SOIL SURVEY OF THE NORFOLK AREA, VIRGINIA.

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LOCATION AND BOUNDARIES OF THE AREA.

The Norfolk area includes the northern half of the Norfolk quadrangle, U. S. Geological Survey, and comprises the country between latitude 36° 45′ north and Chesapeake Bay and longitude 76° 30′ west and the Atlantic Ocean. The land surface, excluding the many small tide-water inlets, amounts to about 303 square miles. These inlets and rivers cover about 50 square miles. The area lies in the extreme southeastern part of Virginia and just at the southern extremity of Chesapeake Bay. It has a water front on James River, Hamp-

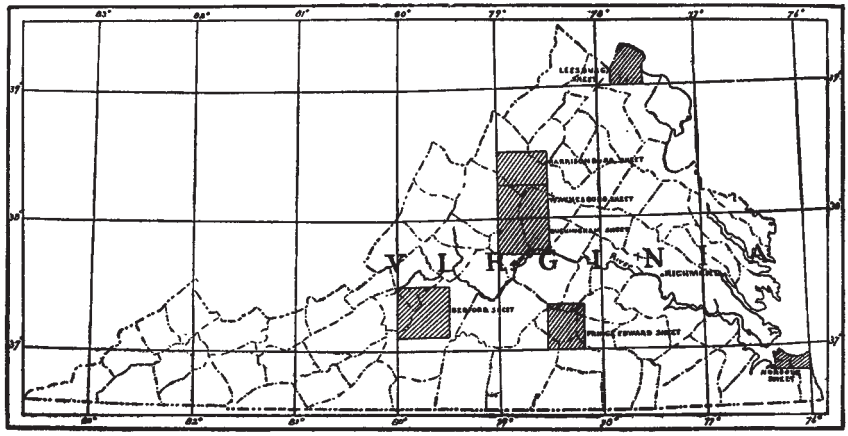

FIG. 8.—Sketch map showing location of the Norfolk area, Virginia.

ton Roads, and Chesapeake Bay of about 30 miles, and extends for 13 miles along the Atlantic Ocean. Norfolk, situated in the center of the area, is about 300 miles from New York by water and 600 miles from Boston, while the distance to Baltimore and Washington is a little less than 200 miles.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

The first settlements in the Norfolk area were made along Elizabeth River and its branches and Lynnhaven River, and communication was had almost entirely by boat. In 1634 the plantations of Virginia

were divided into shires, governed by "lieutenants," as were the shires in England. One of these original shires was Elizabeth City, extending on both sides of Hampton Roads. From this shire Upper and Lower Norfolk counties were formed. In 1691 Lower Norfolk County was divided into Norfolk and Princess Anne counties. In 1680 the building of Norfolk commenced. It was established as a town in 1705 and at that time had attracted quite a population on account of its favorable location for trade and commerce. A profitable trade was soon afterwards built up with the West Indies, flour, pork, and other Virginia products being exchanged for molasses, fruit, etc.

Norfolk and vicinity was the scene of many struggles during the Revolutionary war, and in 1775 the city was entirely destroyed. It was rebuilt, and in 1801 contained a population of 8,000. The value of exports for that year was four and a half million dollars. Three hundred and sixty-nine foreign vessels entered the harbor during the year.

Among the agricultural pursuits tobacco growing was a very important industry during the early history of the section. The first tobacco-inspection warehouse was built in 1818. Truck raising was commenced about 1844 by two or three farmers from New Jersey. An old journal relates that on May 17, 1850, 600 bushels of green pease and 500 quarts of strawberries were shipped to Baltimore, and that 400 bushels of pease were shipped to Boston. In 1852 the shipments of early vegetables had wonderfully increased, and a large and profitable business was done. The growth of the industry has rapidly progressed, until at present nearly all the best available land along the tide-water inlets is devoted to the production of vegetables for the northern markets. According to the Twelfth Census, Norfolk County produced 4,507,730 quarts of strawberries in 1899, while Princess Anne County shipped 2,316,490 quarts. In the same year Norfolk County shipped 591,282 bushels of potatoes. Norfolk, Princess Anne, and Nansemond counties produced on 663 acres 52 per cent of the kale grown in the United States. Norfolk County had 902 acres devoted to the production of spinach.

CLIMATE.

The climate of Norfolk is a very equable one, due both to its proximity to the sea and its favorable latitude. It is situated far enough south to escape the rigors of winter, snow seldom if ever falling, and little damage being experienced from frost; and yet the latitude is northern enough so that the summers are not excessively hot. The rainfall is well distributed throughout the year, severe droughts are seldom experienced, and there is immunity from the storms and floods which sometimes visit the lower Atlantic coast.

The following table, compiled from the Weather Bureau records, shows the normal temperature and precipitation at Norfolk and Hampton:

Normal monthly and annual temperature and precipitation.

Month.	Norfolk.		Hampton.		Month.	Norfolk.		Hampton.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	° *F.*	*Inches.*	° *F.*	*Inches.*		° *F.*	*Inches.*	° *F.*	*Inches.*
January	40.5	3.88	42.0	2.46	August	75.8	6.11	78.2	4.03
February	43.8	3.82	40.8	4.31	September	71.2	4.56	71.4	2.81
March	47.0	4.58	46.9	3.76	October	62.0	3.87	60.5	4.00
April	56.1	4.07	55.7	3.37	November	52.2	3.10	50.2	3.01
May	65.7	4.28	65.9	4.42	December	44.2	3.67	42.2	3.03
June	73.5	4.23	75.2	4.19	Year	59.2	52.09	59.0	44.98
July	79.1	5.92	79.2	5.59					

The average length of the growing season is 221 days, the average date of the last killing frost in spring being April 3 and of the first in fall November 10. During the last ten years the latest frost in spring occurred on April 21 and the earliest in fall on October 10.

PHYSIOGRAPHY AND GEOLOGY.

The Norfolk area is a part of what is popularly known as Tidewater Virginia. It is situated in the Atlantic Coastal Plain, and is characterized by a broad, flat expanse of country, with an average elevation of only about 20 feet above sea level, on little of which is the slope sufficient to afford adequate natural drainage. There are many miles of salt water shore line, including the Atlantic Ocean and Chesapeake beaches. The greater part of the shore line is found along the Eastern, Southern, and Western branches of Elizabeth River, and along Nansemond River, Tanner Creek, and Lynnhaven River, and their many irregular ramifications. The tide ebbs and flows far up these small inlets, affording miles of passage for the sailboats of the truckers, and bringing almost to their doors an abundance of fish and oysters. The width of the tide marshes along the shores of these inlets was in many cases so narrow as to be negligible in the work of soil mapping. In the majority of cases the land forms a low bluff, of an average elevation of about 10 feet, along the rivers and inlets. Broad and Linkhorn bays and Little Creek appear to have been formed by an accumulation of surface water, cut off from escape to the sea by the beach dunes of gradually increasing height and extent. These bays are connected with Chesapeake Bay by only very narrow channels.

The southwest part of the area borders on and includes a portion of the Dismal Swamp. This (the northern) end of the swamp has an elevation of from 15 to 20 feet above tide. The drainage is toward

the north, a part of it discharging into the Western Branch of Elizabeth River, while a portion of it goes through the Dismal Swamp Canal and Deep Creek into the Southern Branch. The generally lower, wetter conditions, together with the darker color of the soil, indicating a greater amount of organic matter present in the country located between the Southern Branch and the 15-foot contour line running south through Pea Ridge, make it appear that swamp conditions may have once existed here, and that through this region a quite large percentage of the drainage of the Dismal Swamp may have passed. South of the Seaboard Air Line Railway and west of the road leading from the village of Deep Creek to Shoulder Hill the country is characterized by a flat, undrained plain, covered with a dense growth of the gums, pine, cedar, cypress, and some willow oak. Throughout this forest is an almost impenetrable undergrowth of cane and briers.

The only surface geological formation appearing in the Norfolk area is the Columbia, of late Pleistocene age. This consists of a layer of sands and loams having, according to Darton, a thickness of about 30 feet and dipping slightly to the southeast. The materials were brought down from the adjacent Piedmont region and laid down as a flood-plain deposit bordering the sea, a process which is going on to a smaller extent even at the present time.

With few exceptions no gravel is seen in the area. About a mile north of Waterworks, and again northeast, are some small areas, characterized by the presence of fine gravel measuring up to one-fourth inch in diameter. This is both scattered about on the surface and mixed with the subsoil. No large gravel, which would indicate that strong currents had been at work during the deposition of the sediments, has been observed. No consolidated materials occur in the area, with the exception of a thin stratum of soft sand rock, containing fossils, exposed in the bluff on the west side of the mouth of the Nansemond River.

SOILS.

Besides the Galveston sand and Swamp—nonarable types—seven distinct types of soil have been recognized and mapped in the Norfolk area. The following table gives the area of each of these types:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Leonardtown loam	53,952	27.8	Galveston sand	10,752	5.5
Norfolk fine sandy loam	38,144	19.7	Portsmouth sand	2,048	1.1
Portsmouth sandy loam	30,016	15.4	Leonardtown gravelly loam	1,536	.8
Norfolk loam	23,872	12.3	Total	194,112	
Norfolk sand	20,864	10.7			
Swamp	12,928	6.7			

NORFOLK SAND.

The surface soil of the Norfolk sand generally consists of a loose, incoherent yellowish-brown sand of medium texture, extending to a depth of about 10 inches. In a few spots it is inclined to be loamy in structure, so that it is sometimes rather difficult to place the boundary line between it and the Norfolk fine sandy loam. Underlying this top soil is a stratum of rather plastic grayish-yellow sand from 6 to 8 inches in thickness. Beginning at 18 and extending to 30 inches the subsoil is a yellowish-red sticky sand, in which a number of quite coarse sand grains are prominent. From 30 inches downward to 36 inches or more the material becomes looser in structure, and usually grades into an orange sand.

The principal areas of this type are found in the western part of the sheet, south of the James River, and between Nansemond River and the western branch of Elizabeth River. Not more than 2 or 3 square miles of it occur east of Elizabeth River.

Nearly all of the Norfolk sand lies adjacent to tide water. Its elevation above sea level is from 10 to 25 feet, and over the greater portion the surface is rolling. This gives such good natural drainage that very little tile or open draining is necessary.

The soil is derived from Pleistocene deposits and is mainly sedimentary in character, though probably modified to some extent by wind-blown sands drifted from the beach.

The Norfolk sand is the earliest truck soil of the area, and almost all of it is in a high state of cultivation. The principal vegetables grown are asparagus, pease, beans, cucumbers, and some of the earliest varieties of Irish potatoes. Comparatively few strawberries are grown upon the Norfolk sand, notwithstanding that its light texture favors an early crop. A good deal of trouble is experienced by the sand washing onto the berries, and their flavor is not as good as when grown upon a heavier soil.

This type of soil is well adapted to the crops to which it is at present devoted, and no suggestions concerning crops need be offered. The occasional turning under of a crop of green manure would serve to make the soil more loamy and more retentive of moisture. Too large a proportion of the fertilizer applied is leached away during the season and washed downward by heavy rains into the lower subsoil and lost.

The table on the following page shows the texture of samples of the soil and subsoil of this type.

Mechanical analyses of Norfolk sand.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
8704	½ mile W. of West Norfolk.	Brown medium sand, 0 to 12 inches.	1.60	0.20	4.64	17.86	46.96	4.32	18.92	6.88
8700	1½ miles N. of Belleville.	Brown medium sand, 0 to 12 inches.	.36	.04	1.22	7.52	55.90	13.96	14.18	7.16
8702	1 mile SW. of Niles.	Brown sand, 0 to 12 inches.	.92	.02	1.16	4.30	55.22	12.70	18.14	8.24
8703	Subsoil of 8702.....	Loose yellow sand, 12 to 36 inches.	.50	.04	.46	4.12	56.80	15.50	15.52	7.46
8705	Subsoil of 8704.....	Yellow medium sand, 12 to 30 inches.	.88	.10	4.42	17.10	44.70	3.92	20.24	9.52
8701	Subsoil of 8700.....	Loose to plastic sand, 12 to 36 inches.	.31	.04	.50	7.28	47.42	13.28	19.20	12.22

NORFOLK FINE SANDY LOAM.

The surface 10 inches of the Norfolk fine sandy loam is a brown sandy loam of medium texture, yet, upon close inspection, a good many grains of coarse sand are seen, and their presence is distinctly felt when the soil is rubbed between the fingers. As a rule the soil has a very characteristic friable structure, but this sometimes gives way to a soil quite sandy in texture. From 10 to 18 inches the subsoil is a yellowish-brown clayey sand, sufficiently heavy to hold moisture well. A quite heavy yellowish sandy clay underlies this stratum, and extends to 30 inches, when the subsoil becomes more sandy and loose, grading into a yellow sand at from 40 to 48 inches.

This type of soil grades imperceptibly into the Norfolk sand, and the boundary line separating the two types is in some localities somewhat arbitrarily placed.

The Norfolk fine sandy loam is the most extensive trucking soil in the area. The greater portion of it occurs in the western part of the sheet, about its only representation east of Waterworks being on Pungo Ridge, 2½ miles back from the Atlantic coast.

The surface is as a rule slightly rolling, though a field is occasionally seen which is quite flat or has only a gentle slope. Some of the Norfolk fine sandy loam abuts directly on the streams and inlets, but the greater portion of the type lies half a mile or so inland and is separated from the water by a zone of Norfolk sand.

The drainage of the Norfolk fine sandy loam is usually fair, though

some artificial aid is required to secure the best results, and to put the soil in the most desirable condition for planting.

The soil is derived from weathered sedimentary deposits of Pleistocene age, in origin differing nothing from the Norfolk sand.

This type of soil has a wide range of usefulness, and nearly all of the principal truck crops are to some extent grown upon it. Potatoes, tomatoes, cucumbers, strawberries, all do well, and cabbage, spinach, and kale are grown to a considerable extent.

Asparagus and beans are also grown, but are best confined to the Norfolk sand. In general this type of soil seems very well adapted to the crops now being grown upon it, but it might be an advantage to grow fewer strawberries on the Portsmouth sandy loam and more on the Norfolk fine sandy loam. It is believed that a few days might be gained in the time of ripening, with little, if any, loss in the flavor of the berry.

The following table shows the texture of typical samples of the soil and subsoil of the Norfolk fine sandy loam:

Mechanical analyses of Norfolk fine sandy loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
8710	½ mile NE. of Oceana.	Medium sandy loam, 0 to 11 inches.	0.87	1.34	21.14	21.90	15.84	5.66	26.64	7.46
8706	2 miles SW. of Churchland.	Medium sandy loam, 0 to 11 inches.	1.33	.00	.54	4.76	54.62	13.42	18.14	8.52
8708	2 miles W. of West Norfolk.	Medium sandy loam, 0 to 12 inches.	1.63	.28	2.34	11.70	52.74	7.60	16.46	8.62
8709	Subsoil of 8708....	Sand to sandy loam, 12 to 36 inches.	.21	.22	2.06	11.32	46.62	5.50	23.42	10.78
8707	Subsoil of 8706....	Fine sandy loam, 11 to 36 inches.	.29	.10	.26	4.30	53.64	12.40	17.32	11.74
8711	Subsoil of 8710....	Fine sandy loam, 11 to 36 inches.	.40	.96	16.74	21.90	14.72	3.00	27.88	14.70

PORTSMOUTH SANDY LOAM.

The surface 10 inches of the Portsmouth sandy loam is a sandy loam ranging from fine to medium in texture, and usually of a grayish-brown color. Following rains it crusts slightly at the surface, and numerous rather coarse grains of white quartz sand are seen, giving to the soil a distinctly grayish appearance. Certain local areas occur, particularly in marked depressions, where the soil is a dark brown, quite

fine in texture, and deeper than usual. The subsoil is a light-gray to bluish-gray sandy loam, mottled with drab and with yellow and brown iron stains. It is quite stiff and heavy in character, yet there are always enough coarse sand grains present to give it a distinctly gritty feel. To the depth of 30 inches it seems quite as impervious to water as a clay. Below this a looser gray sand is encountered.

The largest area of Portsmouth sandy loam occurs southwest of Portsmouth, though the type is found scattered over nearly the whole sheet. In the vicinity of Nimmo there is an area of about 2½ square miles which, in some instances, approaches Leonardtown loam in texture.

The type always occupies flat or depressed positions back some distance from the tide-water streams and inlets, and the natural drainage is always deficient. Drainage can, in most cases, be secured by means of open ditches, though the fall of natural outlets is oftentimes but slight.

The soil agrees in general geological age with the other soils of the area, and is the result of the weathering of sediments deposited during Pleistocene time. It is fairly well supplied with organic matter, and over at least some of it swamp conditions have existed in comparatively recent times. A considerable part of this type of soil is still in forest, the principal tree growth being loblolly pine, the willow and water oak, and sweet and black gum, with, in many cases, an undergrowth of cane.

In the sections where general farming is practiced to the exclusion of trucking, the principal crops found upon this type of soil are potatoes and corn, moderate yields being secured. In the parts of the area where trucking is most extensively carried on the type is in demand for the growing of cabbage, spinach, kale, and crops requiring a heavier soil than the Norfolk sand and the Norfolk fine sandy loam. When tile-drained it is quite extensively used for strawberries. In fact more berries are grown upon this type than upon any other in the area. While they do not mature quite as early as upon the lighter soils, their quality is thought to be superior, the yield is greater, and they are firm and stand transportation well.

When thoroughly drained, deeply plowed, and well aerated, the Portsmouth sandy loam is adapted to quite as wide a range of truck and farm crops as any other type of soil in the area. More of it might be profitably reclaimed from swamp and forest conditions and brought under cultivation.

The table following gives mechanical analyses of the soil and subsoil of this type.

Mechanical analyses of Portsmouth sandy loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
8716	5 miles SW. of Portsmouth.	Fine black loam, 0 to 12 inches.	7.01	0.16	1.50	21.68	32.04	3.20	28.10	12.04
8714	½ mile E. of Churchland.	Sandy loam, 0 to 8 inches.	2.84	.06	1.46	5.80	55.40	6.50	18.42	12.36
8717	Subsoil of 8716.....	Silty fine sand, 12 to 36 inches.	.58	.00	.70	24.22	36.74	2.10	21.38	14.86
8715	Subsoil of 8714.....	Sticky sandy loam, 8 to 36 inches.	1.04	.12	.68	3.30	53.06	6.94	18.74	17.14

NORFOLK LOAM.

To a depth of about 10 inches the soil of the Norfolk loam consists of a reddish-brown or yellowish-brown sandy loam. It is quite fine in texture and mixed with more or less silt. It is fairly loose and friable under cultivation, yet the presence of a great deal of fine material causes it to clod to some extent and, in many cases, to form a thin crust on the surface after rains. From 10 to about 18 inches the subsoil is a pale yellowish-gray compact fine sand, somewhat sticky. Below this layer the color changes to a yellowish-red and the texture becomes decidedly heavier—a fine-grained sandy loam, stiff and plastic. At 30 inches a tendency is frequently shown to greater looseness of structure, and at 4 feet roadside and stream-bank exposures often show fairly loose red sand of medium texture.

Slight variations occur in this type. In some localities, as between the two southern arms of Lynnhaven River, the soil is so fine as to be rather easily mistaken for Leonardtown loam. The area of Norfolk loam represented to the north of the mouth of Tanner Creek and between there and Sewells Point possesses a rather looser, coarser soil than commonly, and the subsoil is not quite as yellow and heavy as noted in the majority of instances, yet the variation was not considered sufficiently marked to call for its recognition as a separate type.

The type is found most extensively and best developed in the eastern part of the area, in the vicinity of Lynnhaven River. Smaller, though not so typical, areas of it occur on Pungo Ridge, west of Dam Neck Mills. It is here somewhat coarser in texture and takes on some of the characteristics of Norfolk fine sandy loam. Further areas of it occur southeast of Norfolk, south of the Eastern Branch, and about Berkley.

For the most part Norfolk loam abuts immediately on tide-water streams, and occupies an elevation of from 10 to 20 feet above them. Near the streams the surface is slightly rolling, gradually becoming more level inland, so that the greater portion of the type presents only a gentle slope. This is, however, sufficient for fairly good drainage, and relatively little ditching is required. By reason of the heavy subsoil moisture is well retained, and there is no undue leaching of fertilizers.

The type is derived from Pleistocene sediments, the soil being the weathered product of the heavier underlying subsoil.

The greater part of the Norfolk loam is under cultivation. The most of it is situated outside of the regular trucking section, and is used largely for general farm crops. A notable exception to this rule is seen 3 miles northeast of Jacksondale, where strawberries and peaches are raised to quite an extent. Irish potatoes are grown extensively on this type of soil, and yield about 200 bushels to the acre. Sweet potatoes are also grown to some extent, giving the same yield. Field corn is also grown, and produces fair crops.

This is one of the best soils in the area for diversified agriculture. Where the soil is not too shallow and the subsoil too impervious specialization in early potatoes may be safely ventured.

The following table shows the texture of the soil and subsoil of this soil type:

Mechanical analyses of Norfolk loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
8686	1 mile NW. of Herbert.	Fine sandy loam, 0 to 9 inches.	0.89	0.60	3.24	12.82	37.94	11.14	27.68	6.58
8684	2 miles NW. of Jacksondale.	Fine sandy loam, 0 to 12 inches.	1.79	.50	5.70	18.12	27.16	3.56	35.02	9.62
8682	1 mile SW. of Virginia Beach.	Brown sandy loam, 0 to 12 inches.	1.94	.28	8.90	16.14	16.58	5.44	42.20	9.66
8685	Subsoil of 8684.....	Fine sandy loam, 12 to 36 inches.	.48	.50	4.46	17.20	26.04	3.08	36.14	12.18
8687	Subsoil of 8686.....	Yellow sandy loam, 9 to 36 inches.	.38	.28	1.54	9.06	27.84	8.70	35.32	16.98
8683	Subsoil of 8682.....	Fine sandy loam, 12 to 36 inches.	.56	.52	6.80	14.34	13.96	3.70	40.28	20.38

LEONARDTOWN LOAM.

The soil of the Leonardtown loam consists of a fine gray silty loam with a depth of about 9 inches. The soil, when rubbed between the

fingers, has a peculiar soft velvety feel which can not well be described, but which somewhat resembles well-kneaded putty. If cultivated in a too wet condition clods form to some extent, but these are not very troublesome, being broken down with little difficulty. From 9 to 36 inches the subsoil is usually a compact fine gray silt, mottled with yellow and reddish iron stains. The subsoil is quite as homogeneous in texture as the soil, and until a depth of 30 inches is reached contains little sand, except a small amount of the finer grades. At 30 inches sand is sometimes encountered.

Some variations in the color and texture of the type are seen. Three miles due north of Nimmo there is an area over which the soil is a grayish brown to a dark brown, and the subsoil is also somewhat darker than usual, although mottled. Some of the best-drained Leonardtown loam has a grayish-yellow soil with a reddish-yellow subsoil in which there is little mottling. This yellow phase is usually contiguous to areas of Norfolk loam, or abuts directly on tide-water streams. Near boundaries of Norfolk loam or Portsmouth sandy loam the texture is sometimes a coarser silt soil containing occasionally a little fine sand, yet retaining the characteristic silty properties and having the agricultural value of the main body of the type.

The greater portion of this type occurs in the southeastern part of the area, between Kempsville and Virginia Beach. The Leonardtown loam has no representation west of the Southern Branch of Elizabeth River, with the exception of a few patches which occur in areas of Portsmouth sandy loam. These are too small to be shown on a map of the scale used.

For the most part the Leonardtown loam occupies level, flat stretches of country, though in cases where it forms the forelands, as along Lynnhaven River and the Eastern Branch, the surface is usually somewhat rolling. These areas near the streams are fairly well drained as a rule, while some of the flat or slightly depressed inland areas have very poor natural drainage. The soil is here cold and wet, and crops are necessarily late in starting and maturing.

The Leonardtown loam is one of the more recent deposits of Pleistocene age, and from its fineness of texture it is evident that it was laid down in comparatively quiet water, probably in estuaries. Its minimum elevation in the Norfolk area is about 10 feet.

The type is devoted principally to general agriculture, and is in use for growing potatoes, grass, corn, and to a small extent some other of the cereals. In some instances late strawberries are grown upon it with fair success. Quite a large proportion of the area is wooded, the principal trees being pine and gum, together with some hickory.

The fine texture and close, firm structure of this type of soil make it better adapted for grass and grain than for truck. It is almost

impossible to drain it so thoroughly as to enable it to be worked early enough in the spring for truck crops. It presents good opportunities for stock raising, and all that is needful for the successful establishment of the dairying industry is the discovery of some economical method of eradicating the troublesome garlic.

The following table shows the texture of the soil and subsoil of this type:

Mechanical analyses of Leonardtown loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
8694	1 mile SE. of Kempsville.	Gray silty loam, 0 to 9 inches.	1.84	0.58	1.34	2.48	12.76	5.10	66.86	10.82
8692	1 mile N. of Princess Anne C. H.	Fine silty loam, 0 to 9 inches.	2.17	.10	1.14	2.44	4.28	6.22	69.66	16.16
8696	1½ miles NW. of Sigma.	Fine gray silt, 0 to 9 inches.	2.76	.06	.42	.46	1.82	8.94	68.60	19.70
8697	Subsoil of 8696.....	Fine gray silt, 9 to 36 inches.	.35	.00	.10	.20	1.30	7.66	70.98	19.76
8695	Subsoil of 8694.....	Silt, 9 to 36 inches..	.81	.16	.80	1.56	7.48	3.44	57.00	29.56
8693	Subsoil of 8692.....	Gray silty loam, 9 to 36 inches.	.47	.04	.46	.90	1.32	5.80	58.70	32.56

LEONARDTOWN GRAVELLY LOAM.

The surface soil of the Leonardtown gravelly loam consists of a brownish-gray silty loam 9 inches in depth. From 5 to 15 per cent of fine white rounded quartz gravel is scattered about on the surface. The largest of this gravel is seldom over one-fourth inch in diameter. The subsoil to 36 inches contains as a rule about the same percentage of gravel as the soil, though in some instances the gravel in the subsoil runs as high as 25 per cent or more. Though the subsoil in some cases is slightly mottled, the color is generally a rather uniform yellowish gray.

The type forms but 0.8 per cent of the entire area, and is found northeast of Norfolk, mainly in the vicinity of Lawson Lake. The surface is usually slightly undulating, or gently sloping, so that fairly good natural drainage has been established.

The soil is derived from the weathering of Pleistocene sediments which were probably deposited under conditions of some slight current movement, and perhaps in an intermittent current.

The Leonardtown gravelly loam gives fairly good yields of the ordinary farm crops. It is best adapted to corn, grass, and cereals.

The following table shows the texture of the soil and subsoil of this type:

Mechanical analyses of Leonardtown gravelly loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
8698	3¼ miles NE. of Waterworks.	Gray silty loam, 0 to 9 inches.	2.54	12.02	9.94	3.68	4.76	4.84	48.24	16.46
8699	Subsoil of 8698.....	Gray silty loam, 9 to 36 inches.	.45	18.54	19.38	3.62	5.00	6.88	28.74	17.72

PORTSMOUTH SAND.

The surface soil of the Portsmouth sand is a black to dark ferruginous brown, loose, medium-textured sand with a depth of about 12 inches. Mixed with this sand is a large proportion of vegetable matter, in some places so much that the soil is quite loamy in character. The subsoil is generally a loose, incoherent yellow sand of rather coarse texture, extending to a depth of about 36 inches. Sometimes, however, the color is a light gray, and in a few instances a dark reddish brown. In some localities, too, a stratum of mottled sandy clay is encountered in the subsoil.

The principal area of this type is found south of Portsmouth, west of the Southern Branch, while a few smaller areas occur south of Berkley, on Money Point, on the east side of that stream.

The surface is below the general level of the rest of the land of the area, not rising over 15 feet above tide, while some of it has an elevation of not more than 10 feet.

As might be expected, considering the low elevation of this soil, the water table is relatively high, usually only from 30 to 36 inches below the surface. When the water table can be lowered by ditching the soil is so porous that it soon dries out sufficiently to allow cultivation.

It appears likely that within comparatively recent times the area occupied by this type was covered by a swamp, the large amount of carbonaceous matter present being derived from the rank vegetable growth produced under swamp conditions. As the further drainage of the Dismal Swamp progresses, through natural and artificial agencies, more of this or a very similar soil will become arable.

The Portsmouth sand is at present but little used for agricultural purposes, though a small amount of truck is grown upon it in the

vicinity of Pea Ridge. It is believed that thorough drainage would make the Portsmouth sand a valuable trucking soil. It should produce good crops of Irish potatoes. Celery ought also to be tried.

The following table shows the texture of typical samples of the soil and subsoil of this type:

Mechanical analyses of Portsmouth sand.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
8688	1¼ miles SW. of Portsmouth.	Coarse gray sand, 0 to 12 inches.	1.55	0.18	4.66	57.46	31.40	1.20	3.30	1.38
8690	3¼ miles SW. of Portsmouth.	Coarse gray sand, 0 to 10 inches.	2.71	.06	3.62	50.50	31.72	1.34	6.26	6.50
8689	Subsoil of 8688.....	Coarse sand, 12 to 36 inches.	.42	.16	5.80	50.38	37.14	1.80	2.90	1.82
8691	Subsoil of 8690.....	Brown medium sand, 10 to 36 inches.	1.77	.10	2.52	49.98	31.00	1.36	7.06	7.98

GALVESTON SAND.

The Galveston sand is a loose, incoherent yellow sand of medium to coarse texture. Near the beaches and to some extent along Broad Bay it is being constantly drifted by the winds and vegetation has little hold upon it, but half a mile or so inland there is a more or less dense forest covering. Here there are a few spots with something approaching a subsoil—a reddish fine sand containing some silt. Intervening between the low, hillocky inland dunes are occasional water holes where swamp conditions exist, and among the cypress and other water-loving trees growing here are accumulations of peaty material. These were of too small extent to map.

The Galveston sand extends from the southern edge of the map up the Atlantic coast, around Cape Henry, and along the shore of Chesapeake Bay as far as Willoughby Spit—a distance of about 32 miles.

East of Ocean View, and from Lynnhaven Inlet around past Cape Henry, the sand is thrown into prominent dunes, the maximum height at Cape Henry being about 100 feet. Elsewhere the sand hillocks are from 5 to 15 feet in height, and do not, except in the Desert, extend inland an average distance of more than a quarter of a mile. The Desert, extending from Cape Henry back to Broad Bay, is 5 miles long and over 2 miles wide. Except along the beach, the dunes on the Desert do not rise to a height of over 20 feet, but the whole surface is roughened by them.

The surface water in the Galveston sand area rapidly sinks into the sand, some of it to appear as small ponds in the intervening hollows, from which there are no outlets. The Galveston sand is of æolian origin and of comparatively recent age. The process of piling up and then leveling is still going on.

The frontal dunes are more or less covered with a low, short growth of bay bushes. A half mile back from the beach the sands are clothed with a dense growth of loblolly pine and hickory on the higher land, and with the gums, magnolia, cypress, and the water oaks in the lower spots. The pine is of merchantable size and is at present being cut and removed for lumber. Near the Chesapeake Bay shore of the Desert are a few specimens of live oak, and somewhat farther back from the beach a thick covering of low huckleberry bushes is found.

This type has no present agricultural value and, aside from the lumber and the wild berries, which grow luxuriantly, gives no income.

SWAMP.

The northern end of the Dismal Swamp projects into the extreme southwestern part of the area, occupying a territory of about 20 square miles. With the exception of a narrow strip along the margin, this part of the swamp has not been reclaimed, and until thorough drainage is effected no agriculture will be possible. In the present condition the Swamp is too saturated with water to permit any satisfactory textural classification of the soil to be made.

The forest growth is characterized by the gums, the water oaks, pine, cedar, and cypress, with an undergrowth of vines, briers, and canebrake forming an almost impenetrable thicket.

AGRICULTURAL METHODS.

The intensive system of agriculture is well illustrated in the Norfolk area. In the highly cultivated trucking sections adjacent to Norfolk and Portsmouth it is the exception when a field is allowed to lie long idle. As soon as one crop is harvested the ground is prepared for another. Very often two crops are growing on the ground at the same time. For example, new settings of strawberries are put out in rows 4 to 6 feet apart, and between these rows, during the growing but nonbearing year of the plant, Irish potatoes are planted; beans or similar crops are planted alongside new settings of asparagus; by the side of early cabbages, which have been set out in the fall, tomatoes are transplanted, and by the time the cabbage is marketed and the stumps pulled the tomatoes have reached a good size. The best truckers gather but one crop of strawberries from mature vines and then turn the soil for some other crop, often kale or spinach.

It is the practice of at least one of the principal truckers to plant

cucumbers alongside of pease. The latter crop is planted in drills about 6 feet apart, and from about April 5 to 10 the cucumber seed are planted in the ridge close to the pease. The pease are out of the way before the cucumbers have reached an advanced stage of growth. No expense for seed or labor is spared by the best truckers to insure an absolutely sure crop of early cucumbers, as many as four separate plantings of seed, a few days to a week apart, being made. These frequent plantings are necessary to guard against loss by drought, bugs, etc. Superfluous plants are later thinned out by hand. One trucker used over 2,000 pounds of cucumber seed for his last year's crop.

On Norfolk sand asparagus is one of the principal early spring crops. Deep rooting is secured by transplanting in deep trenches, the soil being later, from time to time, thrown up about the plants so that high ridges result, with deep intervening furrows.

The use of fertilizers is universal in this section, and forms one of the chief items of expense connected with the trucking industry, being nearly equal to that of labor. The soil is used simply as the vehicle into which the fertilizer and seeds are placed and from which the crop is later harvested. The little natural fertility of the soil is such a minor factor that scant attention is given to crop rotation, except to secure to the following crop what, if any, unused fertilizer remains in the soil after the harvest of the preceding one. Late potatoes are sometimes planted after cucumbers, thus being able to assimilate considerable of the fertilizer still left in the soil.

Two or three of the Portsmouth truckers buy the raw material—nitrate of soda, sulphate of potash, kainit, fish, tankage, etc.—and compound their own fertilizer, but the majority buy the ready-mixed commercial article, sometimes mixing the "high" and the "low" grades to meet the requirements of a certain crop. Comparatively little barnyard manure is used.

AGRICULTURAL CONDITIONS.

A large initial capital is required for the successful prosecution of the trucking business. Only the first deliveries of the crop secure the top prices, and competition is so sharp that the returns obtained for the larger portion of the crop are not infrequently but little above the cost of handling and transportation. Where the margin is very close, but still a margin, the small shipper usually operates to a greater disadvantage than the man who consigns a large number of packages and secures the most favorable rate for transportation, commission, etc. When a crop fails, either altogether or is late in maturing, in one of the earlier trucking sections of North Carolina or farther south, the demand in the Northern markets may continue great and the prices high during nearly the whole of the normal season for that particular

product. The Norfolk truckers sometimes then make small fortunes from the season's sales of one crop. On the other hand, heavy shipments may cause such a sudden and unforeseen glut in the market that the price received will be barely sufficient to cover the cost of production, to say nothing of transportation and commission fees. Hundreds of dollars are sometimes lost through inability to anticipate these fluctuations of the markets. Of course perishable truck has either to be shipped or remain a loss at home, the relatively insignificant local demand for the article having usually been supplied by the market gardeners.

Altogether a great deal of money has been made by the truckers. Their farms are in the highest state of cultivation, and to the management of them is brought as great business ability and foresight as is necessary to the success of any mercantile pursuit. The majority of the best truck farms are situated on tide-water streams and inlets, the residences are commodious and of modern construction, the grounds well laid out and abundantly shaded, the outbuildings ample and well kept, and altogether an air of unusual prosperity prevails among the farmers.

Most of the farms are owned by those operating them; some are run by salaried managers, some worked for a share—usually one-third of the crop—and a few rented for cash. The cash rental asked is variable and depends upon a number of factors, as soil, drainage, nearness to the city, and convenience to the railroad and to water, the latter both for transportation facilities offered and for the freedom from late spring frosts which land adjacent to water is afforded.

The farms generally average from 80 to 100 acres in size in the trucking section, while a few miles back from the water front, where general farming is more the rule, the average acreage lies between 160 and 200 acres.

The labor on the farms is all performed by negroes, under white supervision. The handling of machinery, plowing, and all the team work is done by the men, while in much of the work of thinning out, hand cultivation, and gathering crops the women and children are nearly or quite as efficient and secure as ready employment. Many of the crops, as strawberries, create such a demand for laborers during the picking season that outlying districts have to be drawn upon to meet it. Many of the berry pickers come from North Carolina during this season. They are composed largely of women and half-grown children. They are sometimes given sleeping quarters on the farms, but always board themselves, living principally on such provisions (cakes, canned goods, etc.) as can be procured at the small country stores. They receive 2 cents a quart for picking strawberries, and a fairly good picker is able to make from 50 to 80 cents in a little over half a day. It is not an uncommon sight to see 100 or 150 hands of both sexes

picking in a 20 or 30 acre field. Nearly all the harvesting of truck crops is done by these transient laborers, and is paid for by the piece—spinach 6 to 8 cents a barrel, beans 15 cents a basket, etc. Women are seldom employed by the day, but men receive from 75 cents to $1 a day without board. Shelter is sometimes furnished these laborers free, and in some instances a small rental is asked.

A pretty well balanced diversity exists in the truck crops grown here, so that there is a quite constant and uniform outflow of produce to the northern markets throughout the growing season. The winter shipments are confined to kale and spinach, then in the early spring come cabbage, asparagus, and radishes. Beginning with the last days of April, or more usually the first days of May, strawberries commence to be shipped, and continue the principal product until about May 25. The perishable nature of the berries makes their prompt handling a necessity, and a greater number of laborers are required during the ripening season than at any time later in the harvesting of other crops. The earliest shipments sell for from 18 to 20 cents a quart, the price gradually falling to 5 cents or lower. Five cents is the very bottom figure at which shipments can be profitably made, as even at this price the cost of the crates, picking, transportation, and commission for selling leaves only a fraction of a cent margin.

One of the most important crops of this section is early Irish potatoes. These are shipped in large quantities from about June 5 until the latter part of July and bring high prices. Four dollars a barrel is about the best price received in New York. The earliest potatoes are grown upon Norfolk sand, but the larger part of the crop is produced upon the Portsmouth sandy loam and the Norfolk fine sandy loam. A great many are also produced upon the Norfolk loam and not a few upon the Leonardtown loam, which yields a fair though late crop.

Cucumbers are mainly grown upon the Norfolk sand and are an important crop, the first pickings being put upon the market from about June 5 to June 10. During the season of 1903 some brought as much as $8 a barrel. Later they declined in price to $2 a barrel and less. For cucumbers of a uniform size and about 3 inches in length the pickling concerns pay 50 cents a bushel.

Snap beans are given a quite large acreage on the lighter soils and begin to be marketed at the close of the strawberry season. They are shipped in half-barrel baskets, and the picking, at 15 cents a basket, calls for the employment of a large number of laborers.

Tomatoes are grown upon the Norfolk sand and the Norfolk fine sandy loam. They are shipped to market in crates or carriers containing two half-bushel baskets, and bring from 75 cents to $2 a crate.

It is, of course, generally recognized by the truckers that a light,

sandy soil, warm, and retaining only enough moisture for the needs of the crop, is requisite for bringing vegetables to early maturity, and nearly every foot of the Norfolk sand in the area is accordingly brought into cultivation. The growing of strawberries, however, is largely confined to the Norfolk fine sandy loam and Portsmouth sandy loam. While they reach maturity a little later upon these types, the yield is larger, the flavor of the berry is better, and they keep cleaner than upon the looser sand.

The Norfolk loam produces large yields of potatoes of a good quality, and in the localities where this type is found the potato field is almost invariably situated on it. The superiority of the Leonardtown loam for grass and grain is also well recognized.

The great quantity of truck which is taken away from Norfolk each year is, of course, all shipped to northern markets, so that the principal railroads interested in moving these vegetables are the Chesapeake and Ohio and the New York, Philadelphia and Norfolk. A great deal of the produce is carried by boat: the Old Dominion Line to New York, Merchants and Miners' Transportation Company to Boston and Philadelphia, Baltimore Steam Packet Company to Baltimore, Clyde Line to Philadelphia, and Norfolk and Washington Steamboat Company to Washington. The time from Norfolk to New York and Philadelphia by water is about twenty hours, to Boston thirty-six hours, to Washington and Baltimore twelve hours. Good service is given by clean and well-ventilated boats. When perishable vegetables are shipped by rail they are usually placed in refrigerator cars—sometimes simply in ordinary box cars which have been iced. In many localities a preference is shown for shipping by water, the slightly longer time necessary for transportation by boat being offset by the extra expense for refrigeration when shipped by rail. Under moderately cool weather conditions vegetables and berries stand the trip better by water without refrigeration than when shipped on refrigerator cars. The jolting incident to the railroad travel causes more or less damage, especially to slightly overripe fruit.

Some of the northern and western commission men send their buyers direct to the field, delivery being made at the nearest siding. The local railroads run spurs into some of the principal trucking localities. Three suburban electric lines intersect the trucking section on the Norfolk side of the area, and refrigerator cars are run directly into the truck fields on the trolley tracks. Many of the large truckers living on the tide-water inlets and navigable streams transfer their produce from the farm direct to the Norfolk wharves by their own boats. A number of sloops are also owned by negroes, who make a business of carrying packages of truck from the farm docks to the city wharves. They charge at the rate of about 5 cents a barrel for making the transfer.

An excellent system of shell roads exists in the area in connection with swing bridges over all the navigable streams. The best of these roads are kept up by stock companies, a moderately high toll charge being made.

The produce of the Norfolk trucking district is shipped to the northern cities—New York, Boston, Philadelphia, Baltimore, and Washington. The largest shipments are made to New York, though a great many packages reach Boston, which, by some of the truckers, is considered the more reliable and stable market. Considerable shipments are also made to Chicago and the Middle West.

Each trucking center along the Atlantic seaboard has, within certain limits, its temporary monopoly of the market in the northern cities. The earliest shipments come from farthest south, so that when a certain garden product has reached maturity at Norfolk, in this fairly uniform rate of progress northward, the supply of the article from North Carolina has commenced to decline and a couple of weeks' monopoly of the market may reasonably be expected by the Norfolk trucker before it shall begin to be supplied by Maryland and more northern truck-producing sections.

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