Creek, in the southwestern part of the county, the greater part of the soil material is very high in organic matter, and jet black to very dark brown in color. It ranges in texture from a sandy loam to a silty clay loam to a depth of 12 to 24 inches, where a stratum of peaty or mucky material is encountered, extending to depths below 36 inches.

Practically all the Meadow areas lie along the streams in the western half of the county, with the greater proportion along Cow Marsh Ditch and Marshyhope Creek. The type as mapped includes undifferentiated bodies of Swamp, which is closely related to Meadow, as one merges into the other.

In its original state the Meadow is not grassland, as the name would seem to imply, but supports a dense growth of trees with a thick undergrowth of vines and brush. The principal trees are water oak, spotted oak, maple, birch, alder, sweet gum, willow, and ash, and important smaller plants are cat-brier, wild grape, and poison ivy. In some places in the better-drained areas, or where artificial drainage has been supplied, the timber has been removed, and the land is cultivated or used for pasture. Corn and potatoes grow well, and in places where the organic content is not too high, wheat and hay can be grown successfully.

#### SWAMP.

Swamp consists of strips of poorly drained alluvium. It is of small extent and in most features is much like Meadow, but it has poorer drainage and is practically nonagricultural. It consists of mixed soils, subject to much variation from place to place, but, as a whole, high in organic matter and always saturated with water. In some places the surface soil consists of a dark-brown to black sandy loam to silt loam which grades at variable depths into a brownish to gray silt loam to clay loam. In other localities the surface soil for the first few inches consists of a pasty black Muck, which

grades into brownish fibrous peaty material extending to depths below 3 feet. Sometimes the entire soil column may consist of Peat or Peaty muck.

Besides its alluvial developments Swamp also occurs as a narrow strip between Tidal marsh and the adjacent soil types and represents a gradation of zone between the two; in fact, the greater part of the Tidal marsh is bordered by such a fringe, but in most instances it is too narrow to map. In many places such soils are covered with water throughout all or the greater portion of the year, and in some places, as the lower parts of the area along Murderkill River, are subject to inundation by the tide.

As a whole, the Swamp is too wet for agricultural use, but parts of it when cleared could be used for pasture. The tree growth consists mainly of gum, willow, alder, cedar, pine, bay, birch, and maple. There is an extremely dense undergrowth consisting of brush, vines, and many other plants adapted to swampy conditions. Swamp is mostly confined to the eastern half of the county, and for the most part occurs near the sources of the streams.

#### TIDAL MARSH.

Tidal marsh in most places consists of sediments brought down by the various streams, deposited at practically tide-water level, and subjected to more or less change by tidal action. The material varies somewhat from place to place. As a rule, it is very high in organic matter and consists largely of silts and clays. Ordinarily the soil is a dark-brown to bluish-gray plastic or oozy silty clay loam or clay, in places mottled with yellowish brown, 3 feet or more deep. In places it may grade at varying depths into a dark-brown fibrous Peat or Peaty-muck material, and in others this Peaty-muck material may form the surface, with the heavy-textured deposits underlying, as at Leipsic. Here the type would be described as a brown fibrous Peat, underlain at 12 to 20 inches by a brownish oozy silt loam. Normally the soil and subsoil are filled with plant roots, saturated with water and highly charged with marine salts. Near the bay a belt of very sandy soil is sometimes encountered, which is frequently underlain with a heavy drab-colored plastic material.

Tidal marsh is mapped along Delaware River and Bay in the eastern part of the county and occurs as an irregular-shaped belt varying in width from one-half mile to 4 miles. The surface is uniformly flat and treeless, covered with a dense growth of vegetation consisting largely of cat-tails, swordgrass, calamus, and various salt-water and marsh-loving plants. The type contains numerous sloughs or channels, and the stream courses are always winding and crooked. The type lies only a few feet above sea level and the greater part of it is subject to tidal inundation. The few areas

which are not now inundated regularly are not typical, but they are mapped as Tidal marsh rather than with the more distinct adjacent Coastal Plain soils.

Tidal marsh in its natural state is nonagricultural, and attempts to reclaim portions of it have met with little success. Practically the only method of reclamation is by diking. Some of the type is used for pasture and small quantities of marsh hay are cut in a few places.

#### COASTAL BEACH.

Coastal beach occurs in only a few places adjacent to Delaware Bay, occupying a low narrow bank which serves as a barrier between the Tidal marsh and the bay. The soil is a light-gray loose medium sand which continues uniform in texture and color to depths below 36 inches. When dry, the surface material appears very gray or almost white, but it becomes slightly brownish gray when moist. In places it contains more or less well-rounded gravel. The type has only a very scant growth of vegetation and is nonagricultural. It is found in small patches at Bombay Hook, Fraland Beach, Port Mahon, Kitts Hummock, and Bowers Beach. From Bennett Pier the Coastal beach continues south as a narrow strip to the southern boundary of the county.

#### SUMMARY.

Kent County occupies the central part of Delaware and contains an area of 594 square miles, or 380,160 acres. It lies in the Atlantic Coastal Plain and has a flat to slightly undulating topography with a maximum elevation of only 65 feet above sea level.

As a whole, the drainage of the eastern and western parts is poor, while that of the central belt is good. The eastern three-fourths of the county is drained into Delaware Bay, and the western fourth into Chesapeake Bay.

Very little settlement had been made in this region prior to 1664. The population in 1910 was 27,812, which represents a decrease of 5,062 since 1880. Over 86 per cent of the total population is rural. Dover, the largest town in the county, with a population of 3,720, is the capital of the State and the county seat of Kent County.

The Pennsylvania Railroad, with two branch lines, furnishes good transportation facilities, while the area along Delaware Bay has good boat service. Wagon roads are numerous and, on the whole, are kept in fair condition.

Kent County has an average rainfall of 43.69 inches and a mean annual temperature of 55.3°. The highest temperature on record is 104°, and the lowest, 12° below zero. The humidity is usually high. The precipitation is well distributed throughout the year, and crop failures are seldom caused either by severe droughts or by prolonged

wet spells. The average growing period, or the length of time between killing frosts, is 187 days.

The agriculture of the county began over 200 years ago, with corn, wheat, and tobacco as the principal crops. Thirty years ago the production of peaches was extremely important, but the orchard area has decreased to a thirteenth its former size. To-day the leading crops are corn, wheat, and hay, while tomatoes are produced extensively for canning. Apples and peaches are the more important fruit crops. The stock industry is not important, but dairying is increasing.

The census of 1910 reports over 79 per cent of the farms using fertilizer, at an average expenditure of \$102.81. About one-half of the farms are operated by owners.

The county comprises soils belonging to 4 series, embracing 13 types and 2 phases. Four classes of miscellaneous material also are mapped. The Sassafras soils are the best and the most important in the county. Some of these soils are very productive, and rank among the most desirable of the Atlantic Coastal Plain. The sandy loam and loam have a wide crop range and are well adapted to fruit growing as well as to the production of tomatoes and the general farm crops. The silt loam is an excellent soil and produces good yields of corn, wheat, and hay. The sandier types are well suited for sweet potatoes, berries, and trucking crops.

The Leonardtown soils are relatively unimportant on account of their small extent. The surface soils are like those of the Sassafras series, but the subsoil, like that of the Elkton types, is inadequately drained. This makes these soils less desirable than the Sassafras soils.

The Elkton series in this county comprises a sandy loam, a loam, and a silt loam. These are typically gray soils, occupying flat or nearly level areas with poor drainage. Wheat is the principal crop grown, but hay, corn, and tomatoes are also important.

The Portsmouth soils are black in the surface layer and high in organic matter. They occupy flat areas and are poorly drained. The series is represented by the sandy loam, loam, and silt loam types. Much of their area is covered with forest. When well drained, these soils produce good yields of corn and are well adapted to strawberries.

Swamp and Meadow consist of narrow strips of alluvium along the stream courses. Tidal marsh includes the treeless, flat region along the bay, which are subject to inundation by high tides. Coastal beach occurs as a narrow fringe of light-gray sand adjacent to Delaware Bay.

[PUBLIC RESOLUTION--No. 9.]

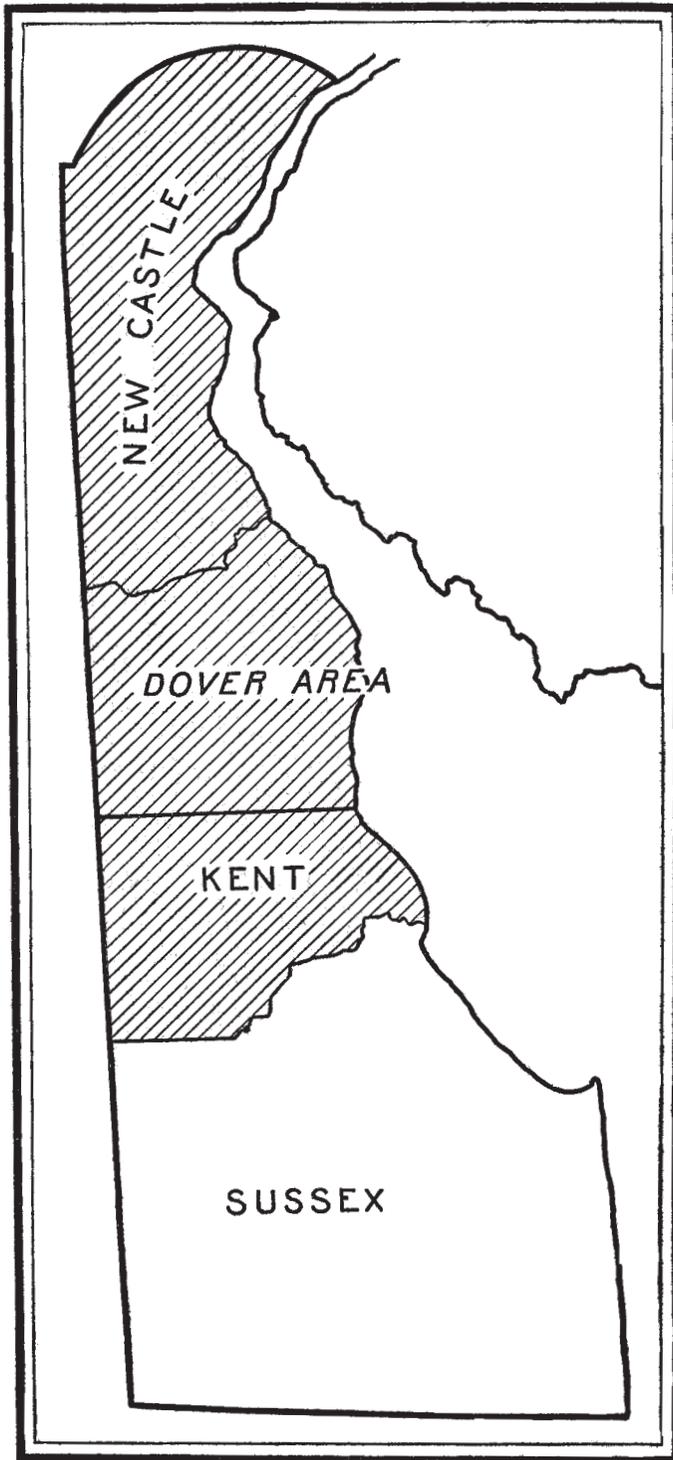
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture "

*Resolved by the Senate and House of Representatives of the United States of America in Congress assembled,* That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in Delaware.

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