

Issued February 4, 1916.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE GEOLOGICAL SURVEY OF NEW JERSEY, HENRY B.  
KÜMMEL, STATE GEOLOGIST, AND THE NEW JERSEY AGRICULTURAL  
EXPERIMENT STATION, JACOB B. LIPMAN, DIRECTOR.

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SOIL SURVEY OF THE FREEHOLD AREA,  
NEW JERSEY.

BY

H. JENNINGS, OF THE GEOLOGICAL SURVEY OF NEW JERSEY,  
J. B. R. DICKEY, OF THE U. S. DEPARTMENT OF AGRI-  
CULTURE, AND L. L. LEE, OF THE NEW JERSEY  
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, 1913.]



WASHINGTON:  
GOVERNMENT PRINTING OFFICE.

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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., June 15, 1915.*

SIR: Under the cooperative agreement with the State of New Jersey a soil survey of the Freehold area was carried to completion during the field season of 1913.

I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1913, as authorized by law.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

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

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## MAP.

Soil map, Freehold sheet, New Jersey.

# SOIL SURVEY OF THE FREEHOLD AREA, NEW JERSEY.

By H. JENNINGS, of the Geological Survey of New Jersey, J. B. R. DICKEY, of the U. S. Department of Agriculture, and L. L. LEE, of the New Jersey Agricultural Experiment Station.

## DESCRIPTION OF THE AREA.

The Freehold area is situated in the eastern part of the State of New Jersey, the Atlantic Ocean forming the eastern boundary. It is bounded on the north by the parallel  $40^{\circ} 28'$  north latitude, Raritan and Sandy Hook Bays; on the south by parallel  $40^{\circ} 12'$ , and on the west by meridian  $74^{\circ} 20'$  west longitude. It includes northern Monmouth County and part of eastern Middlesex County. Freehold, the county seat of Monmouth County, is situated in the southwestern part of the area. It is 42 miles from New York City, 30 miles from Trenton, and 70 miles from Philadelphia. The area contains 305.5 square miles, or 195,520 acres. The base map showing the location of roads, contours, towns, railroads, and streams was constructed and furnished by the Geological Survey of New Jersey.

The topography of the Freehold area varies in general from level to undulating, with some sections which are comparatively hilly. The Highlands of Navesink, a range of wooded hills in the northeastern part of the area, rise abruptly from the water's edge and on this account appear to have a greater height than the other elevations of the area. A second region of marked relief is the range of hills that extends from the vicinity of Middletown nearly to Marlboro. The highest point in this range, which is also the highest point in the area, has an altitude of 391 feet. A third elevated section is found in the south-central part of the area and is known as Hominy Hills. These are characterized by their conspicuous crests of white sand.

Within the borders of the area the Navesink and Shrewsbury Rivers form two bays or estuaries of considerable local importance. Their shores are used as sites for summer residences and the waterways themselves are navigable for a distance of several miles inland. There are several navigable creeks, such as the Cheesequake, Matawan, Luppaccong, and Chingorora in the northern part of the area.

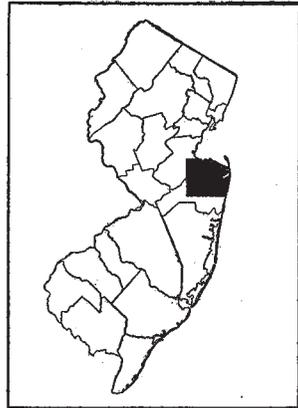


FIG. 1. Sketch map showing location of the Freehold area, New Jersey.

Numerous small, branching streams dissect the region and form an intricate drainage system. Streams which have had considerable influence on the topography of the area are Deep Run in the northern part, Swimming River with its branches in the eastern part, and the Manasquan River in the southwestern part. In their upper portions these streams and their tributaries are mere drainage ways. As they unite and increase in volume they are bordered by bottom lands of varying widths, and near the coast by Tidal marsh.

Monmouth County was established in 1675, but the boundaries were not definitely decided upon until 1709-10 and 1713-14. The county was originally settled by Dutch, Scotch, and some New England emigrants, who removed there about the year 1664. Twenty years later it was the most wealthy county in the province.<sup>1</sup>

In 1708 Middletown was one of the largest places in the area, as was also Shrewsbury. Freehold was at that time a new town. Now Freehold, with a population of 3,233, is the county seat of Monmouth County and the principal agricultural town. It is the shipping point for large quantities of potatoes, and has a large canning factory. There are also a number of manufactories. The town has electric and gas plants and water and sewerage systems. Excellent graded and high schools are also maintained. The New Jersey Military Academy and the first agricultural high school of the State are located in this town.

Asbury Park and Ocean Grove, well known seaside resorts, are in summer by far the most populous towns. These cities afford excellent markets for large quantities of truck produced in the area. The farmers and truckers transport loads of produce to the marketing centers, where the goods are disposed of either to the grocers, hucksters, or directly to consumers. The ocean front from Bradley Beach to Atlantic Highlands is an almost continuous resort. Places of note in this section are Long Branch, Seabright, West End, Elberon, Allenhurst, Asbury Park, and Highlands. Red Bank, Keyport, Keansburg, Oceanic, Fairhaven, and Oceanport are towns of considerable size situated on the bays and rivers which indent the area. With the exception of Red Bank and Keyport, these towns also are dependent to a large extent on summer tourists.

The area is well supplied with transportation facilities. The New York & Long Branch Railroad furnishes frequent communication with New York City for the eastern section of the area and the towns along the coast. Branches of the Central Railroad of New Jersey extend from Matawan to Freehold and from Matawan to Atlantic Highlands. The Trenton division of the Pennsylvania Railroad enters the area at Tennent and leaves it in the neighborhood of Farmingdale.

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<sup>1</sup> Historical Collections of the State of New Jersey, 1844.

During the spring, summer, and fall several steamboat lines offer quick transportation to New York City. Among the points reached by one or another of these lines are Keyport, Keansburg, Atlantic Highlands, Highlands, Oceanic, Oceanport, Little Silver, Fairhaven, Red Bank, Cheesequake, and Matawan. Freight rates by water are considerably lower than by rail and this accounts in part for the success of the trucking industry in this area.

#### CLIMATE.

The climatic conditions prevailing in the Freehold area are characterized by the relatively narrow daily and monthly ranges of temperature, by a rather heavy precipitation, and by the tempering southeast ocean breezes during the late spring, summer, and early fall months. These cooling breezes are usually constant, even during the hottest days, and have been an important factor in making the coast reaches of the area such a popular resort during the summer months. The tempering influence of the adjoining bodies of water is manifested by the comparatively low temperature ranges prevailing throughout the belt of country within about 10 miles of the shore. Thus, at New Brunswick, about 10 miles northwest of the area surveyed, maximum temperatures of  $101^{\circ}$  to  $106^{\circ}$  F. have been reached in four of the summer months and  $-15^{\circ}$  in the winter, while at Oceanic  $101^{\circ}$  has been reached in only two months of the year and  $-11^{\circ}$  is the lowest temperature recorded.

In the spring of 1913 only the lands within a few miles of the water were exempt from the destructive frost that occurred May 11-12 and did considerable damage to early truck crops, such as potatoes, peppers, tomatoes, and berries. A freeze as late as this, however, is exceptional.

At Oceanic the average date of the first killing frost in the fall is October 26, and that of the last in spring, April 11. Frost has been recorded, however, as early as October 11, and as late as April 22, at this station. In the liability to frost the ocean influence is apparent, as in the more inland parts of the Freehold area the average dates of first killing frost in fall and last in spring are about October 19 and April 21, respectively, while frost has been experienced as early as September 22.

During the summer months the humidity is relatively high. The summer precipitation is generally in the form of local showers and thunderstorms, with excessive falls in brief periods at times. Monthly rainfalls of 3 or 4 inches may be expected with marked regularity throughout the entire year.

Snow does not form a considerable percentage of the annual precipitation. Winter storms that begin as snow frequently end in

rain. The average annual snowfall at Oceanic and Asbury Park is 31 inches; inland it is 2 to 4 inches less.

The temperature and precipitation tables printed below are compiled from Weather Bureau records. The first, from the station at Oceanic, shows conditions in the zone of ocean influence. The records from the Freehold and Imlaystown stations apply to the more inland parts of the area.

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

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	35.8	68	4	4.02	3.41	2.09	5.6
January.....	32.3	69	-10	4.00	3.52	8.78	9.0
February.....	31.5	69	-11	3.93	2.95	2.95	10.1
Winter.....	33.2			11.95	9.88	13.82	24.7
March.....	39.6	80	6	4.43	4.03	5.70	4.0
April.....	50.6	91	23	3.60	3.26	5.75	1.0
May.....	60.8	93	30	3.97	1.26	4.09	.....
Spring.....	50.3			12.00	8.55	15.54	5.0
June.....	69.5	101	44	3.91	3.06	5.99	.....
July.....	74.4	101	50	5.89	5.53	8.90	.....
August.....	73.0	98	51	5.02	5.24	9.06	.....
Summer.....	72.3			14.82	13.83	23.95	.....
September.....	67.4	97	40	4.26	3.37	8.76	.....
October.....	55.3	87	29	4.12	2.31	4.28	.....
November.....	45.0	76	17	3.47	1.23	8.79	1.6
Fall.....	55.9			11.85	6.91	21.83	1.6
Year.....	52.9	101	-11	50.62	39.17	75.14	31.3

*Normal monthly, seasonal, and annual temperature and precipitation from records of Freehold and Imlaystown stations.*

Month.	Temperature.			Precipitation.			
	Mean. <sup>1</sup>	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth. <sup>1</sup>
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	34.8	68	2	3.72	2.62	1.45	4.0
January.....	31.6	70	— 4	4.01	1.23	8.30	7.7
February.....	30.7	68	—11	3.97	4.10	2.23	9.4
Winter.....	32.4			11.70	7.95	11.98	21.1
March.....	39.7	76	3	4.69	7.39	5.34	4.1
April.....	50.5	88	18	3.64	2.36	6.31	.8
May.....	62.2	93	30	3.84	2.94	4.99	.....
Spring.....	50.8			12.17	12.69	16.64	4.9
June.....	70.7	96	37	3.63	1.93	2.92	.....
July.....	75.1	102	42	5.12	2.83	9.89	.....
August.....	73.2	96	44	4.71	.55	7.98	.....
Summer.....	73.0			13.46	5.31	20.79	.....
September.....	66.7	96	36	4.29	5.92	10.63	.....
October.....	54.9	84	24	3.52	1.41	3.45	.....
November.....	44.2	77	7	4.02	7.19	7.26	1.0
Fall.....	55.3			11.83	14.52	21.34	.....
Year.....	52.9	102	—11	49.16	40.47	70.75	27.0

<sup>1</sup> The records of mean temperature and snowfall only are from the station at Imlaystown, about 13 miles west of Freehold.

#### AGRICULTURE.

Farming has been the dominant industry in the region covered by the survey of the Freehold area ever since settlement was started, and during most of this period agriculture has been in a flourishing condition. The Freehold area now contains the most prosperous farming communities in the State or along the Atlantic seaboard.

The statistical data of the census are arranged by counties, and it is impossible to give definite figures for the products of the farms included within the area surveyed. Monmouth County, however, is fully representative of the area, including both good and poor lands and highly and poorly developed farming communities. The figures for the county will therefore be given as indicating the agriculture of the area.

According to the census of 1840, 493,554 bushels of corn, 144,066 bushels of oats, 166,013 bushels of rye, 39,368 bushels of wheat, and 273,280 bushels of potatoes were grown in Monmouth County during

the preceding year. There are reported for the year of that census 19,592 head of neat cattle and 23,241 hogs. The census of 1870 gives the crop production as follows: Corn, 760,479 bushels; wheat, 176,473 bushels; oats, 180,461 bushels; rye, 46,567 bushels; and potatoes, 1,263,403 bushels. There were 8,033 milch cows, 4,189 head of other cattle, and 10,890 hogs. The corresponding figures in the census of 1890 were as follows: Corn, 874,847 bushels; oats, 96,875 bushels; wheat, 153,471 bushels; rye, 158,493 bushels; and potatoes, 914,280 bushels; milch cows, 10,097; other cattle, 2,651; and hogs, 28,149. The corresponding figures in the last census were as follows: Corn, 1,099,659 bushels; oats, 11,105 bushels; wheat, 90,048 bushels; rye, 162,323 bushels; hay and forage, 38,117 tons; potatoes, 1,893,523 bushels; dairy cows, 9,256; and hogs, 14,132.

It thus appears that both vegetables and the general farm crops have had important places in the agriculture from an early date. Corn and potatoes, for example, have been important crops at least since 1839. Potato production has increased, as has also that of other vegetables, but not so much wheat is now grown.

The type of farming now prevailing in this area is trucking, carried on in conjunction with the production of several of the general farm crops, chiefly corn, hay and forage, rye, and wheat, for sale, as subsistence crops, principally for feed for work stock and dairy cows, and for the purpose of maintaining the productiveness of the soil. Some dairying is carried on, and fruit is grown in certain localities, but the principal source of income is the truck crops, such as potatoes, tomatoes, beans, lima beans, asparagus, and peppers. The values of the principal crops of Monmouth County for 1909 as given by the last census were as follows: Vegetables, \$2,001,775; cereals, \$1,002,818; hay and forage, \$630,470; and fruits, \$385,140. The receipts from sale of dairy products amounted in that year to \$458,405; those from the sale of poultry and eggs to \$329,971, and from animals slaughtered to \$137,323. About 45 per cent of the total value of farm products was represented by vegetables. These figures do not show the real importance of truck products, because practically all of the vegetable crop is sold, whereas a considerable proportion of the other crops, excluding fruits, such as apples and peaches, is consumed on the farm. Some of the corn crop is sold, but probably the greater part of it is consumed by work animals, dairy cows, and other live stock. Wheat is grown for market. The greater part of the hay and forage is consumed on the farm. The importance of the trucking crops in this county, including small fruits, such as strawberries, raspberries, and blackberries, is indicated by the acreage under cultivation, which, as given by the last census, amounted to 25,883

acres, whereas cereals occupied only 39,952 acres, and hay and forage 27,673 acres.

According to the last census, there were in this county 181,232 apple trees and 210,691 other fruit trees, principally peach and pear.

Intensive methods prevail in connection with all farm industries carried on in the more highly developed farming sections of the area. This is indicated in some degree by the high average yields of crops. For example, the average acreage yield of potatoes for the county in 1909 was 128 bushels, corn 45 bushels, and wheat 22 bushels. There is perhaps no place on the Atlantic seaboard where more intensive methods are employed or where the system of farming accords better with the soil adaptations and the advantages offered by the exceptionally good transportation and markets than is the case in the better farming sections of this area, such as that about Freehold. Vegetables can be put on the New York and other near-by large markets in the best of condition, and the same is true of dairy products, live stock, poultry, and eggs. The dominant system of farming and the market conditions, together with the high valuation of land, encourage the employment of such efficient methods as are general here.

In the area surveyed the influences of topography and soil have an important bearing upon the localization of important farming industries. In the vicinity of Freehold, where the soils are of excellent character, well drained, topographically well suited to cultivation, and productive, agriculture has attained a very high development, but in the southeastern part of the area, where the soils are prevalently sandy, droughty, and rather unproductive, farming is of comparatively little importance, large areas being occupied by timber and brush. In the Highlands of Navesink there is practically no agriculture, for the reason that the topography is steep and rough and the soils mainly of an unfavorable character for crop production. There are other comparatively rough tracts in this northeastern section of the area where little is being done in the way of crop production, owing to unfavorable topography and soils. There is considerable marshland in the northwestern part of the area, on Raritan Bay, which is subject to tidal inundation, and on that account can not be cultivated. Much land is also occupied by the residences and grounds of those who own country estates and who are not engaged in farming. Practically all of the land along the Atlantic coast, aside from the marshland and precipitous areas, is occupied by the buildings of shore resorts and by residences and their surrounding grounds.

There is a marked tendency among the farmers of this area to use the soils in accordance with their crop adaptations. For example, the well-drained loam and sandy loam members of the Colts Neck,

Sassafras, and Collington series are the principal soils used for potatoes, as they are recognized as the types best adapted to this crop. The Sassafras soils are preferred to those of the Colts Neck series for potatoes and are more generally planted. The red soil material of the Colts Neck soils is said to give an undesirable reddish color to the surface of the potatoes, which is due probably to the clinging of the red soil particles to the tubers. The sandy soils are given preference for asparagus, while tomatoes are largely grown on the well-drained loams and sandy loams. The sandy soils and friable loams are preferred for the production of peas and lima beans. Peppers are more extensively grown on the sandy lands having drainage ranging from good to rather imperfect. The crop seems to do about as well on the Keansburg sandy soils as on the well-drained sandy soils of the Sassafras series. The Colts Neck and Sassafras are believed to be the best peach and apple soils, but fruit growing has not been developed to that point where careful attention is given to the selection of orchard sites.

As a rule good farming methods are practiced, including deep, thorough, and seasonal preparation of the land with ample horsepower and efficient implements, excellent cultivation with a lighter equipment of implements and horsepower, heavy fertilization with high-grade mixtures and barnyard manure, and good rotations.

Discussion of the details of handling the different soils belongs properly under the descriptions of the types in the following chapter, but some of the more general practices which are broadly applied to one or more soil types are discussed here.

The corn crop of Monmouth County in 1909 amounted to 1,099,656 bushels. This crop is grown throughout the area on all the well-drained soils. It is planted on well-prepared land and is intensively cultivated with weeders and cultivators, which, together with the liberal fertilization, accounts for the high average yield. As a rule the crop follows grass. In about 50 per cent of the area cultivated to corn some other crop, such as rye, vetch, crimson clover, or cowpeas, is sown, thus effecting an excellent rotation. Other crops of the area are also handled in a very efficient way, so that the yields are in general good.

Potato planting begins usually about March 20 to April 1 and is finished usually by April 15, the planting being done with machine planters. The seed is mostly obtained from northern localities, particularly from New York and Maine. The American Giant, a heavy yielding and scab-resistant variety, is now grown on probably more than 75 per cent of the area used for potatoes. The Irish Cobbler, a very early variety, and the Green Mountain, a late variety, are probably the next in importance. The potato crop is harvested usually

between July 15 and September 1, most of the harvesting being done with potato diggers of the elevator type. High-grade fertilizer mixtures in acreage applications of 1,200 to 2,000 pounds are usually used. There is some variation in the composition of these mixtures, but they usually analyze about 4-8-10.

Asparagus is sown early in the spring on well-fertilized beds. Early the following spring the plants are transferred to rows about 6 feet apart, at intervals of about 12 or 15 inches in the row, the plants being set deep, sometimes 8 to 10 inches below the surface. The seed bed is usually treated with acid phosphate or bone meal and tankage, while the transplanted rows are fertilized during the growing season of the first year, generally with acreage applications consisting of a mixture of 100 pounds of muriate of potash and 300 pounds of tankage, heavy applications of manure being made in the fall. After cultivation begins 1,000 to 1,200 pounds of a 4-8-10 mixture are commonly used, being applied either in the early spring or after the cutting begins. The principal varieties are the Palmetto and Giant Argenteuil. Some cutting is done the second year on roots which were 2 years old when set, or the third year where yearling roots have been used. After the fourth year cutting is done during the full season, which usually extends to the last of June. Heavy applications of manure are made late in the fall by all of the better farmers.

As soon as there is any growth of the asparagus plants, which usually starts in April, the rows are ridged to a height of about 18 inches, dirt being thrown up from the middles. In this way the stalks are bleached, since most of the growth is made below the surface, the plants being cut soon after the tips appear, with knives passed through the ridges below the surface. At the end of the cutting season the ridges are torn down and the land thoroughly cultivated before the remaining shoots start, and about the middle of July cover crops of soy beans or cowpeas are usually planted. Good asparagus beds continue to produce well for about 12 to 14 years, depending on the care given the fields. Properly handled, good asparagus fields yield from 1,200 to 1,800 bunches per acre annually. The asparagus crop is of considerable importance in the northern part of the area, especially around Marlboro.

Tomatoes are transplanted to the field from about May 10 to 15 at the rate of about 2,500 plants per acre. The principal varieties grown are the Erliana, Stone, and Matchless. If set out early the Erliana can be expected to begin to ripen about July 10. Acreage applications of 700 to 1,000 pounds of fertilizer are commonly made. Some of the common mixtures analyze 4-7-7 and 4-8-10. Manure is frequently placed in the hill, especially in case

of the early planting. The crop is cultivated somewhat in the same manner as corn. The early crop, which consists largely of the Erliana variety, is marketed, most of it going to New York, but the later varieties, which are generally grown on the heavier types of soil, are in part used in the local canneries, the remainder going to market. The tomato industry is largely confined to the northern and northwestern sections of the area, although it has some importance in the southeastern part near Farmingdale.

Peas planted early in April with drills, on land to which large quantities of fertilizers have been applied, are harvested about the 5th to 10th of July. The vines are mowed and taken to shelling establishments.

Lima beans are planted any time from early in July to the middle of August, the seed being put in by machines in rows about 3 feet apart. In case the soil is very dry at the time of seeding, the planters are equipped to water the ground. Fertilizers are also liberally used for this crop. The beans are hand-hoed one to three times, cultivated with light-running cultivators, and finally mowed and carted in the vine to the shelling houses. The bean harvest extends over a season of 8 to 10 weeks, sometimes continuing until about the 1st of November. The land on which peas and beans are grown is kept in cover crops between seasons as much as possible, rye being one of the principal plants grown in rotation with these crops. The peas and beans are used in large canning factories at Freehold, the industry being restricted principally to this section.

Peppers constitute an important crop in the region which borders the bays in the northern part of the area, and to a less extent in the southeastern part. The plants are transferred from hotbeds as soon as danger of frost has passed, and set about 15 to 20 inches apart in the row, on land fertilized at the rate of about 700 to 1,400 pounds per acre with mixtures analyzing about 4-8-10. The crop receives extremely careful attention throughout its growth. As soon as the peppers have attained full size they are picked, placed in barrels, and marketed, the field being picked over from two to four times during the season. Owing to the fact that the tender peppers are easily damaged by frost, much care must be taken to protect the late fall crop from injury of this kind. At the first indication of frost the peppers are picked and stored in cool places under shelter or piled in large windrows and covered with some protecting material, such as straw. In this way marketing can be continued even after the plants in the field have been killed. As a rule, this crop is very remunerative with proper management and soil selection. Yields of 400 barrels of green peppers per acre are not unknown among the better growers. The principal varieties are the Cheese, Neapolitan, Red Giant, Red King, Chinese Giant, Magnum Dulce, Bull Nose, and Squash.

The census gives the volume of the peach crop for the year 1909 for Monmouth County as 58,331 bushels and the apple crop as 277,996 bushels. The principal varieties of apples grown are the Duchess, Gravenstein, Maiden Blush, Wealthy, Jonathan, Stayman Winesap, and English Coddling. The peach and apple orchards are rather widely distributed. There are no very large commercial orchards.

The supply of labor in Monmouth County usually is plentiful and the hands efficient.

The census of 1910 gives the number of farms in Monmouth County operated by owners as 2,179, the number operated by tenants as 630, and by managers as 132. The high state of development in this area may be attributed in part to the large percentage of farms operated by owners.

The area of land included in farms, according to the last census, comprises 206,856 acres, or about two-thirds the total area of the county. Of this, 156,583 acres are classified as improved land and 40,857 as woodland. The average farm in 1910 included 70.3 acres. The total valuation of farm lands was \$14,803,850.

#### SOILS.

The Freehold area lies in the Coastal Plain Province, the geological formations of which are, in this region, chiefly unconsolidated and nearly horizontal beds of greensand marl, clay, sandy clay, sand, and gravel. These can be grouped in two classes—underlying and surficial formations. Owing to their slant of 25 to 45 feet per mile, and to the inequalities of the topography, the former appear at the surface in narrow, irregular bands which have a general northeast-southwest direction. Since they dip toward the southeast, the lowermost, and hence oldest, beds outcrop at the northwest and successively younger formations are found to the southeast. The formations outcropping north of a line from the headwaters of Manasquan River through Blue Ball, Jerseyville, Pine Brook, and Oakhurst are of Cretaceous age, while those south of this line are Tertiary, chiefly Miocene. Except for a bed of marl which outcrops near Farmingdale, along Shark River, and north of Asbury Park, and lenses of clay which are most conspicuous southeast and southwest of Pine Brook and west of Asbury Park, the Tertiary beds are predominantly sand, and the soils derived therefrom are of much less value than those on the Cretaceous formations, which on the whole carry more clay.

Three beds of greensand marl, ranging in thickness from 20 to 30 feet, constituting three layers within the Cretaceous beds outcropping

in the area, have had an important influence on the agriculture. They are composed in large part of the mineral glauconite, and owing to their dark-green color and former utilization as fertilizer they have been widely recognized. They are underlain and overlain by heavy beds of sand which form broad belts of soils both north and south of the greensand belts, while the latter are separated by narrower belts of sandy materials due to thinner beds of sand separating the greensand beds from one another. The presence of marine shells and of bones of extinct swimming reptiles, particularly in the marl beds, as well as the marl itself, is conclusive evidence of the marine origin of these formations.

The surficial formations consist of scattered, irregular areas of sand and gravel, more or less clayey in texture and generally yellowish in color, which overlie the eroded and beveled edges of the underlying formations. They represent deposits laid down at a much later period than the underlying formations, but nevertheless sufficiently long ago to permit of extensive erosion, since the areas now found are only remnants of deposits formerly more extensive.

The upland soils, being derived largely from the underlying beds, necessarily have been influenced by their lithologic character. Many of the types include material from more than one formation, but there is a close relationship between the formation and the soil in many instances. Owing, however, to the narrow belt formed by the outcrop of each formation, the unconsolidated character of the beds, the shifting of material on the surface by water and wind, the removal over wide areas of all except a thin veneer of the later deposits, and the artificial mixing of large quantities of marl with many soils during more than a century of cultivation, the soils do not uniformly show a closely fixed relation to geologic formations and their boundaries.

The soils on the marl beds are on the whole quite distinctive and readily separable from those on the adjoining sand belts.

Wide areas of a reddish sand, the Red Bank formation, have influenced the soil types materially.

Those soils having a common origin and the same range of color and structure in the soil and subsoil and the same type of drainage and topography have been grouped into series. The series includes various types differentiated upon the basis of texture—the relative content of the various grades of sand and of clay, silt, and gravel.

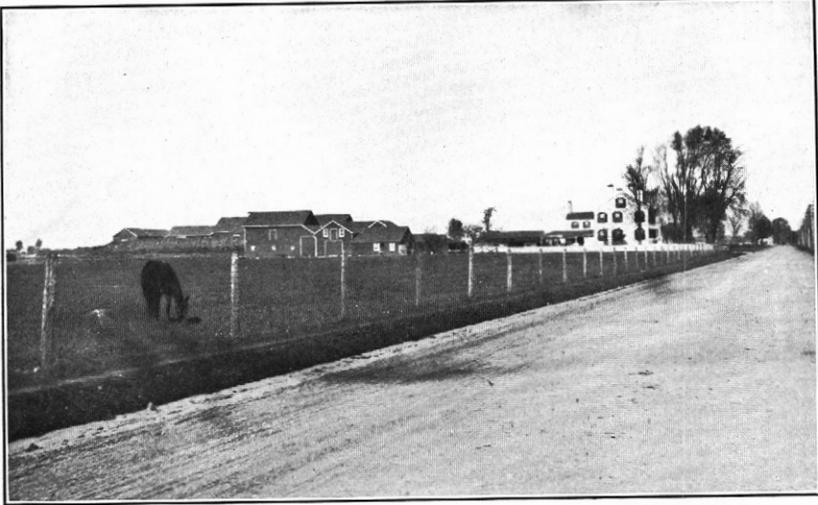


FIG. 1.—TYPICAL FARM BUILDINGS ON SASSAFRAS LOAM, SOUTH OF FREEHOLD.



FIG. 2.—FARM BUILDINGS ON POTATO FARM ON SASSAFRAS LOAM, SOUTH OF FREEHOLD.



The table below gives the name and extent of each of the soils mapped in this area:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Sassafras loam.....	20,160	10.3	Keyport sandy loam.....	3,072	1.6
Sassafras loamy sand.....	17,600	9.0	Freneau loam.....	2,944	1.5
Sassafras fine sandy loam.....	16,448	8.4	Keansburg sand.....	2,816	1.4
Sassafras sand.....	13,504	6.9	Coastal beach.....	2,688	1.4
Sassafras sandy loam.....	11,968	6.1	Shrewsbury fine sandy loam..	2,624	1.3
Meadow.....	11,968	6.1	Keyport clay loam.....	2,112	1.1
Lakewood sand.....	11,520	5.9	Collington fine sandy loam...	1,984	1.0
Sassafras fine sand.....	8,128	4.7	Shrewsbury silt loam.....	1,344	.7
Rolling phase.....	896		Keyport fine sandy loam.....	1,280	.7
Colts Neck loamy sand.....	6,528	3.3	Colts Neck gravelly sand.....	1,152	.6
Colts Neck sandy loam.....	4,672	3.3	Shrewsbury sandy loam.....	1,152	.6
Eroded phase.....	1,728		Collington clay loam.....	704	.4
Tidal marsh.....	6,144	3.1	Collington loamy sand.....	704	.4
Collington loam.....	5,952	3.0	Shrewsbury loam.....	704	.4
Keansburg fine sandy loam...	5,696	2.9	Keansburg loam.....	640	.3
Lakewood fine sand.....	5,312	2.7	Madeland.....	640	.3
Collington sandy loam.....	5,184	2.6	Keyport loam.....	512	.3
Lakewood gravelly sandy loam.....	4,544	2.3	Sassafras coarse sand.....	320	.2
Muck.....	3,648	1.9	Colts Neck fine sandy loam...	256	.1
Keansburg sandy loam.....	3,200	1.6	Total.....	195,520	.....
Colts Neck loam.....	3,072	1.6			

SASSAFRAS SERIES.

The soils of the Sassafras series are predominantly light brown to yellowish brown in color, ranging occasionally from brown on the one hand to light yellowish brown on the other. The subsoils are bright yellow to reddish yellow in color, with upper subsoils as heavy as or heavier than the soils. The lower subsoil is often lighter in texture than the upper subsoil, consisting of sandy or gravelly material. This layer is not universally present, but whether present or not the subsoil is well drained, uniformly oxidized, and free from mottling. The topography is smooth and the soils are often, though not invariably, derived from terrace material, either of marine, estuarine, or river origin. They occur in the Coastal Plain region of New Jersey, Maryland, Delaware, and part of Virginia. Seven soils of this series are mapped in the Freehold area—the loam, sandy loam, loamy sand, sand, fine sandy loam, fine sand, and coarse sand.

SASSAFRAS SAND.

The surface soil of the Sassafras sand to a depth of 7 to 10 inches is a grayish-brown to brownish-yellow loose sand. The subsoil is an orange-yellow sand which is loose and porous, with a tendency to

be a little more loamy at lower depths. The sand grains of which this soil is composed are largely of quartz and predominantly slightly rounded. In few areas of this type is there a large admixture of quartz gravel.

The Sassafras sand occurs in almost all parts of the survey, but particularly in the northern and northeastern sections. Considerable areas are also found skirting the heavier soils along the Manasquan River, around Jerseyville, and south of Eatontown. Along the Manasquan River small areas occur as high terraces, but in other parts of the area the type is typically an upland soil. In the northern part of the area, where the greater part of this type is utilized for agricultural purposes, the land is generally quite level and at only a moderate elevation above sea level.

The material forming the Sassafras sand has been derived in large part from the Cape May and Cohansey formations. The forested areas support a growth of oak and pine, with an undergrowth made up largely of blueberry bushes.

This soil is well drained, warm, and early, and well adapted to truck growing, and especially to early market gardening. Early tomatoes, peppers, sweet potatoes, garden peas, melons, and cucumbers are grown to a large extent.

The application of large amounts of stable manure supplemented by chemical fertilizers is quite essential for the successful production of crops on this type. Unless the season is an especially wet one general crops are likely to suffer from drought to a marked extent. Some sweet corn is grown successfully, but as a rule the greatest success is achieved with early truck. The soil has a tendency to drift and should be protected as much of the time as possible by some growing crop. Winter cover crops are thus important.

Values for this type vary considerably, depending on location and development.

#### SASSAFRAS LOAMY SAND.

The Sassafras loamy sand has a light-brown to brownish-yellow loamy sand surface soil, with a depth of about 6 to 8 inches. This is underlain by a yellow to reddish-yellow loamy sand. As mapped there are some included areas where the subsoil is not so loamy and still others with sandy loam below a depth of 24 to 30 inches. In other words, there are included areas of Sassafras sand and Sassafras sandy loam. The type represents a transitional soil between the lighter Sassafras sand and the Sassafras sandy loam or fine sandy loam. Under these conditions it naturally presents variations which are quite pronounced and apparent, though it was not possible to indicate them on the map on account of their complexity or the gradual change in texture from place to place.

Areas of Sassafras loamy sand are mapped in the section around Locust, Freneau, Fairview, south of Keansburg, Tennent, Gordons Corner, Hillsdale, south of Eatontown, and in the neighborhood of Pine Brook. The largest area of the type occurs as an almost continuous body extending along the south shore of the Navesink River from the neighborhood of East Oceanic to a considerable distance above Red Bank on Swimming River.

For the most part the topography of the type is gently undulating, though areas of considerable size south of Keansburg are nearly level. On account of the light texture the soil drifts to some extent and as a result of wind action may vary in character with slight differences in elevation. In places where slightly elevated areas of considerable size have been formed, largely by the redeposition of wind-blown sands, the soil has been mapped as the Sassafras sand, while similar areas of small size are included with the loamy sand.

The native tree growth consists of oak and a little chestnut. The greater part of the type, especially in the northern section, where not too steep, has been cleared and farmed extensively.

The soil is easily cultivated, responding readily to the application of manure and commercial fertilizers. A large acreage of tomatoes, asparagus, peppers, eggplant, strawberries, watermelons, cantaloupes, sweet potatoes, sweet corn, and other truck crops is grown for market annually on this type. These crops are raised with success in practically all sections where this type occurs, but in the northern section the largest areas are planted. Blackberries are grown successfully. Kieffer pears grown on this and the other light types of the area are of better quality than fruit of the same variety grown on the heavier soils. Apples and grapes are also produced in small quantities. Very little general farming is done on this type. Scarcely any grass and little grain other than an occasional patch of rye are grown.

The Sassafras loamy sand has enough of the fine grades of material in its content to form friable clods on drying, in this respect differing from the loose, less coherent Sassafras sand with which it is so closely associated. The organic content is relatively low, and it is due to this that the type has such a variation in value. By maintaining and increasing the supply of organic matter in the soil the Sassafras loamy sand can be made one of the best early truck soils in the area. This can be done by plowing under green crops to a greater extent than is done at the present time, by giving more care to the protection of the soils from wind erosion and blowing, and by the liberal use of manure and fertilizers. On this type, as well as on the other soils, the greatest benefit will be derived from commercial fertilizers only after there has been an increase in the organic content. Liming

in connection with the plowing under of green crops will be of great assistance in breaking down the materials plowed under.

The market value of this soil depends on the care that has been given it and on the location. Values range from \$50 to \$150 an acre. Tracts located within easy reach of steamboat shipping points are particularly valuable.

#### SASSAFRAS FINE SAND.

The Sassafras fine sand consists of a grayish-brown to light-brown fine sand, underlain at 2 to 5 inches by orange-yellow fine sand. In places the lower subsoil has a slightly reddish cast. There are some included patches of Sassafras fine sandy loam too small to map. Both the soil and subsoil are friable. There is, however, considerable variation in the soil, according to differences in situation and in the soils with which it is associated. Where the type borders the Sassafras fine sandy loam there is an almost imperceptible gradation into the heavier type.

With the gently sloping topography which prevails where this soil is found, and its loose, porous structure, moisture is readily absorbed and the excess water escapes by seepage. In no case is it necessary to resort to ditching or draining the fields.

The largest areas of Sassafras fine sand are in the neighborhood of Atlantic Highlands and near Robertsville. Many small areas are scattered over different parts of the survey.

The native timber growth on this soil is largely oak, with some hickory and chestnut.

This is mainly a truck soil, the porous nature of the surface making it warm and early. To a very small extent it is suited to heavier crops which require more moisture and a longer growing season. Early potatoes with favorable moisture conditions do well, though the yields are not nearly as large as on the heavier types. One of the main truck crops is asparagus, which with proper management gives excellent yields. Peppers are grown on large acreages and yield well. Carrots, turnips, cucumbers, melons, and cantaloupes all give good yields when care is taken to prevent rapid losses of evaporation or when the rainfall is abundant. Fruits can be grown successfully. Peaches and Kieffer pears do better than apples, though this last crop is grown successfully. Other fruit crops are grapes, raspberries, blackberries, and in the lower lying areas, as in slight depressions, strawberries.

It is the practice on this land to use heavy applications of manure and considerable quantities of fertilizer. During the season, depending on the condition of the growing crops, nitrate of soda or other chemical fertilizers are frequently applied. The great difficulty with this important type, as with a number of the other soils of the area,

is the low organic-matter content, due to the porous nature of the soil, which favors rapid oxidation of humus-forming constituents. It is important to keep the soil protected with some cover crop during as much of the year as possible, but especially in the fall and winter. Land of this type ranges in price from \$100 to \$200 an acre.

*Sassafras fine sand, rolling phase.*—The Sassafras fine sand, rolling phase, consists of a grayish to pale orange yellow fine sand to loamy fine sand, passing below, usually between 24 and 30 inches, into orange-yellow or reddish-yellow to yellowish-red loamy fine sand. In places yellowish-red fine sandy loam to sandy loam is reached in the lower portion of the 3-foot section, but such areas represent mere patches or spots of little importance. This phase also includes patches which are decidedly gravelly and others which are both gravelly and stony, the gravel consisting of small quartz pebbles and the stones of fragments of reddish sandstone and sandstone conglomerate. These gravel and stony areas also are of little importance in point of extent, not being of sufficient size to warrant their recognition as distinct soil types. There are also places where greensand material is encountered in the subsoil. Such areas represent patches of Collington soil too small to show on the map.

This phase is found in the northeastern part of the survey, in what is known as the Highlands of Navesink. The drainage is adequate and even excessive, the steep surface making the run-off rapid.

The areas of the Sassafras fine sand, rolling phase, are unimproved, and practically nonagricultural on account of the topography. Occurring on steep hillsides in which the different formations lie in horizontal bands, it is natural that the substratum of this soil should be somewhat variable and that the surface soil in places should consist of several classes of material. For this reason the type has been mapped over the sections which have topographic characteristics making them unfit for agriculture.

A high valuation is placed on this type where it is entirely in forest as locations for summer residences. It is within easy commuting distance of large cities and this adds to its value. The forest growth is composed of oak and chestnut.

#### SASSAFRAS COARSE SAND.

The Sassafras coarse sand is a grayish coarse sand, underlain at shallow depths by yellow coarse sand which passes below into yellow or reddish-yellow loamy coarse sand of a much more loamy nature than the overlying material.

The type occurs on slopes and also as nearly level areas at lower elevations than a considerable part of the surrounding country, but by no means as lowlands. The drainage, on account of the coarseness of the soil, is in most cases excessive.

This type is derived from the Pensauken formation. It is covered with a rather sparse growth of oak. Very little other vegetation is found. On account of its porous nature very little of the type has been used for farming, though it lies relatively near to the cities of Perth Amboy and South Amboy.

A considerable part of the type has been dug over for molding sand, a use to which the loamy sand subsoil material is well adapted.

#### SASSAFRAS SANDY LOAM.

The soil of the Sassafras sandy loam in its typical development consists of a light-brown to brown sandy loam, underlain at about 6 to 10 inches by reddish-yellow friable sandy loam. At about 28 to 30 inches reddish loamy sand is encountered. This in some areas shows the presence of greensand. Gravel is present in the lower subsoil and in the substratum of some areas, particularly those in the southern part of the survey. There are included variations from the typical soil, a heavy phase representing that portion of the type where it grades into the heavier Sassafras loam, and a light phase representing that grading into the Sassafras loamy sand. In the southeastern part of the area some of the soil is inclined to be rather fine in texture, bordering closely upon a fine sandy loam.

This type is mapped in scattered areas in a belt extending in a southwesterly direction from the neighborhood of Atlantic Highlands to the vicinity of Tennent. It is associated with the Sassafras loam, which lies at slightly lower elevations, or where the heavier type passes into the drainage ways. The drainage is good and the soil retentive of moisture.

The materials from which the typical soil is derived are either closely associated with the marl deposits or represent marly layers, the soil having been subjected to more solution and leaching than the Collington and the associated redder soils.

This soil is adapted to a wider range of crops than any other type of the area because of its heavier texture and consequent better conservation of moisture and organic matter. The crops vary in different parts of the survey.

In the vicinity of Freehold it is not considered as strong a soil as the Sassafras loam, but on account of its earliness and relative ease of cultivation it is utilized for the growing of large acreages of potatoes, particularly the earlier and better varieties. Yields range from 40 to 75 barrels<sup>1</sup> per acre. With good care somewhat heavier yields of American Giant and others of the coarse varieties are obtained.

Other crops grown extensively are corn, which gives good yields, grass, clover, peaches, and apples of different varieties, especially

<sup>1</sup> Throughout the type descriptions the yields of potatoes are reported according to local usage, in barrels of a capacity of 2½ bushels.

early fall sorts. Truck crops are also grown successfully on this type, tomatoes being produced to some extent.

In former years heavy applications of marl were made to practically all the lands in the area. This resulted in materially increasing the productiveness of the soils temporarily, and to this can be credited in part the high productiveness of this soil even to the present day.

Within the last 15 years the profit in potato growing has been so satisfactory that all soils having a high producing power are utilized to the greatest extent possible for the production of this crop. Under these conditions this soil, though it will produce other crops successfully, is utilized largely for growing potatoes, in conjunction with grass and corn, the three crops being grown in rotation.

The maintenance of the organic matter in this soil is accomplished by sowing crimson clover, rye, wheat, or rye and vetch when the potato crop is removed, and plowing this under in the spring. It is the aim to keep the supply of organic matter as high as possible. Good crops of crimson clover appear to be obtained on this type with very little difficulty. This legume is sowed in the late summer or in corn at the last cultivation.

This type has a value slightly lower than that of the Sassafras loam.

#### SASSAFRAS FINE SANDY LOAM.

The surface soil of the Sassafras fine sandy loam is a light-brown to brown loamy fine sand to fine sandy loam, grading at about 7 inches into yellow fine sandy loam, which gradually becomes somewhat heavier and more compact with depth, grading into reddish-yellow friable fine sandy clay. At a depth of about 28 to 40 inches somewhat coarser material is usually reached.

In the southeastern part of the area occurs a variation which has a grayish surface soil and a yellow subsoil.

The surface is usually gently rolling to nearly level. Both the surface and under drainage are well established.

The type occurs in practically all parts of the area surveyed, the greatest development being in the northeastern part. The more rolling areas occur on Rumson Neck and in the vicinity of Hamilton and Jerseyville.

The type is easily cultivated, and practically all of it is farmed. The small area still in forest is covered with a growth consisting mainly of oak, chestnut, dogwood, and some hickory. The type is used extensively for both general farming and trucking and gives good yields of the crops of either class.

The yield of corn ranges from 50 to 80 bushels of shelled corn per acre. Potatoes give yields of 60 to 80 barrels of American Giant and other large varieties and 50 to 60 barrels of Irish Cobbler or other table varieties where 1,500 pounds of 4-8-10 fertilizer is applied.

Clover and timothy yield from 1 to 1 $\frac{3}{4}$  tons of hay per acre, the yield depending largely on the rainfall. Wheat yields on the average about 23 bushels per acre, though much larger yields are often harvested. Of the truck crops grown, especially along the northern part of the area in the neighborhood of Middletown and Atlantic Highlands, tomatoes probably occupy the greatest acreage. These are shipped to canning factories or to New York City. In the vicinity of Hamilton a large area of this type is used for all kinds of truck crops, important among them being snap beans, beets, peas, spinach, and tomatoes.

The value of the soil varies considerably, but as a rule it is sold for \$125 to \$200 an acre. Where close to town it commands higher prices.

Mechanical analyses of samples of soil, subsoil, and lower subsoil gave the following results:

*Mechanical analyses of Sassafras fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
170445.....	Soil.....	0.6	8.0	14.6	27.0	24.1	19.8	5.9
170446.....	Subsoil.....	1.0	8.3	14.6	23.2	19.4	22.8	10.7
170447.....	Lower subsoil...	1.4	12.0	24.6	30.4	17.6	9.5	4.7

SASSAFRAS LOAM.

The surface soil of the Sassafras loam consists of a brown mellow loam about 8 to 12 inches deep. The subsoil is a yellowish-brown to reddish-yellow heavy loam or silty clay loam of a moderately friable structure. In the typical soil at about 28 to 34 inches a coarser stratum consisting usually of reddish-yellow to yellowish-red sandy loam is reached. In places the lower subsoil shows the presence of greensand. There are included areas where coarse material is not reached within the 3-foot section. In the areas southwest and northeast of Freehold and in the neighborhood of Holmdel much of the type does not show a coarser layer in the lower subsoil, at least not within the 3-foot profile.

In the section near the coast at Long Branch a phase of this type has a rather grayish or grayish-brown soil. This is a well-drained soil, with other characteristics so similar to the typical soil that it was included with the latter.

The Sassafras loam is one of the important soil types of the area, both in extent and agricultural value. The largest areas of typical soil occur in the vicinity of Freehold and Holmdel. Many other areas are scattered throughout the survey, as at Rumson Neck and in the vicinity of Long Branch.

The type occupies the nearly level to very gently rolling portions of the area south of the highland section. In the vicinity of Freehold the topography is more nearly level and cultivation is carried on in the most intensive manner. Most of the type has excellent drainage. In a few flat areas artificial drainage has been installed, resulting in the improvement of crops, both in quantity and quality.

Practically all this soil is cleared and under intensive cultivation, though a few small areas are still forested. The original forest consisted of white oak, red oak, black oak, beech, and chestnut. The Sassafras loam is without exception the heaviest yielding potato soil in the area and State, and a large acreage is devoted to this crop. Potatoes are usually grown in rotation with other crops, but even where grown continuously excellent yields are obtained. Minimum yields are never less than 75 barrels, and the maximum yield may be as high as 110 barrels. The average, however, is about 85 to 90 barrels. Crops which supplement potatoes or are grown in rotation with them are corn, grass, and alfalfa. Little grain is grown.

In the vicinity of Freehold large acreages of garden peas and lima beans are grown for canning factories.

Farm improvements on this type are equal or superior to those found on other types of the area. Large houses and barns seem to be more common than on the lighter soils (see Pl. I). This may in part be explained by the fact that these heavier soils have been more highly valued for a long time, in fact ever since the settlement of the county. A good many of the farms have remained in possession of the same families almost from the beginning.

Farms of this type range in value from \$200 to \$300 an acre, depending on location and improvements. Near Freehold even higher prices than these are asked.

#### COLLINGTON SERIES.

The Collington series is characterized by the brown to reddish-brown color of the surface soils, by the yellowish-brown, yellow or greenish-yellow color of the upper subsoil of the heavier members and of the whole subsoil of the light members, and by the dark-green or olive-green deeper subsoil of the heavier members, which contains considerable glauconitic sand. These soils are typically derived from the greensand deposits of the Maryland, Delaware, and New Jersey portion of the Coastal Plain. The topography varies from nearly flat to gently rolling, and the drainage is good. Five types of this series are mapped in this survey, the fine sandy loam, loamy sand, sandy loam, loam, and clay loam.

## COLLINGTON FINE SANDY LOAM.

The Collington fine sandy loam, to an average depth of 8 inches, consists of a dark-brown fine sandy loam which has a greenish or olive tinge. Beneath this is a stratum of yellowish-brown fine sandy loam of about the same texture as the surface, which ranges in thickness from a few inches to as much as a foot and a half, where it rests on a fine sandy loam containing considerably larger quantities of greensand than occur in the surface. On close examination of this soil considerable quantities of black glauconite particles can be detected and it is this characteristic that determines the classification of the type with the Collington series. In some areas of this type rounded quartz pebbles are present.

The largest areas of Collington fine sandy loam lie between Tinton Falls and Eatontown. Here a considerable area of this type is used for growing nursery stock, to which this soil appears to be well adapted. Another large area of this type is in the neighborhood of Middletown.

Where this type is used for the growing of general farm crops good yields are obtained, but the somewhat heavier soils of this series are better for this purpose, because they conserve moisture better during the dry periods likely to occur in the life of long-season crops.

Cultural methods on this soil do not differ radically from those on other soils of similar texture. A large number of different crops are grown. Potatoes yield slightly less than on the Collington loam, the average being close to 60 barrels per acre, with an acreage application of 1,500 to 2,000 pounds of fertilizer. Asparagus was formerly grown extensively on this soil, and it is still used for this crop to a greater extent than many of the heavier lands where asparagus was formerly grown. All tree fruits seem to thrive on this soil.

## COLLINGTON LOAMY SAND.

The surface soil of the Collington loamy sand is a brown loamy sand underlain at about 5 to 8 inches by yellowish-brown, incoherent loamy sand which frequently shows a greenish cast. At depths of about 24 to 30 inches greenish-brown to green loamy sand to sandy loam occurs. The characteristic distinguishing this soil from the Sassafras loamy sand is the marked green color in the subsoil, especially at the lower depths.

The type is found in different parts of the survey where the greensand marl lies near the surface. Practically all of it is cleared, but its utilization varies. In some cases but little use is made of it, while in others it is used extensively for trucking. It has a level to very gently sloping surface, favoring tillage, and the usual presence of a heavier substratum makes it more retentive of moisture than the texture of the

surface soil would lead one to expect. It is in most places greatly in need of organic matter.

Such crops as asparagus, watermelons, cantaloupes, early tomatoes, and peppers are grown with success. Sweet potatoes give good yields. Land of this type of soil ranges in value from \$75 to \$150 an acre.

#### COLLINGTON SANDY LOAM.

The soil of the Collington sandy loam typically consists of a brown to light-brown sandy loam, underlain at about 8 inches by greenish-brown heavy sandy loam or brown sandy loam having a greenish cast. This grades below into greenish-brown sandy clay loam of a friable structure and at about 30 inches into green or brownish-green light sandy loam. A small quantity of rounded quartz gravel may be present in the surface portion of the type but gravel is seldom found in the lower portion.

Along the northern edge of the "Pine District" in the southwestern part of the survey and in the sandy sections extending from near Jerseyville to the vicinity of Pine Brook and West Long Branch occurs a sandy phase of this soil. It consists of a grayish to slightly brownish, loose, porous sand, underlain at about 8 inches by an orange-yellow or bright-yellow, loose, porous sand, which overlies olive-green, rather plastic sandy clay at about 20 to 30 inches.

Practically all of this phase is covered with forest, consisting of oak, pine, sassafras and in some cases a little chestnut. Very little of this soil is farmed. On account of its open, porous nature it would probably be necessary to use manure or commercial fertilizer in order to produce good crops.

The typical Collington sandy loam is one of the important agricultural soils of the area, though its distribution is somewhat restricted. It is developed in the districts where the marl beds have a wide distribution, and is confined to a belt about 8 miles wide crossing the area from the neighborhood of Atlantic Highlands in a southwesterly direction into Delaware. Along this belt there are a number of large pits from which marl has been removed for distribution over other soils. In the vicinity of Marlboro several acres have been dug over for marl.

The topography of the Collington sandy loam is level to gently sloping. The sloping areas cover parts of the survey where there is a gradation from the heavier level land of the Collington loam to lands of distinctly lower situation, often the stream bottoms.

Practically all the typical soil is cleared and utilized for intensive farming. It is especially adapted to potatoes, and a large acreage is devoted to the production of this crop. The type is more easily worked than the heavier soils of either the Collington or Sassafras series,

and consequently earlier planting is possible than on those types. There is a tendency to grow a greater proportion of early crops on the sandy loam. Wheat and grass, however, do fairly well. Corn also gives yields close to those reached on the loam types of the Collington and Sassafras series. Some truck crops are grown successfully, especially peas and lima beans. Apples do well. Good crops of Yellow Transparent, York Imperial, and Ben Davis were seen during the course of the survey.

Heavy applications of fertilizers are made in growing potatoes, and the same land may be planted to potatoes for two or three years in succession. With each succeeding crop it is the practice to seed to a green cover crop as soon as the potatoes are removed. These green crops consist of rye and vetch, rye, crimson clover, or wheat. They are plowed under early in the spring. On farms where a rotation is followed the crop succession is: (1) wheat or grass, (2) corn, and (3) potatoes.

Excepting the areas of the sandy phase the type has a high value, prices ranging from \$100 to \$200 an acre.

#### COLLINGTON LOAM.

The soil of the Collington loam is a brown loam or heavy loam, having a faint reddish to greenish cast. Beginning at a depth of about 10 to 14 inches, the subsoil consists of a greenish-brown, moderately friable clay loam or clay to friable sandy clay loam. Frequently in the lower portion of the 3-foot section the material is coarser than that of the upper subsoil, but this is not always the case, as this lower material may be a rather plastic sticky clay. In this lower part the characteristic color is decidedly greenish (greenish brown to green) with faint reddish mottling in places.

Frequently quartz gravel from one-half inch to 2 inches in diameter is distributed over the surface. Gravel is very seldom found in the subsoil, and in many cases the type is gravel free. In any case the quantity of gravel contained is not sufficient to warrant the separation of a gravelly type, and never enough to change materially the value of the type. The Collington loam seems to be slightly more difficult to handle and keep from clodding than the Sassafras loam. However, where the organic-matter content has been increased by the use of manure and the plowing under of green crops a good tilth is maintained.

The Collington loam is confined to the section of the area in which the greensand or marl beds come to or near the surface. These beds occupy a belt running in a southwesterly direction whose northern boundary runs from the Highlands of Navesink to Tennent and whose southern boundary extends from the Manasquan River south of Freehold in an irregular line northeastward to the neighborhood of Pine

Brook, and thence to West Long Branch. The principal developments occur in the neighborhood of Oceanport, Tinton Falls, Bradevelt, Wickatunk, and Holmdel.

The topography is generally level to gently undulating. In some sections, as in the neighborhood of Holmdel, erosion has developed ravinelike drainage ways. The surface of the land, however, has been protected as much as possible, so that the areas are not badly dissected.

On account of the rather impervious subsoil frequently found, artificial drainage may be beneficial, especially in depressed areas.

This is one of the best soils of the area, being used successfully for the production of potatoes, corn, grass, clover, and alfalfa. Some wheat is grown, though on a smaller acreage than formerly. Yields of 60 to 100 bushels of shelled corn, from 75 to 100 barrels of American Giant potatoes, and 60 to 80 barrels of Irish Cobbler potatoes per acre are normally obtained. In favorable seasons the yield of hay ranges from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  tons per acre. Alfalfa where grown has given good yields.

It is the custom on this soil, as on the other potato soils of the area where a rotation is used, to apply lime to the land when the grain or grass crop is to be seeded in the fall, in this way keeping the effects of the sweetened condition, which favors the growth of scab, as far removed as possible, in point of time, from the potato crop. Corn follows the seeding and potatoes follow corn. Potatoes receive liberal applications of fertilizer. The American Giant probably occupies 90 per cent of the potato acreage. Potatoes are often grown continuously for two or three years. In this case, with the removal of each crop the land is planted to crimson clover, rye, wheat, or rye and vetch, which are plowed down early in the spring. In this way the organic supply of the soil is kept up and the heavy yield maintained.

Very little stock raising is carried on on the Collington loam, most of the type being planted to the general farm crops mentioned above.

The value of the type is less dependent on location than in case of any other soil in the area, except the Sassafra loam. All of it has a recognized high value, and is held at prices which to the outsider seem unreasonable, but considering the yields which are produced year after year the value set on the land is not above its real worth. From \$150 to \$250 an acre, with improvements, is the ordinary range in price. On this land the buildings are usually of good size and in good repair.

#### COLLINGTON CLAY LOAM.

The color of the surface soil of the Collington clay loam varies from brown or greenish brown to dark green, while the subsoil varies from brownish green to yellowish green or bright green. The type consists of a clay loam, underlain at a depth of about 5 or 6 inches by

clay, which when wet is plastic and sticky and when dry is only moderately friable. This material usually extends to a depth of 36 inches without much change except in intensity of the greenish color. In places the immediate surface soil is more nearly a loam than a clay loam, but typically the clay is sufficiently near the surface to be turned up in plowing, thus bringing about a clay loam texture. The soil is more difficult to work than the Collington loam, being inclined to clod and bake. When the clay is turned to the surface, upon drying it becomes compact, hard, and lumpy, giving rise to an undesirable tilth. Unfavorable structural conditions also follow if the soil is plowed when too wet or if it is allowed to become very dry before plowing begins.

Small quartz gravel up to about 2 inches in diameter is scattered over the surface of some areas, but seldom is there any gravel found in the subsoil.

The Collington clay loam is confined to the areas where the greensand marl beds occur. The principal areas are found in the section north of Eatontown and south of Freehold. A number of small patches are mapped with other soils.

The surface of the type is undulating or level to very gently sloping, the latter condition prevailing where it lies close to streams.

The type is best adapted to general farm crops, such as hay, corn, and grain. When associated with the loam type it is usually planted to the same crops. It is, however, recognized that it is not a potato or intensive-farming type and when practicable it is avoided in growing such crops. Artificial drainage, liming, and the introduction of organic matter are recommended for the improvement of the type. Owing to its high content of greensand, it is probably one of the richest soils in the area, but on account of its textural and structural composition it is one of the most difficult to handle. It usually occupies but a small part of a farm.

#### COLTS NECK SERIES.

The soils of the Colts Neck series are characterized by the brownish-red to dark-red color of the surface material and by the bright-red to deep-red color and friable to moderately friable structure of the subsoil. Usually the color resembles that of iron rust, particularly in the lower part of the subsoil, and in some areas this color is quite pronounced. These soils typically occupy undulating to gently rolling areas, are well drained, and are easily tilled. In some respects the Colts Neck soils resemble the Greenville soils of the southern Coastal Plain, yet they differ in having the tendency to the color of iron rust and apparently in being somewhat less productive. Greenish material is noticeable in the lower subsoil in places. The soils of this series are probably closely related to the Collington soils, into

which they frequently grade. The types of this series mapped in the Freehold area are the gravelly sand, loamy sand, sandy loam, fine sandy loam, and loam.

COLTS NECK GRAVELLY SAND.

The Highlands of Navesink and various isolated hills in different parts of the area are capped with grayish to reddish gravelly sandy soil which has been classed as Colts Neck gravelly sand. The typical soil is a grayish to red or dull-red sand to loamy sand which passes below into red loamy sand having rusty iron stains and a rather compact structure. This compact structure appears to be the result of cementing by iron, at least in places. Small quartz pebbles are present in sufficient quantity to give a decidedly gravelly character to the body of the soil. Gravel is more abundant on the crests of ridges and tops of knolls. There are also present some sandstone and conglomerate fragments in the soil and substratum. There are included variations not deemed of sufficient importance for description.

This soil is inclined to be droughty, and this, with its unfavorable location at the higher elevations, has prevented its use for farming. In one or two places peach orchards have been set out and appear to be giving satisfactory returns. The greater part of the type is covered with oak and chestnut.

The value of the type as an agricultural soil is extremely low, probably as low as that of any type in the area, with the exception of some tracts of the Lakewood sand. In those parts of the area where the type is of no use for summer residences its value probably does not exceed \$20 an acre, being governed by its use as a source of stone.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Colts Neck gravelly sand.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
170426.....	Soil.....	5.3	24.7	18.0	11.3	7.0	23.6	10.1
170427.....	Subsoil.....	9.4	30.1	22.1	10.2	4.3	15.8	7.8

COLTS NECK LOAMY SAND.

Typically the surface soil of the Colts Neck loamy sand is a dark-red to brownish-red loamy sand with a depth of 5 or 6 inches. The subsoil is a bright-red loamy sand carrying a little more clay than the surface soil and consequently having a somewhat loamy character. This may extend through the 3-foot section without much change,

or the lower portion may have an iron-rust or limonite color. The brownish color of the surface is due very largely to the organic matter which it contains. Occasionally a stratum of a slightly lighter colored material is reached at a depth of about 3 feet.

A lighter colored phase consists of brown to reddish-brown loamy sand, underlain at about 10 to 14 inches by dull-red or yellowish-red loamy sand. There does not seem to be much difference between the agricultural value of this phase and that of the typical soil.

Also there are a few small areas of another soil (not yet recognized as a distinct series owing to the small development) occupying terrace positions on Swimming River. This is a brown to dark-brown loamy sand underlain by reddish-yellow loamy sand or coarse sand.

The typical Colts Neck loamy sand is most extensively developed in the vicinity of Montrose and Lincroft. Smaller, scattered bodies occur. The type has a nearly level to gently undulating surface. The larger areas cover rather low ridges and slope gently to the streams. The drainage is in all cases adequate, and in some of the higher lying areas it is inclined to be excessive.

The natural timber growth is mostly oak, with some chestnut. Sassafras and locust spring up in abandoned fields.

The Colts Neck loamy sand may be cultivated at practically any time. On account of its light texture there is no danger of puddling after the frost is out of the ground. For this reason it is one of the best early truck soils in the area. Fertilization, especially where organic material is applied, is markedly beneficial. Lime gives good results. Green-manure crops, and especially winter cover crops, are valuable. The soil has a tendency to drift where left exposed during the winter.

Watermelons, cantaloupes, tomatoes, sweet potatoes, and especially asparagus are among the satisfactory crops. Sweet corn can also be grown. In a few instances fairly good alfalfa was seen growing on this soil. Cowpeas and soy beans also succeed. Peaches do exceptionally well on this type of the "red lands." The value of the land varies considerably, but ordinarily prices are about \$100 an acre.

#### COLTS NECK SANDY LOAM.

The Colts Neck sandy loam differs from any other sandy loam of the area in that the typical soil has a pronounced reddish color. It consists of a brownish-red loamy sand to sandy loam, underlain at about 8 to 15 inches by red, moderately friable, sandy clay. Frequently the lower subsoil is lighter in content of sand and has more of the color of iron rust. In isolated areas there may be a relatively large quantity of fragments of ferruginous rock.

A lighter colored phase is included with the type as mapped, occurring in the neighborhood of Middletown, Crawfords Corner,

Hillsdale, and in other places. This soil differs from the typical soil chiefly in having more the color of iron rust; that is, a yellowish color in the surface soil and a yellowish-red color in the subsoil.

This type, like the other Colts Neck soils, is locally called "red land."

On account of the rather porous structure of the soil and the slightly coarser substratum excellent drainage is found in all the type. In some parts of the type this is very favorable during wet seasons, but during times of drought it is disadvantageous.

The Colts Neck sandy loam has its greatest development in the section to the northeast of Freehold. The areas form a relatively narrow broken band. Small and isolated areas lie in other parts of the survey. This is distinctly an upland soil and, considering its heavy texture, one of the best aerated and best drained soils in the area. It has a comparatively level surface. The general elevation of the areas on Colts Neck is about 100 feet, and that of certain isolated areas is much more. The hill at Hillsdale reaches nearly 200 feet.

The Colts Neck sandy loam is more subject to erosion than most of the other soils of the area. The type appears to be mainly derived from materials of or closely associated with the Red Bank formation.

This soil is utilized for a comparatively large number of crops, among which potatoes, corn, tomatoes, asparagus, wheat, melons, sweet corn, general truck crops, and grasses are important. Under favorable moisture conditions and with careful management this is a fairly good general farming and truck soil. Asparagus is said to have a greater tendency to "rust" on this type than on other soils in the area.

The type sells for \$75 to \$150 an acre, depending on location and the care which has been given the land.

*Colts Neck sandy loam, eroded phase.*—The Colts Neck sandy loam, eroded phase, is a variable soil comprising sandy and eroded clay areas, occurring in intricate association. The portion which is considered most representative of the area mapped consists of a rusty-red or limonite-colored sandy loam underlain at depths varying from 1 to 10 inches by red sandy clay loam to sandy clay. There are many places where the subsoil is yellowish and yellowish red or reddish yellow; in other words, there are many included areas of other soils which could not be satisfactorily mapped. In some instances a substratum of loamy sand occurs. Small reddish or rusty iron-ore fragments are present in many places and these give the soil the local name of "shell land."

The Colts Neck sandy loam, eroded phase, occurs principally in the southwestern part of the area. Its largest extent is on slopes and in

eroded sections, where Sassafras soils occupy the more level areas. It is invariably gently to steeply sloping and occurs in positions intermediate between the upland and the lowland.

On account of the sloping topography and the rather porous nature of the soil the drainage is good throughout the phase. In time of little rainfall the soil is likely to be droughty.

This phase is used for practically the same crops as the adjoining upland soils, potatoes, wheat, grass, lima beans, and corn being grown. The difference in yields is noticeable, returns being lower on the phase. Greater care should be taken to prevent the washing of the surface soil.

The value of the phase is materially less than that of the Sassafras loam, to which it is so closely allied. From \$75 to \$125 an acre is about the range in price. This relatively high value is due in part to the favorable location of the areas of the phase as regards markets and means of transportation.

By using stable manure in connection with green manure and checking erosion this soil can be greatly improved and brought more nearly to the value of the surrounding soils.

#### COLTS NECK FINE SANDY LOAM.

The Colts Neck fine sandy loam consists of a reddish-brown or iron rust colored fine sandy loam, underlain at 6 inches by reddish-brown to red fine sandy loam, which passes below into a compact red sandy clay. Varying quantities of angular reddish-brown sandstone fragments are encountered in some areas, though this is not an invariable characteristic of the type.

This soil occurs principally in the northeastern part of the area. The topography is gently rolling to rolling, affording good drainage.

Much of the Colts Neck fine sandy loam is forested. It is one of the least important types of the series. It has practically the same crop adaptations as the Colts Neck loam, although the yields are slightly lighter than on the heavier soils.

#### COLTS NECK LOAM.

The soil of the Colts Neck loam consists of a red or brownish-red loam, having a depth of 7 or 8 inches. The subsoil is a deep-red friable sandy clay loam to sandy clay. In the lower subsoil, usually below 30 inches, the structure becomes more porous and the color is frequently a reddish brown or a yellowish red. In some localities there is a considerable admixture of angular fragments of reddish ferruginous rock. This can hardly be considered a type characteristic, though it is found in many areas, especially in those of higher elevation lying in the north-central part of the area.

A lighter colored phase occurs in the vicinity of Hillsdale, to the south and west of Middletown, and on Rumson Neck. This is a rusty-brown to reddish-brown loam, underlain at about 8 to 10 inches by dull-red sandy clay loam which quickly grades into moderately friable sandy clay. Fragments of ferruginous rocks are common in the deeper subsoil and are present to a less extent on the surface and through the soil section. In places the lower subsoil is coarser and more porous than the upper subsoil.

The drainage of the Colts Neck loam is usually good, the topography and elevation favoring a ready run-off of excess water. The subsoil is slightly impervious and retards the loss of moisture by percolation.

Practically all this type is under cultivation. It is considered one of the best soils in the area and is adapted to a wide variety of general crops. If plowed at the proper time good tilth results. Potatoes are produced successfully in the vicinity of Colts Neck. Alfalfa, timothy, clover, corn, and wheat all give good yields. In some sections peaches are grown, especially on areas lying at higher elevations. Apples also do well.

There is probably no farm made up entirely of this type. It is ordinarily held at slightly lower prices than the Sassafras or Collington loams. However, some areas could not be bought at present for less than \$250 an acre.

Mechanical analyses of samples of the soil and subsoil gave the following results:

*Mechanical analyses of Colts Neck loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
170431.....	Soil.....	1.7	10.0	13.4	16.2	10.4	26.5	22.1
170432.....	Subsoil.....	2.4	11.0	15.0	16.8	8.4	24.6	21.9

#### LAKESWOOD SERIES.

The types included in the Lakewood series are characterized by the white color of the surface soil and the orange or golden-yellow color of the subsoil. The surface material resembles that of the Leon soils, while the subsoil resembles the subsoil of the Sassafras series. The soils occupy rolling to nearly level areas and the drainage is well established except in some of the lower situations. They are derived mainly from the Tertiary sand formations, with some admixture of material from the later Pleistocene gravel beds. Some areas, however, occur on belts of Cretaceous sand. The native growth consists chiefly of scrub oak, scrub pine, and huckleberry.

There is a large development of these soils in southern New Jersey. They are sometimes spoken of as "the barrens." The Lakewood sand, gravelly sandy loam, and fine sand are recognized in this area.

#### LAKWOOD SAND.

The soil of the Lakewood sand consists of a light-gray or white loose sand to depths varying from 6 to 24 inches. In places the presence of organic matter gives the surface 2 or 3 inches a dark-gray appearance. The subsoil is a yellow or golden-yellow sand which is often uniform to considerable depths. In some places there is a rather compact, though unconsolidated, yellowish-brown hardpanlike stratum occurring at varying depths, usually below 15 to 20 inches. Below 24 inches a stratum of gravelly sand is encountered in some places. A few included areas have a somewhat loamy sand subsoil. There are also, especially in the largest area, that in the Hominy Hills section, included patches of Lakewood fine sand, coarse sand, and gravelly sand, which were too small to map separately.

The Lakewood sand is confined chiefly to the southeastern part of the survey. It also occurs in the north-central part around Centerville and to the south of Keyport. The topography is level to gently rolling, except in the Hominy Hills, where it is quite rolling. Even here little erosion has taken place, as the soil is so porous that rain water is readily absorbed.

Except in the section south of Keansburg little of the type is cleared and farmed. Where it is under cultivation, Kieffer pears, dewberries, blackberries, and some asparagus are produced. The yields are generally fair. The Lakewood sand has been found to be particularly adapted to the Kittatinny blackberry. In general it is one of the poorest soils in the area surveyed. A sparse growth of scrub oak and pine, with little undergrowth, is indicative of poor moisture conditions. In the northern areas the growth of oak is somewhat better.

Land of this type ordinarily ranges in value from \$3 to \$10 an acre, but in some sections in the northern part of the survey the value is considerably higher.

#### LAKWOOD GRAVELLY SANDY LOAM.

The Lakewood gravelly sandy loam is a gray to dark-gray loamy fine sand to light fine sandy loam, with a depth of about 6 inches, resting on a yellow or golden-yellow fine sandy loam to fine sandy clay subsoil. The change from soil to subsoil is abrupt. Quartz gravel is present over the surface and through the soil body of much of this type. The quantity is variable, but over most of the soil it is

sufficient to interfere somewhat with cultivation, and in some localities it forms a large percentage of the soil mass. The subsoil of some included areas is not heavier than a loamy fine sand.

This type is found in two parts of the area, the northwestern part, where the elevation is usually rather low and the soil gravelly, and the southeastern part, where the topography is sloping to gently rolling. The drainage is in general fair to good, though in a few cases artificial drainage is necessary. In the areas in the northwestern part of the survey this soil is rather difficult to cultivate and handle properly on account of its fine texture and dense, retentive subsoil.

The soil after becoming saturated runs together and bakes unless stirred very soon after rains. The gravel content unfits this type for some crops, asparagus for instance, and also adds to the difficulty of tillage in the growing of small truck crops. The less gravelly areas comprise fairly good truck land, capable of producing, with liberal fertilization, such crops as sweet corn, tomatoes, peppers, and potatoes. Among the general farm crops oats, wheat, grass, and corn are grown.

Large tracts of this type are still in forest, which consists principally of oak, pine, scrub oak, huckleberries, ferns, etc. The forest growth is relatively small.

#### LAKWOOD FINE SAND.

The surface soil of the Lakewood fine sand consists of a light-gray or whitish loose fine sand, usually about 6 inches deep. This is underlain by a yellow or orange-yellow fine sand, practically the same as the soil in color and structure, although a little more compact. At varying depths a more compact layer, somewhat resembling hardpan and having a brownish color, is found in the subsoil of some areas. This hardpan stratum is more likely to be developed in low-lying areas.

Areas of Lakewood fine sand are confined to the southeastern part of the survey. It is developed to the greatest extent in the vicinity of Green Grove and to the west, southwest, north, and east of this place. The topography here is level to gently undulating. The drainage ways, which, with the exception of the Manasquan and Shark Rivers, are not large, are yet of sufficient size properly to drain all the type. In some areas, although the surface is loose and porous, artificial drainage may be beneficial because of the low position. By far the greater part of this type, however, is rolling enough to allow the ready escape of excess water.

This type is easily cultivated at practically any time, except in places where the subsoil is in a saturated condition. Only a small part of it is under cultivation, the larger part being wooded. The native

vegetation comprises scrub oak and pine, with an undergrowth of ferns, smilax, brambles, and huckleberry. Where farmed the soil is used primarily for trucking. It responds readily to the application of manure and fertilizers, giving good crops of truck if the season is not abnormally dry. Crops produced are usually such as meet with a ready sale in the Asbury Park and Ocean Grove markets. These include snap beans, lima beans, tomatoes, sweet corn, eggplant, squash, turnips, peas, spinach, peppers, asparagus, beets, cabbage, cucumbers, lettuce, watermelons, cantaloupes, strawberries, blackberries, dewberries, and currants.

This is not a general farming soil and heavy crops can hardly be grown successfully on it. Corn is a possible exception, as it, when properly manured, gives fair yields. Grass and pasturage soon run out. Potatoes give light yields and unless early markets are sought can not be produced in competition with the heavier soils.

The location of the areas of this soil has a marked influence on its value. Some isolated areas are held as low as \$10 an acre, while in other parts of the survey with good roads and easy access to Asbury Park as much as \$150 an acre may be asked.

#### SHREWSBURY SERIES.

The Shrewsbury series is characterized by the gray to grayish-brown or light-brown color of the surface material and by the mottled gray and yellow to mottled reddish-drab, yellow, and greenish-yellow color of the subsoil. The characteristic subsoil material is a rather plastic clay or sandy clay, which, however, sometimes becomes lighter textured in the lower portion. The lighter textured material where present in the subsoil has a rather wide range in color from orange yellow through greenish yellow to red. These soils occupy relatively low areas or slight depressions, in which the drainage is imperfectly established, particularly in case of the heavier members. The surface portion of the sandy types may be well drained, but usually the lower subsoil remains wet or soggy. The Shrewsbury types mapped in the Freehold area are the fine sandy loam, sandy loam, loam, and silt loam.

#### SHREWSBURY FINE SANDY LOAM.

The soil of the Shrewsbury fine sandy loam is a grayish-brown loamy fine sand to brown heavy fine sandy loam, underlain at about 6 to 10 inches by yellow or pale-yellow fine sandy clay loam, and at about 15 to 20 inches either by heavy fine sandy loam of a greenish-yellow color, becoming lighter textured below, or by mottled drab and yellow fine sandy clay. Quartz pebbles are present in some areas. The subsoil carries considerable quantities of small mica flakes and is frequently poorly drained.

The type is confined largely to a relatively narrow, irregular band. The more important areas lie in the neighborhood of Tennent, Gordons Corner, and Robertsville. The topography varies from level to very gently rolling. On the lower, more nearly level areas artificial drainage may be necessary for the best development of the type. Elsewhere the drainage is good.

Where properly drained this soil is easily cultivated, and when a good tilth is obtained early in the season little difficulty is experienced in maintaining it later. When neglected, especially in the heavier areas, there is a slight tendency to bake and form clods.

The greater part of this type is under cultivation, the remainder being forested with oak and chestnut. Both general farming and trucking are practiced. Potatoes are grown with good success, giving yields of 60 to 85 barrels per acre of the American Giant, where heavily fertilized. Other varieties give yields of 50 to 65 barrels per acre. Wheat is grown to some extent, yielding about 20 bushels per acre. Corn is another successful general farm crop. Grass, while grown with fair success, runs out sooner on this type than on heavier soils. Among the truck crops grown are peppers, cucumbers, cantaloupes, watermelons, and tomatoes. Potatoes and corn, however, are the most important crops on this type.

In the more undulating areas peach and apple orchards are found. From statements of the growers apples are especially successful. Fruit of good color and quality is produced. The value of this soil ranges from \$75 to \$175 an acre.

Average results of mechanical analyses of samples of the soil and subsoil follow:

*Mechanical analyses of Shrewsbury fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
170422, 170485.....	Soil.....	0.1	1.5	6.9	58.3	14.5	11.5	7.2
170423, 190486.....	Subsoil.....	.1	.5	4.0	53.8	13.6	16.9	10.9

SHREWSBURY SANDY LOAM.

The Shrewsbury sandy loam is a light-brown to brown loamy sand to sandy loam, underlain typically between 8 and 12 inches by mottled gray or drab and yellow to reddish and yellow sandy loam, which passes below into mottled yellowish-red and drab or bluish plastic clay. The lower subsoil of some areas has a pronounced greenish cast and lighter texture than the upper subsoil. There is considerable color and textural variation in the subsoil. Some of the included areas do not have the plastic clay within the 3-foot section

but have a rather loamy sand or coarse sand in the subsoil to a depth of 3 feet or more.

In the northern part of the area a soil which has a texture varying from a sandy loam to a sandy clay and a predominating black or very dark brown color with small reddish and yellowish patches has been mapped with the Shrewsbury sandy loam. The subsoil, like the soil, is variable, consisting of a sandy loam to a sandy clay and having a mottled yellow and red or gray color. The subsoil is usually quite moist; in places it is saturated at the lower depths. The reddish and yellow spots are of relatively small extent and are scattered throughout the development of this variation.

The type occurs in various parts of the survey, particularly in the eastern section. It occupies nearly level, low areas. While the drainage of the surface portion is usually sufficient for the production of good crops of corn and grain, the subsoil or the lower subsoil is quite frequently saturated or sticky for all or most of the year. The drainage of the type is better established than that of the heavier members of the Shrewsbury series.

Most of the Shrewsbury sandy loam is cleared and used for farming. The more poorly drained tracts are utilized for the production of hay and for pasturage. When properly drained, good crops of corn are produced. Corn grows slowly in the early part of the season, but rapidly later in the summer, after the soil has become thoroughly warmed. During dry seasons good crops of potatoes can be produced. The soil is also used in growing tomatoes. Small grains can also be grown with success. Strawberries do not do as well as on the Keansburg soils.

Those areas of dark-colored soil including small patches of reddish and yellowish soil, mapped in the northern part of the area, are used in the production of truck crops. On account of the slightly lower position of these areas the soil is later than much of the higher lying sandy loams of the area, but during dry periods which occur in summer this position is really an advantage. Good crops of sweet corn, strawberries, tomatoes, and peppers are produced on this phase.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Shrewsbury sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
170424.....	Soil.....	0.3	5.4	26.9	41.7	4.4	12.3	8.9
170425.....	Subsoil.....	.6	5.2	30.5	42.6	2.6	10.5	7.9

## SHREWSBURY LOAM.

The surface soil of the Shrewsbury loam is a light-brown loam, which when dry has a decidedly gray color on the surface. Underlying this at a depth usually of 6 to 10 inches is encountered a mottled gray and drab or yellow, reddish, and grayish clay loam, which quickly passes below into mottled drab, reddish, and yellow plastic clay. The lower part of the subsoil section is in places lighter textured and more friable than the upper part, the former stratum consisting of loamy sand to sandy loam of a mottled reddish-brown, rusty reddish brown, and greenish color.

The Shrewsbury loam occurs in small areas, usually in slight depressions, in various parts of the survey, but especially in the neighborhood of the Shrewsbury River. Drainage, which is inadequate, is improved by open ditches supplemented by tile drains.

Practically all of the type is cleared and cultivated. At the present time it is utilized almost entirely for the growing of hay and pasturage. Small grains are also grown. Some corn is produced, and this crop does better on this soil than on the later, colder Shrewsbury silt loam. With drainage and the application of lime, the structure of the type is materially improved.

Because of favorable location the price of land of this type is relatively high.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the Shrewsbury loam:

*Mechanical analyses of Shrewsbury loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
170433.....	Soil.....	0.4	4.4	10.6	12.8	11.2	50.8	9.7
170434.....	Subsoil.....	1.2	6.5	16.2	18.7	8.9	34.9	13.7

## SHREWSBURY SILT LOAM.

The Shrewsbury silt loam is a grayish-brown to gray or drab silt loam to silty clay loam, underlain at about 8 to 10 inches either by yellow silty clay loam which passes quickly into plastic silty clay of a mottled yellowish and greenish color or by mottled yellow and drab silty clay loam, which in turn passes below into plastic clay, mottled yellow or reddish yellow and greenish in color. In places sandy clay of a green or olive-green color is reached at a depth of about 28 inches. This clay contains some minute flakes of mica.

The Shrewsbury silt loam attains its best development within a few miles of the water front, especially in the rather low parts of the necks, located back from the protecting sand beaches and adjacent to the tidal marshes bordering the estuaries of the area.

The type occupies slight depressions which are poorly drained in wet seasons, unless tiled or ditched. The subsoil is usually sticky or nearly saturated. At greater distances from the shore some areas lie at slightly higher elevations.

Practically all of the Shrewsbury silt loam is cleared. Forested areas support a mixed growth of various deciduous trees. Much white oak is found on this soil, and it is called locally "white-oak land."

Though the greater part of this type is cleared, comparatively little of it is under a cropping or rotation system. This is because the soil is inclined to run together when saturated, and is very difficult to handle, puddling badly if worked when too moist and breaking up into clods if too dry. Most crops, especially corn, are likely to get a poor start, and while they make good growth late in the season, will not produce a full yield. Grass, especially timothy, is the principal crop grown on this land, although some wheat and corn are produced. Clover and legumes do not thrive. Late tomatoes are grown successfully in some sections. The type makes good pasture land where care is taken not to allow stock to trample it when in a saturated condition. It is generally accepted that the production of grass is the best utilization of this soil.

Results of mechanical analyses of samples of the soil and subsoil follow:

*Mechanical analyses of Shrewsbury silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
170439.....	Soil.....	0.4	1.6	3.3	4.1	14.4	62.9	13.2
170440.....	Subsoil.....	.4	1.0	1.7	2.2	10.2	61.5	23.0

KEANSBURG SERIES.

The soils included in the Keansburg series have dark-gray to black surface soils and mottled gray, drab, yellowish, and frequently reddish colored subsoils. Greenish material is frequently noticeable in the subsoil. These soils occupy poorly drained depressed areas, in the northern part of the Coastal Plain and have a high content of organic matter. Four types of this series are encountered in the present survey, the sand, sandy loam, fine sandy loam, and loam.

## KEANSBURG SAND.

The soil of the Keansburg sand is characteristically a black or dark-gray loamy sand carrying a high percentage of organic matter and having a depth of 8 to 15 inches. The subsoil is a porous, white or gray sand, frequently containing greenish material. In places at depths of about 24 to 30 inches a compact dark-brown or blackish hardpan stratum is found. The thickness of this layer varies considerably, but it is usually about 3 or 4 inches. It gradually changes to a yellow or golden-yellow sand below.

The Keansburg sand occurs as small depressed areas in various parts of the survey, but has its greatest development around Hockhockson Swamp and in the north-central part of the area. It is naturally poorly drained. Practically all the type in the northern part has been cleared and drained, and is utilized at the present time for the production of truck crops. The type is somewhat later than the sand and loamy sand of the Sassafras series, with which it is associated. When properly drained excellent crops of strawberries, corn, and tomatoes are produced.

## KEANSBURG SANDY LOAM.

The surface soil of the Keansburg sandy loam typically consists of a black sandy loam with a depth of 8 to 10 inches. The subsoil, although varying considerably in color and texture, is in most cases a dark-gray loamy sand or sandy clay, which passes below into mottled drab and yellowish sandy clay. The lower part of the subsoil is frequently lighter in texture and shows the presence of considerable greenish, yellowish, and bluish material. As mapped there are small included areas of the other members of the Keansburg series.

Areas mapped as Keansburg sandy loam are scattered widely over the northern half of the survey. They occupy low, poorly drained situations.

A part of the area of this soil is covered with birches, elder, and other water-loving plants, including a variety of grasses. Where drained the soil is used for the production of corn, tomatoes, grass, late truck crops, and potatoes. This last crop does better in dry than in wet seasons. The grasses make an excellent growth, and at the present time the greater part of the type is utilized for pastures.

## KEANSBURG FINE SANDY LOAM.

The Keansburg fine sandy loam typically is a dark-gray to black fine sandy loam or loamy fine sand, underlain at depths of 5 to 10 inches by grayish fine sandy loam, frequently mottled with yellow. The lower subsoil is orange yellow to greenish yellow in color and of

a fine sand or loamy fine sand texture. In places there is a compact, impervious hardpan layer at about 15 to 24 inches. This layer varies in thickness, and usually at lower depths grades into a yellow or golden-yellow sand or loamy sand. The lower subsoil is always saturated.

The Keansburg fine sandy loam is one of the more extensive members of the series. It occurs as low-lying depressions, usually along drainage ways and in areas subject to the influence of seepage waters. This type is mapped in various parts of the area, but particularly in the southeastern part, where it is principally associated with the light-gray or white soils of the Lakewood series.

In this section very little of the type is used for farming, and the greater part is covered with a growth of deciduous trees and a more or less dense undergrowth of bushes, shrubs, and smaller plants, among them gallberry. On account of its poor drainage and the lack of other arable land in the vicinity, little attention has been given to this soil. Grass yields heavily on drained areas.

In its undeveloped condition this land has a relatively low value, seldom bringing more than \$40 an acre. Areas under cultivation command a much higher price.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Keansburg fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
170461.....	Soil.....	1.7	8.5	12.6	32.4	26.4	12.4	5.8
170462.....	Subsoil.....	1.9	12.0	16.4	35.0	25.4	5.3	4.0

KEANSBURG LOAM.

The Keansburg loam consists of a black loam, underlain at about 10 to 15 inches by mottled gray and yellowish loamy sand, which passes below into yellow loamy sand or sand having in many places green mottling in varying degrees. In some places the texture of the soil approximates a heavy fine sandy loam or sandy loam, but generally it is a distinct loam. Occasionally the sub-surface consists of a brownish loam. The type represents areas in which drainage has been so deficient as to favor the accumulation of organic matter and in some parts of the survey this soil has a decidedly peaty structure, the organic content being so high as almost to make it a Peat or Muok.

The Keansburg loam occurs almost entirely in the northern part of the area in the vicinity of Keyport. It lies in depressions but a few feet below the surrounding country. It is practically all cleared and utilized for farming. Drainage is necessary to bring the soil under cultivation. Though of small extent this is a productive soil. It is utilized for the growing of corn, grass, potatoes, and late truck. Good celery, cabbage, and onions could doubtless be produced on it.

#### KEYPORT SERIES.

The soils of the Keyport series are characterized by the grayish-brown to brown color of the surface material, by the yellow color and friable structure of the upper subsoil, and by the drab or mottled drab and yellowish color and plastic structure of the lower subsoil. The soils typically are well drained in spite of the apparent imperviousness of the tough lower subsoil. These soils characteristically occupy relatively low situations in the Coastal Plain. Much of the surface is undulating to nearly level. In the Freehold area the Keyport loam, clay loam, sandy loam, and fine sandy loam are mapped.

#### KEYPORT LOAM.

The soil of the Keyport loam is a grayish-brown loam, underlain at a depth of 8 to 12 inches by pale-yellow moderately friable clay loam, which passes at 15 to 24 inches into mottled drab and yellow or drab plastic clay. Some quartz gravel is present on the surface in places.

Areas of Keyport loam occur in the northwestern part of the survey, especially near Matawan.

The topography of this soil ranges in general from gently sloping to almost level. A small area is steep and broken. On account of the favorable surface configuration in most places drainage is usually good. In the more level areas, however, tile drains would be beneficial.

This type has a comparatively small extent. Where found it is considered a good general farming soil, and practically all of it is under cultivation. Wheat, grass, and corn are the principal crops. Some truck crops, principally peppers and tomatoes, are grown, the produce going mainly to the New York market but to some extent to the canning factories at Matawan and Morganville. This is one of the better corn soils of the area. Potatoes do not do especially well, on account of the impervious nature of the subsoil, which tends to hold water in the soil too long during wet seasons.

Land of this type of soil is purchasable at prices ranging from \$100 to \$150 an acre.

## KEYPORT CLAY LOAM.

The Keyport clay loam is a grayish-brown heavy loam to silty clay loam, underlain at about 4 to 6 inches by pale-yellow, moderately friable silty clay which, in turn, is underlain at about 18 to 20 inches by mottled drab and yellowish plastic clay. Ordinarily deep plowing will turn sufficient clay to the surface to bring the texture of the soil to that of a clay loam. Scattered over the surface and through the soil small iron concretions or iron gravel are frequently found.

The Keyport clay loam, though of relatively small extent, is the most important type of this series. It occurs in the northwestern part of the area, in the section northwest of Matawan, where it covers an irregular but comparatively compact tract of level to gently undulating country. It is an upland soil, but on account of its heavy surface soil and compact, impervious subsoil, some areas are in need of drainage and aeration.

Practically all the type is cleared and utilized for general farm crops, tomatoes, and peppers. Crops are likely to suffer from drought unless extreme care is taken to keep the land in good tilth. During dry periods the soil cracks, and when once saturated in the early spring it retains the moisture for a long period, making it impossible to work the land until late. Corn grows on this soil with fair success, as do late tomatoes. Peppers are planted on a small acreage. Some fruits are produced. Only a few farms consist entirely of this type. In many instances, however, it forms the main general-farming soil, being supplemented by lighter soils suitable for truck growing.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Keyport clay loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
170471.....	Soil.....	0.6	1.0	1.6	11.4	29.4	42.4	13.6
170472.....	Subsoil.....	.6	1.4	1.9	11.1	18.3	38.7	27.7

## KEYPORT SANDY LOAM.

The Keyport sandy loam is a grayish loamy fine sand to sandy loam, underlain at about 8 inches by yellow sandy loam and at about 18 inches by greenish-yellow fine sandy clay. Below a depth of about 26 inches there occurs a mottled yellow or grayish-yellow and drab plastic clay, which becomes in the lower part of nearly uniform drab color. The type has good drainage.

The Keyport sandy loam occurs exclusively in the northwestern third of the area. Very little of it occurs as rolling land. The areas

are not extensive, the largest lying near Morganville, Matawan, and Keyport. The native forest growth consists of several varieties of oak; it has been almost entirely removed.

The Keyport sandy loam is an easily tilled, productive soil. It is an excellent type for the production of early truck crops, and a large acreage of peppers is planted annually. The yields are equal to those on any other soil in the area. The early varieties of tomatoes also produce satisfactory crops. Melons are grown extensively, and it is probably one of the most satisfactory soils of the area for the production of asparagus. Fruits grown successfully are grapes, cane fruits, and strawberries, though the last do better on the lower moist lands of the Keansburg series. General crops, such as potatoes, corn (except sweet corn), grass, and small grains, are seldom grown.

It is recognized that this soil is low in organic matter, and it is the practice of the better farmers to apply large amounts of stable manure. It is the custom to apply nitrate of soda in varying quantities.

The value of this type varies considerably in different sections, but with the generally poor condition of farm buildings \$100 to \$140 an acre is about the average price now asked for the greater part of this land.

#### KEYPORT FINE SANDY LOAM.

The Keyport fine sandy loam is a grayish fine sandy loam, underlain at 6 to 10 inches by yellow or pale-yellow friable fine sandy clay loam, which grades below into yellow, moderately friable fine sandy clay. At 20 inches mottlings of drab appear and within a few inches plastic drab clay with a faint yellow mottling is encountered. Minute mica flakes are discernible in this material. There is present in the soil some fine quartz gravel.

The type occurs in areas of varying size in a belt crossing the area in a northeast and southwest direction with Matawan as a center. The topography favors ready surface drainage. In some cases the extremely impervious substratum retards the escape of water and, especially where the surface is relatively flat or depressed, the friable surface soil remains in a saturated, miry condition during long wet periods. This makes it a late soil, although the surface is relatively light.

A growth of oak, hickory, and chestnut is found on uncleared areas. West of Matawan most of the type is under cultivation and is utilized for the production of a number of vegetables. The general farm crops are also grown to some extent. The most common crops are tomatoes, peppers, cucumbers, melons, cane fruits, and strawberries. Potatoes do fairly well on this soil. Heavy applications of fertilizers and manure are used. Present prices for land of this type range from \$125 to \$200 an acre.

Below are given the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of this type:

*Mechanical analyses of Keyport fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
170463.....	Soil.....	0.0	2.6	21.3	56.0	8.5	7.8	3.7
170464.....	Subsoil.....	.2	2.6	19.9	52.2	6.8	9.9	8.2
170465.....	Lower sub-soil.	.0	.6	5.6	16.4	5.2	33.9	38.1

FRENEAU SERIES.

The soils included in the Freneau series are characterized by the reddish-brown color of the surface material and by the red to mottled reddish-brown, yellow, and grayish color of the subsoil. Dark-colored ferruginous material is frequently present in the subsoil. These soils occupy overflowed bottoms and consist of alluvium carrying sufficient wash from the associated red upland soils, or Colts Neck series, to impart a characteristic reddish color to the surface material. Only the loam type is mapped in this survey.

FRENEAU LOAM.

This soil of the Freneau loam consists of a dark reddish brown loam, underlain at a depth of about 10 inches by material of quite variable character, ranging in color from mottled reddish brown, rusty brown and greenish brown to limonite yellow, and in texture from clay to sandy clay, often containing dark-colored ferruginous material. In places the subsoil has a mucky nature.

This is a bottom-land soil, with a level topography. The stream beds are frequently 4 or 5 feet below the surface of the type, and the stream banks are very abrupt. During spring freshets and at other times when there has been extremely heavy rainfall these bottom lands may be inundated. Aside from these overflows the type is in need of drainage to fit it for most successful cropping.

Very little of the type is under cultivation. The greater part is used for the growing of grass for hay and pasturage. It is a very good soil for this purpose, crops of 2½ tons of hay frequently being obtained. Some corn and potatoes are also grown on well-drained areas of the type.

MISCELLANEOUS MATERIAL.

TIDAL MARSH.

Tidal marsh comprises areas of land subject to inundation by tide water. Tidal marsh passes gradually into Meadow as the head of tide water is approached and sharp boundaries between these types

are not always determinable. Much of this land is covered with cat-tails and other coarse vegetation. In such places the material has a very oozy character, and consists of bluish or dark-drab silty clay loam or silty clay matted with grass roots in the upper part. A strong odor of hydrogen sulphide is noticeable over the freshly exposed subsoil material. A considerable part of this land is covered by short marsh grass. In the better drained portions there is a larger proportion of mineral constituents, with less of the organic matter, and a lighter grayish or drab color.

Tidal marsh occurs in areas of varying size along all stream courses near tidewater. As a rule these tracts are protected from the ocean or bays by strands of beach sand. On the smaller estuaries, as along the Shrewsbury and Navesink Rivers, Tidal marsh abuts the water.

No systematic attempt has been made to reclaim this class of land by diking or ditching. Some pasturage is afforded on parts of the higher and firmer areas, but the main use made of Tidal marsh is for the production of salt hay. This is used to a small extent for coarse fodder, but largely as packing material for glass and earthenware, which is manufactured in Old Bridge and other near-by towns.

#### COASTAL BEACH.

Along the northern and eastern shores of the area there is a strip of Coastal beach of varying width between the bay and ocean waters and the upland and Tidal marsh areas. The material of these beaches consists largely of quartz sand which, because of the continual washing to which it has been subjected, is more or less rounded. The sand is predominantly rather fine. There are some dark-colored specks incorporated in the mass which on close examination are seen to be comprised of certain dark-colored minerals. These give the sands a pepper-and-salt appearance. Very little gravel or coarse material is present in these beach sands.

From Highlands to Monmouth Beach, where the Coastal beach is composed of little more than a narrow sand bar, much of the type, even though but a few feet above sea level, has been graded and included in the grounds of handsome summer residences.

Sandy Hook is the most extensive area of Coastal beach. Here there has been considerable development of sand dunes. Much of this peninsula is covered with a dense growth of red cedar, scrub oak, poison ivy, beach plum, bayberry, beach grass, wild lupine, and weeds of various sorts. The growth of this vegetation is surprisingly dense where the water table is at shallow depths. Along the greater part of the coast, however, there is very little if any vegetation, except some of the sedges, which find a foothold wherever there is opportunity. Coastal beach is nonagricultural.

## MEADOW.

The areas mapped as Meadow are low-lying wet tracts in which the soil materials are of such variable color and texture as to prevent satisfactory mapping as types. It occurs along stream courses and in depressions throughout the survey. The vegetation as a rule consists of maple, shrubs, and coarse grasses.

Most of the Meadow can not be used for agriculture until it has been properly drained. This in many cases would be too costly to warrant the undertaking. In some cases a little late summer pasturage is afforded.

## MUCK.

Closely associated with Keansburg soils, in various parts of the area, there occur areas of Muck. The soil is dark colored, usually black, and consists largely of vegetable matter. The dark-colored material usually extends to a depth of about 8 inches, where it becomes dark brown, the brown material being underlain usually at about 18 to 36 inches by gray sand or gray and drab sandy clay or clay loam.

Muck, where undrained, supports a dense growth of white cedar, birch, maple, and many other water-loving plants, especially coarse grasses. Where drained, it gives excellent yields of corn, potatoes, grass, celery, onions, cabbage, and other truck crops. In some sections such land is used successfully for cranberry bogs.

The value of this soil is variable. When cleared and otherwise improved it is worth from \$150 to \$250 an acre. In the uncleared state its value, except for the timber, is very low.

## MADELAND.

Madeland as mapped in the Freehold survey comprises small areas located for the most part along the coast where sand beaches and tidal meadows have been built up and covered with earth. In those parts of the area back from the coast where this condition is mapped it represents lands whose the surface has been changed so that there is no definite characteristic to the soil or subsoil. Many of these areas represent extensive clay pits or diggings for molding sand. Madeland has no agricultural value.

## SUMMARY.

The Freehold area is situated in the eastern part of the State of New Jersey, on the Atlantic Ocean. It embraces an area of 305 square miles, or 195,520 acres. The topography varies from level to gently undulating. The area is drained by small streams, which flow either into the bays on the northern shore or directly into the ocean.

The area is quite densely settled. The population is primarily dependent upon agriculture, although the coast reaches comprise a popular resort for summer visitors. Asbury Park is the largest town of the area.

The present agriculture is diversified, trucking, potato growing, general farming, and fruit raising being followed. All are of considerable importance. The greater part of the produce is shipped to the New York market.

Thirty-eight types of soil were mapped, including Muck, Meadow, and other miscellaneous soils. The soils vary greatly in texture and in the materials from which they are derived.

The Sassafras soils are found in various parts of the area, but particularly around Freehold and Holmdel. This series contains the largest number of types and is the most widely distributed. The agricultural value of these soils varies greatly, as do also their crop adaptations.

The Collington soils, which are characterized by the occurrence of the glauconite sand, are found in various belts crossing the area. These soils are of considerable importance in the agriculture of the area and many different crops are grown on them.

The Colts Neck series consists of red soils, especially developed in the region around Colts Neck. The lighter types of this series are inclined to be somewhat droughty. These soils are well adapted to the growing of early truck. The heavy types are used for general farming.

The Keyport series is found in the northwestern part of the area. The heavy members are good general farming soils, and those of lighter texture are used to good advantage as truck soils, especially for tomatoes and peppers.

The Lakewood soils, except under rather unusual conditions, are not developed intensively. These soils are in need of organic matter.

The black soils of the Keansburg series are found in various sections of the area. In nearly all cases these soils are in need of drainage. When well drained and sweetened by the use of lime, they should form some of the best farming land in the area.

The Shrewsbury series comprises low-lying poorly drained soils. Besides their poor drainage they are lacking in organic matter, a deficiency not usual under such conditions.

[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.]

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